# Feasibility Study on the Use of Mobile Positioning Data for Tourism Statistics

Eurostat contract no. 30501.2012.001-2012.452

# Task 1. Stock-taking

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# 1. Introduction

## 1.1. Aims, Content and Structure of Task 1 Report

The objective of Task 1 is to make an inventory analysis of conducted research, applications and experience in EU member states, EFTA, candidate countries and the world; and to give an up-to-date description of the state of the art in using mobile positioning data in research and applications in tourism statistics and related domains. It serves as important input for the research that is to be conducted in the subsequent tasks of the feasibility study. The report emphasises existing problems and solutions in technology, methodology, and regulations and other aspects of accessibility to mobile positioning data. The information covered in this task is based on the circumstances of summer 2013 regarding:

- Publicly available information (applications and scientific research);
- Knowledge of the consortium partners;
- Information from surveys and interviews.

While the use of mobile positioning-based data in tourism statistics is of course the main focus of this report, experience in other domains and with different info-communications technology (ICT) data sources is also included to give a wider overview of the state of the art in the field. The thematic priorities of the report are:

1. Tourism statistics;
2. Other official statistics;
3. Tourism applications/research;
4. Transport/mobility applications/research;
5. Other applications/research.

Bearing these categories in mind, the consortium collected and reviewed more than 100 cases which had included the use of mobile positioning data. The above priorities and referenced use cases were selected because of their direct or indirect pertinence to using mobile data for tourism studies or as a statistical source. 31 significant and representative cases have been selected, and are covered in detail in Annex 2: “Use Cases” of this report. Some mobile tourism guides (travel apps) were also included, as user data of such devices is very relevant for analysis and they are used in many cases for research or statistics.

The structure of this report consists of four interlinked parts:

1. The first part of the report covers the main overall findings of this task in the different thematic priorities, references use cases and countries with significant examples, and draws conclusions from these condensed findings. It then goes on to present the implications for the subsequent tasks of the feasibility study.
2. Annex 1 (country profiles) gives a detailed overview and assessment of the experiences in the use of mobile positioning data in the five thematic priorities for each EU, candidate and EFTA country. It is referenced with use cases and bibliography.
3. Annex 2 (use cases) displays detailed profiles of the selected significant cases for the use of mobile phone positioning data in the five thematic priorities. Each profile also contains a success/failure assessment and an explanation why the case was selected for this report.
4. Annex 3 (bibliography) covers an overview of the present representation of the use of mobile phone data in the five thematic priorities in scientific literature.

## 1.2. Background of the Report

The Task 1 report is an input to serve as a basis for the subsequent Tasks 2 through 4. The following overview shows its position and objective in the overall structure of this feasibility study:

a) Task 1 – Stock-taking: the current report contains an up-to-date description of the state of the art in using mobile positioning data in research and applications in tourism statistics and related domains. This report will provide a list and descriptions of the experiences of consortium members and other public and private institutions that have been involved in projects where mobile positioning data has been accessed. The report will emphasise existing problems and solutions in technology, methodology, regulations and other aspects of accessibility to the data and will serve as important input for subsequent tasks.
b) Task 2 − Feasibility of access: Task 2 will provide an overview of the regulatory, financial, technical and other related topics that cover the aspects of data accessibility. The knowledge of different use cases together with results from surveys and interviews with the stakeholders provides a variety of possibilities and methods to access the data. Task 2 provides input regarding barriers as well as opportunities on this topic. In this, the results from the current task will also be used.

c) Task 3a − Feasibility of use, methodological issues: Task 3a provides insights to identification, description and possible solutions to the number of issues in the long chain of processing the raw anonymous passive mobile positioning data into statistical indicators and results. Differences between methodological aspects depending on the characteristics of the initially used data will also be discussed.
d) Task 3b − Feasibility of use, coherence: Task 3b provides insights to the evaluation of coherence between the statistics based on mobile positioning data and the statistics gleaned from other sources. This task is closely related to Task 3a which addresses how methodological differences can produce different results.
e) Task 4 – Opportunities and benefits: This task concentrates on the potential opportunities and benefits of using mobile positioning data from the tourism statistics point of view. In task 4, the consortium does not collect and research new data and information, but rather integrates the results from previous work packages into a structured and coherent assessment of potential opportunities and benefits.

# 2. Use of Mobile Positioning Data

## 2.1. Mobile-Based Tourism Statistics

The mobile phone-based tourism statistics in the focal point of this study have been directly gathered and used by official statistics authorities in at least three European countries: Estonia, the Netherlands and the Czech Republic (see the country profiles of Estonia, the Netherlands, Czech Republic and use cases 1, 2, 3). Extensive use of mobile data for tourism studies has been documented in France (see the country profile of France and use case 5) and Italy (see the country profile of Italy and use case 23). Statistics authorities from at least five countries - Ireland, Slovenia, Montenegro and Finland - have taken specific steps to start the process of acquiring the data from MNOs using either national legislation initiatives (national statistical act) or other methods. There have been direct or indirect projects in other countries as well: Portugal, Austria, Switzerland, The United Kingdom, etc., where telephone data has been used for tourism-related analyses and even art projects. From what we know from direct contacts or feedback from surveys and interviews, tourism statistics have been tested in cooperation with mobile operators in several countries, but often the information has not been published yet due to issues of privacy and business secrets and/or due to the stage of the project. In most cases the projects are long-term and take up to several years to succeed.

The earliest ideas on using the data in tourism research and statistics date back to the end of the 1990s and early 2000s where several official agencies as well as research institutes brought out the idea of using data from mobile network operators as an alternative source for estimation of touristic flows (Observatorie National du Tourisme France, Swedish Tourism Authority etc.), but with no significant results at that time. From our study, Estonia has some of the most extensive experience in the practical use of mobile positioning data in tourism statistics and other fields. The University of Tartu together with the private company Positium LBS (partner of the current feasibility study consortium) started analysing tourism data flows in cooperation with the largest Estonian mobile network operator, EMT, in 2003. The processing of the steady flow of the data of inbound roaming subscribers began in 2004, domestic in 2007 and outbound in 2008. Positium has accumulated a voluminous set of statistics in the database on approximately 50% of phone users in this manner. The data has been used primarily in several tourism studies (see use case 6, 7, 8).

The Central Bank of Estonia has been using state-level inbound and outbound tourism statistics (trips, spent nights) based on mobile positioning data and calibrated with official accommodation and travel statistics since 2009, when a feasibility study on using the data in Estonia was conducted (see use case 2). The monthly data flow is used in the calculation of travel account of the national balance of payments. The initiation of this came from the cancellation of border surveys due to the financial cutbacks that have been seen in most European countries.

Today the tourism database processed and handled by Positium is used for developing various tourism applications for local municipalities and tourism organisations in Estonia. According to the experience of Positium LBS, the high interest in the mobile positioning-based analyses and data is due to following reasons:

a) More accurate and in-depth data source for describing the behaviour of people within a destination (in tourism research);
b) New aspects and indicators for describing the time-space behaviour of people;
c) Highly quantitative data source with many options and methods for processing and analysis;
d) Better time-space insights compared to traditional methods;
e) Cheaper than other same-scale data collection methods;

f) Possibility to register trips to sparsely populated locations such as natural parks and hiking trails, in the case of which it is difficult to reach visitors with questionnaires or counters.

The Czech Tourism Authority has tested mobile data as a statistical material in cooperation with CE-Traffic using technology by TrendIT (http://trendit.net/en/) (see the country profile of Czech Republic and use cases 3, 15) to analyse specific touristic locations and for comparison with other tourism statistics. There are similar initiatives in other countries, for example Japan, Ukraine etc. where statistical authorities have been looking into, or even tested, the data from MNOs.

Statistics Austria has been investigating the possibilities to use A1 (Austrian MNO) data for statistical purposes. This opportunity arose because of A1's business initiative to provide anonymous subscriber location data, mainly for geomarketing purposes. Although this project was discontinued because of privacy protection reasons, Statistics Austria is still showing interest in this.

Examples show that there is high interest from official statistics authorities to implement new data sources such as mobile positioning data. There are many specific steps that indicate the practical possibilities to access the data and earned value from the results in tourism statistics; however, there are also strong challenges to overcome before the use of mobile positioning data becomes the usual practice. The main obstacles to consider on this path are legislation, privacy protection, and the MNOs' resistance. These obstacles could be overcome by the introduction of privacy preserving methods to handle the sensitive data, creating appropriate legislation framework, and by providing palpable benefits for the MNO's.

## 2.2. Other Official Statistics

Mobile telephone data is also very relevant for mobility and transportation statistics. This is a domain which requires fast data collection and mobile data has great potential for use in modelling, planning and monitoring. The Methodology and Quality Division of Statistics Netherlands has analysed call detail records (CDR) data for economic activity, tourism, population density, mobility, commuting and transport statistics (see use case 1). Their findings confirm that this data source can be successfully used in different forms of statistics. Such examples of mobile data usage can also be found in other countries, e.g. Finland (see use case 13), Israel (see use case 9), the US, etc.

Statistics Estonia is discussing the possibilities of using mobile data for official statistics on daily spatial mobility and commuting (see use cases 12 and 19) and in the next registry-based census. It is also known that in the Czech Republic mobile data will probably be used for transportation statistics in close future.

The use of mobile positioning data in other forms of official statistics is closely related to tourism statistics as the essence of calculations (the raw data) is often the same and based on human mobility. Implementing new methods in official statistics takes a long time, and success in theoretical methods (as seen from examples) leads to a long path of practical implementation, which unfortunately is often discontinued for various reasons. The feedback from experts suggests that the usage of data in many fields follows a successful example from one field (i.e. success in tourism statistics is followed by faster implementation in other fields).

## 2.3. Tourism Applications/Research

### 2.3.1. Business Applications

MNOs themselves have sometimes initiated projects that involve mobile positioning data and can present use cases relevant to the current study. O2 is running applications to show the statistics of O2 / Telefonica roaming subscribers travelling around Europe (see use case 4 – O2 jetsetme.com). Telefonica has deployed its Smart Steps service from Telefonica Dynamic Insights (see use case 24 – Telefonica Dynamic Insights) that provides information on the population based on the data from its networks (also including data on foreign phones). A1 – the Austrian MNO – has piloted a service that offers information about the movement and locations of phones (see use case 10 – A1 Traffic Data Stream) that has been tested (although without success) by Statistics Austria.

Tourism data has been used on cross-border projects such as international commuting between countries (see use case 8) in Estonia. As mobile data provides insights on smaller scales than official statistics, tourism indicators have been used in projects by tourism management, municipalities, and tourism marketers (see use case 7) and for tourism development plans (see use case 6) in Estonia and other countries. An important centre where mobile data is used as statistical material to describe tourism is the Orange Labs in France (http://laborange.academia.edu). The research team of Orange Labs has been conducting mobile-based studies on the mobility of tourists in Paris and other cities. Orange Labs has also

dealt with generating statistics for transportation, mobility and in displaying urban life (see the country profile of France and use cases 5, 16, 17, 18).

There are more and more tourism-related mobile applications such as travel guides and information systems. By now, most of the former PDA-based travel guides have been relocated to smartphones. Travel guides and travel information systems have important added value to offer tourists both in the natural environment as well as in cities. Many such solutions deal with guides to nature hiking trails. These systems are relevant because the location information of most of them can be, and often is, used to examine the behaviour of tourists at their destinations. Such user tracks are short-term, but enable the selection of journeys in specific towns or the objects of interest visited in a specific national park to be examined (see use case 29). It is very difficult to collect such intra-destination statistics with the help of traditional methods.

As mobile positioning data often provides more detailed information on local and regional tourism, such data is successfully used along with surveys and other statistics in the private sphere if they are available. If such data were available through official statistics, many new users and new use cases can arise that were not available before.

## 2.3.2. Event Monitoring

Monitoring of events is one of the important areas where mobile-based tourism statistics have been collected and used. Mass events have been in the focus of researchers' interest due to the increase in the importance of event tourism, safety and logistical problems. The behaviour of the people participating in events has, however, also been monitored via mobile phone data in order to map the emotional responses of society. Some of the first experiments in history were "Mobile Landscapes: Graz in Real Time", conducted by C. Ratti, A. Shevtsuk et al (MIT&Ratti Associates) in 2005 (http://senseable.mit.edu/graz/) (see use case 21), the experiment "Real Time Rome", conducted by MIT to study a Madonna concert in Rome (http://senseable.mit.edu/realtimerome/) and football matches in Milan analysed by the Frauenhofer Institute in 2008 (http://geoanalytics.net/and/papers/vast10.pdf) (see use case 20). The events studied in Estonia include large-audience concerts (Metallica, Madonna, etc.); a special methodology has been developed by Positium for monitoring events and the factors influencing the shaping of the events' catchment areas (see use case 7). In addition to mobile phones, visitors of events have been studied with the help of various ICT-based means; we would like to highlight the Bluetooth technology-based methods for event monitoring, used at the Ghent Light Festival, developed by N. van Veghe, F. Witlox et al, a working group of the

Geography Department of the University of Ghent (Belgium) (http://geoweb.ugent.be/cartogis/research/tracking-of-moving-objects). Researchers from Ghent and the University of Tartu have also conducted more thorough analyses of events and have explained the algorithms for segmenting visitors, the subjects of the duration and complexity of visits and several other aspects. Looking towards the future, three subjects have been proposed for focusing these studies on: a) marketing; b) safety; c) logistics.

Event monitoring in research and practical applications is one sphere where more detailed tourism data can successfully be used. This field of data usage has been expanding since the availability of mobile data and can be seen as one new major sphere of use if mobile data-based statistics were more available (e.g. through statistics authorities).

## 2.4. Transport/Mobility Applications/Research

Most of the important initiatives dealing with mobile-based data have been made in the study of transport, traffic and travel behaviour. This shows the direction of the scientific, industrial and public interest, as well as the most important problems. In most European countries, as well as in other countries across the globe, TomTom HD Traffic is using anonymous mobile positioning data as one important information source for intelligent traffic guidance systems (see use case 11). To draw the full picture, it has to be taken into account that massive anonymous mobile positioning data is an auxiliary data source in this context (as soon as there are enough cars with GPS/Floating Car Technology, mobile positioning data may become redundant) and it seems to be hard for the MNOs to make a successful business case out of it (e.g. termination of cooperation between Telefonica/O2 and BMW). This is also a lesson on the importance of public relations work and transparency of using such data sources. Creating transparent data collection and awareness takes time and effort.

In Estonia, Positium LBS, in cooperation with the Scandinavian transport planning company Ramboll, has been using mobile data to assess the density of traffic and the need for transport arising from suburbanisation for the preliminary estimation of the need for the road corridor between Tallinn and Tartu (http://tartutee.ramboll.ee/), and for the preparation of the OD matrix of the Tartu Eastern roundabout (http://www.tartu.ee/idaringtee/) (see use case 12). In France and Belgium, Orange Labs has been using mobile data to assess the density of traffic; Orange Labs has also executed special projects, for example distinguishing transportation modes on the basis of mobile data (http://laborange.academia.edu/ZbigniewSmoreda) (see use case 5). Transportation has also

been studied using the data obtained through Austrian operator A1 and in the Czech Republic in cooperation with CE-Traffic (http://www.ce-traffic.com/) and Israeli company Trend IT (http://trendit.net/en/) (see use case 3). The focal point of transportation studies is the easier-than-before collection of data and the development of various solutions on the basis of the data. Such data is of very significant potential in the development of web-based transportation monitoring solutions functioning in real time. Transportation studies based on anonymous mobile data have also been conducted in Germany where privacy protection legislation can be considered the strongest (http://www.isprs.org/proceedings/XXXVI/5-C55/papers/ramm_katrin.pdf). Deriving from the need to use mobile data in transportation management, new methods of privacy preservation (e.g. 60-minute ID token) have been developed in order to allow processing of the data.

From the transport statistics perspective, other interesting transport solutions include studies on the geographical distribution of traffic (http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0049171) and transit traffic studies. These clearly demonstrate the advantages of the time continuity of mobile-based tracking compared to surveys, census data and travel logs.

Even more than tourism, the transportation sphere has already gained value from the data of mobile phone movements, with studies being conducted since the earlier stages of the mobile phone revolution. Mobile data in traffic management and transportation planning is used widely in research, business initiatives and statistics, and there are methods and principles for accessing and processing the data that can also be successfully used in tourism statistics.

# 2.5. Other

## 2.5.1. Emergency and Safety Solutions

Use cases regarding emergency solutions were another important subject covered in this task. Even though the content of such solutions is quite different from the systems related to tourism statistics, they contain important information– how the state has regulated information obtained from operators – which is very relevant for the current project. The positioning of E112 emergency calls in Europe is regulated by various directives and local acts of law. In the EU, it is provided by Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive) (http://eur-

lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:108:0051:0051:EN:PDF) and the "E-Call" project based on the Directive, initiated and supported by the European Communication Committee. These services and calls are generally free of charge. In most European countries, the local security and rescue services have the legal right and tools for locating mobile phones within the framework of surveillance activities imposed by courts at their disposal, but this right is only exercised in a case by case basis (see also use cases 30 and 31).

In the EU, the collection and storage of passive positioning data are provided by Directive 2006/24/EC of the European Parliament and of the Council of 15 March 2006 on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks and amending Directive 2002/58/EC. (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:105:0054:0063:EN:PDF), which establishes the need for the storage of the data by mobile operators. The availability of this information is indirectly an opportunity for using the dataset in question for statistical purposes.

Active mobile positioning data is widely used by rescue services and the police, and can be a good example of how legislation initiatives provide the technical possibilities to utilise MNO systems.

## 2.5.2. Business Initiatives

A number of use cases show the increasing interest in the commercial value of the data in different domains. Telefonica, Orange, Telekom Austria (A1), and other mobile operators have started their own business units to investigate the possibility of earning new revenue from commercially offered products based on mobile positioning data. These initiatives are mainly geared towards the advertising market (geomarketing, see use cases 24, 25, 26, 27), but some provide a possibility for the data to be explored in urban studies, transportation and other domains (see use cases 10, 12, 15).

A number of non-MNO businesses aimed at providing technology to MNOs have launched their own line of products, for example TrendIT (Israel), CE-Traffic (Czech Republic), Reach-U (Estonia) and Positium, a consortium member of this study, to name a few. There is a variety of different business models, from simple MNO technology vendors to data brokerage models.

Commercially, the market with the most potential in regard to mobile positioning data is geomarketing. This is something that investors in this field express the most confidence in. However, this business model has not yet been proved. Derived from the wider use of the data by commercial operators, a data feed can be provided for official tourism statistics.

### 2.5.3. Scientific Research

The list of gathered articles shows that mobile positioning is increasingly being used in studying the temporal-spatial mobility of people. Our list includes a total of 77 research papers, most of them in highly-rated (ISI Web of Science) scientific journals or books. The most common areas for using mobile data in research are mobility (see use cases 16-23), travel (see use case 9), transport (see use case 13), urban studies (see use case 19), social network studies (see use case 28), and tourism. Scientific use cases have been presented dispersedly in previous descriptions of the topics.

As seen from various projects, scientific research is often a driving force in the use of new ICT data. Successful results in scientific projects are often followed by practical implementation. This also applies to mobile positioning data, specifically in the field of statistics, where scientific methods are required and developed by researchers in order to guarantee reliable statistics.

# 3. Conclusion

Results of the use case analyses highlight that there is an increasing number of mobile data-based studies, research papers, projects, applications and businesses being created. It can be assumed that in the next 2 to 5 years, such datasets will probably become a common source for studies and statistics in most European countries, and that alongside this process the data will become available for generating tourism statistics. All successful use cases were developed step-by-step and success was guaranteed by user persistence.

## 3.1. Privacy

The lesson to be learnt is that society is getting used to the idea of implementing such data along with the widespread progression of other privacy-sensitive developments, especially in the social media sphere. We are seeing progress in the data protection sphere, where the last decade has shown turbulence with new aspects of privacy protection and many

countries are reviewing their national legislation in order to cope with social issues as well as security threats in the area of data protection. Though tourism statistics neither require nor are intended to track the activities of a specific person, it is closely related and perceived as a part of data protection. MNOs are overcoming privacy and business secret-related concerns as they see new revenue possibilities and also value from internal use of such data. The development of the technology and principles for processing sensitive data safely and anonymously should allow legislation to adopt and develop the practices for using such data. The study also demonstrated the most valued strengths of mobile data: relatively simple, quick and cheap collection of data whilst including a large sample. The time (including the level of individual events) and spatial (the accuracy of a mobile cell, potentially GPS precision) accuracies are also better than previously. The problems of the dataset include lack of qualitative information on the user, such as the purpose of the visits, the means of transport; as well as privacy issues and the problems accompanying the processing of large amounts of data. The implications of these problems with regard to tourism statistics will be discussed in detail in Tasks 3a and 3b of this feasibility study.

## 3.2. Access to the Data

Most of the use cases studied did not address the details of data accessibility. There are probably different reasons for that as well as practices used. Some of the use cases are initiated by MNOs themselves or their affiliates where data accessibility is not an issue. A number of projects include business cases where all the data accessibility aspects are classified by the contract. In some cases a data provider MNO is not disclosed at all because of the fear of the possible effects on the public image of the MNO.

Most of the time, data access results in long-term, trust building cooperation between parties involved, where projects grow from small-scale testing projects to wider collaboration (as in the Estonian case with 10 years of on-going cooperation between a university, a business firm and MNOs). The trust is built based on the large number of measures directed to mutual openness and transparency. The provider of the data often requests explanatory publishing about the projects in the local media and a PR strategy based on the feedback from the public. This has led to a step-by-step process of obtaining larger amounts of and better quality data.

Companies with direct business solutions focused on providing technology for MNOs have yet to give a clear explanation regarding their motivations and conditions of obtaining the data. This could be seen as an interest in opening new business models to use projects that are beneficial for society as a means to advertise the operator. Some negative responses from society have been seen in the Dutch case where data from the Tom-Tom car navigation system was used in locating areas of speeding (http://www.telegraph.co.uk/technology/news/8480195/Police-use-TomTom-data-to-target-speed-traps.html). This example shows possible setbacks on the reputations of the companies.

The third group of cases for obtaining data consists of short-term projects, such as Live Rome or sports competitions in Milan. MNOs agree to reveal "a bit" of their data for certain events or projects for the purpose of publicity or testing potential business opportunities. We know that several big projects started from such small ventures.

The use cases here do not include the largely invisible national initiatives for obtaining mobile data for different purposes. Such approaches are, however, faced with several significant obstacles. Firstly, operators are often not interested in providing data for the state as they see threats in handing the state private and business-sensitive data. Secondly, operators are afraid of new national requirements concerning free delivery of the data and the related investments in meeting state requirements that in most cases are not compensated. Thirdly, the opposition of the collectors and users of traditional statistics is noticeable. Mobile data has its advantages and shortcomings; however, the users of traditional statistics are certainly not interested in losing their jobs; there is little money in the EU countries in the area of statistics and the budgets are being cut.

## 3.3. Methods

Relatively little information has been published on the methodology of collecting data. In most cases, passive positioning data is used, i.e. extraction of data from MNO databases where phone activity logs are stored. The most common sources for extracting the data are databases holding call detail records (CDRs) or Erlang values (volume of connections used by antennas). Various CDR-based roaming databases are in use from the tourism perspective. In some cases there is no geographical information associated with CDRs, so the data represents the overall number of subscribers in the network and can be used to describe statistics on the country level. In most cases the location information is of the accuracy of a mobile antenna

(cell identity). The accuracy of CDR without probabilistic geographical distribution or interpolation is of low accuracy. The significant number of respondents compensates its low accuracy compared to information from GPS-precision travel guides where geographical accuracy is much better but the number of respondents is relatively low. However, the collection of such information for obtaining extensive statistical overviews is still in the beginning stages. As relatively little is known about the details of data collection and data processing in publicly available information, a more in-depth study on methods will be covered in Tasks 3a and 3b of this feasibility study.

## 3.4. Final Remarks

Based on findings from the examined use cases we can conclude that mobile data is being used increasingly in a number of different fields. Most of the active usage is within academia, with some already established applications on state level (E-112). There are a few direct use cases and examples about using mobile positioning data for generating tourism statistics. The preliminary results from the Task 2 questionnaire show, however, that the majority of statistical bodies have already considered use of such data or have even contacted MNOs with data requests. We discovered that a major problem for statistical bodies was not methodological but access to data, privacy concerns and the relatively high "entering cost" of using new ICT-based data sources.

Business-oriented projects from the mobile operators' side concentrate on geomarketing; non-MNO models focus on providing technology and/or brokerage of the result data for usage in transportation, traffic, urban studies, regional development, and tourism applications.

All interested parties seem to realise the potential of utilising this data source but see many obstacles in privacy protection and legislation, user adaptation (the switch to new data sources from traditional practices), representativeness of the data and different methods of translating mobile data to represent the real world.

All aspects of accessing mobile positioning data for official tourism statistics will be discussed in detail in Task 2 of this feasibility study. It will provide an overview of the regulatory, financial, technical and other related topics that cover the aspects of data accessibility using, amongst other things, the results from the current Task 1 report.

A final evaluation about the opportunities and benefits (and of course also the obstacles and problems) of using mobile positioning data for official tourism statistics will take place in Task 4 of this feasibility study.

# Annex 1. Overview of Mobile Positioning Related Activities in EU Member States, EFTA Countries and Candidate States

A description of the situation in assessed countries is listed alphabetically as follows:

**European Union Member States**

# European Union Member States

## Austria

### Official Tourism Statistics

Following the announcement of Austria's biggest MNO, A1, to sell the use of mobile phone positioning data on the market, Statistics Austria started negotiations with A1 with the aim of using mobile positioning data for official tourism and mobility statistics in 2010. A data sample was analysed and evaluated by Positium LBS from the point of view of tourism statistics (inbound and domestic), but the project has been on standby since 2011, as A1 has decided not to put the mobile positioning data of their subscribers on the market.

See: Use case 10 – A1 Traffic Data Stream

| | |
|---|---|
| Key players | Statistics Austria – potential user of the data<br>Austria Telekom (A1) – data provider (test data) |

### Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

### Tourism

#### Business

There are no examples of the use of massive anonymous mobile positioning data of the MNOs in the Austrian tourism industry. Talks with the tourism industry indicate that there is a growing awareness and interest in the future use of information based on the analysis of massive anonymous mobile positioning data.

Austrian tour operators and destinations offer mobile services to their guests. Tourism apps use the location data of mobile phones to provide users with location-based services. On the other hand, the providers of the apps can analyse the movement patterns of their guests, e.g.

- iAustria (http://www.austria.info/us/basic-facts-on-austria/free-smart-phone-application-1525262.html);
- Welcome to Vienna or M. Vienna (http://m.wien.info/en);

- Salzburg Travel Guide (http://www.fodors.com/world/europe/austria/salzburg/);
- Tripwolf (http://www.tripwolf.com/en/page/travel-app);
- And several local ski applications like Schmitten (http://www.bandarin.com/web/deutsch/mobile-guides/schmitten-mobile-info-mobiler-urlaubsguide-schmittenhoehe-oesterreich/).

| | |
|---|---|
| Key players | Austrian National Tourism Board, Vienna Tourism Board, Fodors, Tripwolf, Bandarin |

### Research

There are no examples of the use of massive anonymous mobile positioning data in scientific projects dealing with tourism or other scientific tourism projects relevant for this feasibility study.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

A1, Austria's biggest MNO, started a data stream service that provided aggregated location data of their subscribers. Only local subscriber info was collected without identification of foreign SIMs (roaming service). However, this could be improved as the service was only intended to measure how Austrians commute, and not foreigners (or tourism statistics at all). Based on this data, A1 also planned and tested some traffic analyses with mobile data. The project has been on standby since 2011, as A1 then decided not to put the mobile positioning data of their subscribers on the market.

See: Use case 10 – A1 Traffic Data Stream

| | |
|---|---|
| Key players | Austria Telekom (A1) – MNO as data provider<br>WIGeoGIS – analytical and GIS company assisting with the processing of the data and technological partner |

### Research

The Austrian Institute of Technology tested several data collection methods and transportation projects in their research focus "Large Scale Mobility Information Acquisition and Modelling" (http://www.ait.ac.at/departments/mobility/research-areas/transportation-and-infrastructure-

| | |
|---|---|
| solutions/?L=1). | |
| Key players | Austrian Institute of Technology |
| Publications | Loibl, W., Peters-Anders, J. 2012. Mobile phone data as a source to discover spatial activity and motion patterns. In: Jekel, T., Car, A., Strobl, J., Griesebner, G. (Eds.). GI_Forum 2012: Geovizualisation, Society and Learning. Berlin/Offenbach, pp. 524-533. (see annex 4 Pub. 16) |

## Other Domains

One of the first examples of the use of mobile positioning data to track human behaviour was "Mobile Landscapes: Graz in Real Time" in 2005-2006. It harnesses the potential of mobile phones as an affordable, ready-made and ubiquitous medium that allows the city to be sensed and displayed in real-time as a complex, pulsating entity. Because it is possible to simultaneously 'ping' the cell phones of thousands of users – thereby establishing their precise location in space at a given moment in time – these devices can be used as a highly dynamic tracking tool that describes how the city is used and transformed by its citizens. (http://senseable.mit.edu/graz/).

The City of Vienna along with the Austrian Institute of Technology is a partner in urbanAPI (http://www.urbanapi.eu), a project partly funded under the 7th Framework Programme of the European Commission. The urbanAPI – Information and Communication Technology (ICT) project will provide urban planners with the tools needed to actively analyse, plan and manage the urban environment. Along with other aspects, this project also considers mobile phone data for exploring time-dependent population distribution and motion patterns, by detecting the dynamics within these changing distributions. A1 is included in the project as a data provider, with sample data (specifications unknown) provided as pilot data for the project in Austria. The project runs from September 2011 to August 2014.

See: Use case 21 – Graz in real time

| | |
|---|---|
| Key players | SENSEable City Laboratory, MIT, M-City exhibition, Kunsthaus Graz –users of the data<br>City of Vienna, Austrian Institute of Technology GmbH – partners of the urbanAPI located in Austria<br>Austria Telekom (A1) – data provider in Austria |
| Publications | Ratti, C. 2005. Mobile Landscape – Graz in real time. Proceedings of 3rd Symposium on LBS & TeleCartography, Vienna University of Technology, pp. |

| | |
|---|---|
| | 28-30. |

## MNO Background

- A1 43%
- T-Mobile Austria 34%
- "3" 13%
- Orange Austria 10%

A1 was one of the pioneers experimenting with the use of mobile positioning data to track and analyse human behaviour. However, it presently seems that all their activities in this regard have been put on hold since 2011.
There are no indications that the other MNOs have been active in using mobile positioning data in a sense that is interesting for this feasibility study.

## Situation Assessment

Despite being pioneers in the use of mobile positioning data, all projects and discussions in this regard in Austria seem to be on hold at present mainly because of the setback from public opinion. Our results show that mobile positioning data is not used for official statistics; however, it is used in some research projects and tourism guide systems. Mobile Network Operators control their data and do not want to share it with any end user. The outlook for the future suggests that despite available methodological and technical know-how, there are many barriers that need to be overcome before the wider use of massive anonymous mobile positioning data is feasible in Austria.

# Belgium

## Official Tourism Statistics

The Central Bank of Belgium as well as regional tourism organisations has expressed interest in using mobile positioning data; however, no known steps have been taken so far.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

There are several smartphone-based travel guides (local and international) that provide guide information on tourism attractions with navigation and geolocation capabilities. Such travel guides provide the possibility for the owner companies to analyse the movement of tourists to assess the popularity of different travel routes and attractions:

- Triposo Travel Guide for Belgium
- Sity Trail Belgium

| | |
|---|---|
| Key players | Triposo Travel Guide for Belgium, Sity Trail Belgium |

### Research

Bluetooth tracking has been conducted for analysing people in mass events by researchers in Ghent University, which has a resemblance to mobile positioning from the methodological point of view (http://geoweb.ugent.be/cartogis/research/tracking-of-moving-objects). Mobile positioning datasets from other countries have been used in the tourism research area, but no local datasets are known to be used.

See: Use case 11 – TomTom Traffic

| | |
|---|---|
| Key players | Department of Geography, University of Ghent – collector and analyser of the data |

| | |
|---|---|
| Publications | Delafontaine, M., Versichele, M., Neutens, T., Van de Weghe, N. 2012. Spatiotemporal sequences in Bluetooth tracking data. Applied Geography, 34, pp. 659-668.<br>Versichele, M., Neutens, T., Delafontaine, M., and Van de Weghe, N., 2011. The use of Bluetooth for analyzing spatiotemporal dynamics of human movement at mass events: A case study of the Ghent Festivities. Applied Geography, 32, pp. 208-220. |

## Mobility and Transport

### Business

Some companies (http://www.be-mobile.be) have looked into the use of mobile data to assess traffic information but so far all services use other sensors and data from MNOs are not used in the service. Orange, the owner company of one Belgian MNO (Mobistar), has been looking into the usage of mobile data for transportation research and practical applications but there is no knowledge of the use of Belgian data.

| | |
|---|---|
| Key players | Be-Mobile, RailTime<br>Orange Labs – data provider (MNO) and analyser |

### Research

Small samples of mobile positioning datasets (directly from subscribers and not MNOs) have been used in travel and mobility (activity spaces) studies by the researchers of University of Liege. Researchers from the University of Ghent and University of Louvain have been using mobile positioning datasets from other countries (Portugal) for traffic and mobility analysis.

Researchers from University of Ghent have conducted studies based on Bluetooth tracking (http://geoweb.ugent.be/cartogis/research/tracking-of-moving-objects).

| | |
|---|---|
| Key players | Department of Geography, University of Ghent; Transportation Research Institute (IMOB), Hasselt University; TLU+C (Transport, Logistique, Urbanisme, Conception), University of Liege<br>Unspecified Portuguese MNO – provider of the data |
| Publications | Liu, F. et al 2013. Annotating mobile phone location data with activity purposes using machine learning algorithms. Expert Systems with |

| | |
|---|---|
| | Applications, 40, pp. 3299–3311.<br><br>Csáji, B., Browet, A., Traag, V.A., Delvenne, J-C., Huens, E., van Dooren, P., Smoreda, Z., Blondel, V. 2012. Exploring mobility of mobile users, Physica A, 392:6, pp. 1459-1473, 2012. doi: 10.1016/j.physa.2012.11.040 arXiv:1211.6014.<br><br>Järv, O., Ahas, R., Saluveer, E., Derudder, B., Witlox, F. 2012. Mobile Phones in a Traffic Flow: A Geographical Perspective to Evening Rush Hour Traffic Analysis Using Call Detail Records, PLoS ONE 7(11), http://dx.plos.org/10.1371/journal.pone.0049171<br><br>Silm, S., Ahas, R. 2013. Ethnic differences activity spaces: The study of out-of-home non-employment activities with mobile phone data, Annals of Association of American Geographers (in press). |

## Other Domains

The Department of Mathematical Engineering, University of Louvain used mobile positioning datasets from other countries (Portugal) for social network analysis and different applications.

The Department of Geography, University of Ghent has been involved in research on ethnic segregation using mobile positioning data from other countries.

Research on the privacy of the subscribers related to analysis based on mobile positioning data has been conducted in the Massachusetts Institute of Technology (MIT) and University of Louvain (Belgium) (http://www.nature.com/srep/2013/130325/srep01376/pdf/srep01376.pdf).

| | |
|---|---|
| Key players | Department of Mathematical Engineering, University of Louvain; Department of Geography, University of Ghent<br><br>Unspecified Portuguese MNO – provider of the data |
| Publications | Montjoye, Y-A., Hidalgo, C.A., Verleysen, M., Blondel, V. 2013. Spotted in the Crowd: Mobility Data as a Digital Fingerprint, Nature Scientific Reports.<br><br>Montjoye, Y-A., Hidalgo, C.A., Verleysen, M., Blondel, V.D. 2013. Unique in the Crowd: The privacy bounds of human mobility. SCIENTIFIC REPORTS, Volume: 3, Article Number: 1376, DOI: 10.1038/srep01376. |

## MNO Background

- Proximus 44%
- BASE 28%
- Mobistar 28%

There are no indications that any MNOs have provided massive location data of subscribers for use in projects. Orange-owned Mobistar is a part of the Orange group, which has been studying mobile positioning data for tourism, mobility and other domains, but it is not known if data from Belgium has been used.

## Situation Assessment

Our results, based on public information and contacts from current projects, show that there is strong interest in using mobile positioning data in tourism as well as other spheres driven mainly by researchers. There is no use of mobile phone data for statistical services. Good examples can be noted in the tourism and event tracking with smartphone and Bluetooth data and in fields of mobility studies and social networks. There is great potential for the development of mobile positioning-based statistical services as there are a number of activities in ICT-based tourism guides and academic research projects in this matter.

| | |
|---|---|
| **Bulgaria** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

The City of Sofia (and/or city of Ruse), Bulgaria is a participant city of urbanAPI (http://www.urbanapi.eu), a project partly funded under the 7th Framework Programme of the European Commission. The urbanAPI – Information and Communication Technology (ICT) project will provide urban planners with the tools needed to actively analyse, plan and manage the urban environment. Along with other aspects, this project also considers mobile phone data for exploring the time-dependent population distribution and motion patterns, by detecting the dynamics within these changing distributions. Local MNO – Mtel is included in the project as a data provider; however, no specific information concerning the actual use of mobile data is provided. The project runs from September 2011 to August 2014.

| | |
|---|---|
| Key players | ASDE (http://www.asde-bg.org/) – a partner of the urbanAPI located in Bulgaria<br>Mtel – MNO as potential data provider within the urbanAPI project |
| Publications | |

## MNO Background

- Mtel 48%
- GLOBUL 38%
- Vivacom 14%
- Max Telecom N/A
- Nexcom N/A

MTEL, as Bulgaria's market leader is involved in the urbanAPI project; however, there is no specific information concerning the actual use of the mobile data.

## Situation Assessment

According to public information and contacts from the current feasibility study, mobile positioning data has not been used in Bulgaria for objectives relevant to this project. There is limited information available about developments and use cases in Bulgaria.

# Croatia

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

The mobile tourism guide mX Croatia has been popular among tourists. Its functionality provides anonymous statistics for the movement of users but it is unknown if such statistics are used in any way.

http://www.mobiexplore.com/croatiaedition

| | |
|---|---|
| Key players | mobiexplore (creator of mX Croatia) |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- T-Hrvatski Telekom 46%
- Vip 40%
- Tele2 14%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel guides, where the data can be used for analysis but we do not have information about any concrete cases.

# Cyprus

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Discover Cyprus (http://www.cyprusmobileapps.com/ios/iphone/travel/item/discover-cyprus-3);
- Official visitor site VisitCyprus (http://m.visitcyprus.com).

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

The University of Cyprus has developed several research applications about crowdsourcing and data management with mobile phones. The main focus of the research has been the indoor locations of mobile phones. Not much information is publicly available.

| | |
|---|---|
| Key players | Department of Computer Science and Research Centre for Intelligent Systems and Networks of the University of Cyprus. |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Cytamobile N/A
- MTN N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

# Czech Republic

## Official Tourism Statistics

There is no indication of official use of mobile positioning data in official tourism statistics; however, there is interest in outcomes of the pilot analysis. Official statistics have been compared to data from mobile operators at least in one case (CzechTourism).

See: Use case 3 – CzechTourism

| | |
|---|---|
| Key players | Czech Statistical Office, Czech National Bank, CzechTourism<br>Unspecified Czech MNOs – providers of the data |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

There have been pilot studies to use mobile positioning data by tourism authorities (CzechTourism) that have used the mobile positioning data for monitoring tourism flows in April 2012. Data was collected for 45 locations (UNESCO sites, mountain regions, spa towns) and combined with existing traditional data (from Czech Statistical Office and Czech National Bank). The MNO providing the data is identified as "one mobile operator on the Czech market" whose name is not publicly revealed. Project leaders consider it too soon to evaluate the contribution of this method for practical use by CzechTourism and other parties. However, there are many interested parties (representatives of monitored attractions, touristic regions) that see potential in monitoring tourism flows by such a method. Regarding the fact that use of mobile positioning data often has negative reactions in media and from the general public, there is a need to speak about its contribution for the whole branch of tourism in the Czech Republic.

CE-Traffic has launched the services providing unique reports about foreign and domestic tourists for national, regional, or specific area level for governmental agencies, cities, municipalities, banks, consulting companies and many other organisations.

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

<table>
<tr><td colspan="2">

- mTrip Travel Guide (www.mtrip.com);
- iDNES Journey Planner (http://jizdnirady.idnes.cz/vlakyautobusy/idos).

See: Use case 3 – CzechTourism

See: Use case 15 – TrendIT People Analytics

</td></tr>
<tr><td>Key players</td><td>Czech Tourist Authority – CzechTourism (end-user of data)<br><br>CE Traffic – provider of the data. The company runs the system of continual and continuous online monitoring of the current distribution of the population and its mobility in space concerning domestic and foreign visitors.<br><br>TrendIT – company providing the technological basis for data collection from MNOs<br><br>Unspecified Czech MNOs – providers of the data</td></tr>
<tr><td colspan="2">Research</td></tr>
<tr><td colspan="2">No indication.</td></tr>
<tr><td>Key players</td><td></td></tr>
<tr><td>Publications</td><td></td></tr>
<tr><td colspan="2">Mobility and Transport</td></tr>
<tr><td colspan="2">Business</td></tr>
<tr><td colspan="2">CE-Traffic, a Czech based company, provides live and historical traffic and geodemographic data based on anonymous signalling data from MNOs (http://www.ce-traffic.com/en/).<br><br>See: Use case 15 – TrendIT People Analytics</td></tr>
<tr><td>Key players</td><td>TrendIT, CE-Traffic<br><br>Unspecified Czech MNOs – providers of the data</td></tr>
<tr><td colspan="2">Research</td></tr>
<tr><td colspan="2">The Geography Department of Charles University of Prague used mobile telecom data in cooperation with Estonian colleagues from the University of Tartu.<br><br>The Research and Development Centre for Mobile Applications of the Czech Technical University in</td></tr>
</table>

| | |
|---|---|
| Prague is developing mobile applications for active tracing and mobility studies (http://www.rdc.cz/en/aboutUs/). | |
| Key players | Geography Department of Charles University of Prague; Research and Development Centre for Mobile Applications of the Czech Technical University in Prague |
| Publications | Novák, J., Ahas, R., Aasa, A., Silm, S. 2013. Application of mobile phone location data in mapping of commuting patterns and functional regionalization: a pilot study of Estonia. Journal of Maps 9(1), pp. 10-15.<br><br>Novák, J., Novobilsky, J. 2013. Innovative approaches to the study of the present population: Data of mobile operators. Urbanismus a územní rozvoj 3, pp. 14-18.<br><br>Novák, J., Temelova, J. 2012. Everyday Life and Spatial Mobility of Young People in Prague: A Pilot Study Using Mobile Phone Location Data. Sociologicky Casopis-Czech Sociological Review 48(5), pp. 911-938.<br><br>Novák, J. 2010. Mobile phone location data: possibilities of use in geographical research. PhD Thesis, Prague 2010.<br><br>Dufková, K., Ficek, M., Kencl, L., Novák, J., Kouba, J., Gregor, I., Danihelka, J. 2008. Active GSM cell-ID tracking: Where did you disappear ? In: MELT 2008: Proceedings of the first ACM international workshop on mobile entity localization and tracking in GPS-less environments, San Francisco, California, USA, pp. 7-12.<br><br>Ficek, M., Pop, T., Kencl, L. 2013. Active tracking in mobile networks: An in-depth view. *Computer Networks* 57 (9), pp. 1936-1954.<br><br>Ficek, M., Kencl, L. 2012. Inter-Call Mobility Model: A Spatio-temporal Refinement of Call Data Records Using a Gaussian Mixture Model, IEEE Infocom 2012, March 25-30, 2012, Orlando, Florida, USA.<br><br>Ficek, M., Clark, N., Kencl, L. 2012. Can crowdsensing beat dynamic cell-ID? Proceedings of the Third International Workshop on Sensing Applications on Mobile Phones. ACM, pp. 10.<br><br>Ficek, M., Pop, T., Vláčil, P., Dufková, K., Kencl, L., Tomek, M. 2010. Performance study of active tracking in a cellular network using a modular signalling platform. Proceedings of the 8th international conference on Mobile systems, applications, and services. ACM, pp. 239-254. |

| | |
|---|---|
| | Ficek, M., Kencl, L. 2010. Spatial Extension of the Reality Mining Dataset. Mobile Adhoc and Sensor Systems (MASS), 2010 IEEE 7th International Conference on. IEEE, pp. 666-673. |

## Other Domains

Local MNO O2 has rolled out a project for opt-in SMS advertisement based on the geographical behaviour of subscribers (http://www.globaladvertisingsolutions.telefonica.com/content/czech-republic; http://www.globaladvertisingsolutions.telefonica.com/content/opt-in-push-messaging).

The Israeli technological company TrendIT along with the Czech company CE-Traffic is offering an MNO data-based geodemographics data service with potential use in traffic, geomarketing, tourism marketing, etc. (http://nocamels.com/2012/03/trendit-mapping-population-movements-through-mobile-signals/).

See: Use case 26 – O2, Telefonica Global Advertising Solution

| | |
|---|---|
| Key players | Trend-IT<br>O2 – MNO running the service and using opt-in data of its subscribers |
| Publications | |

## MNO Background

- T-Mobile 40%
- O2 35%
- Vodafone 24%
- U:fon 1%

Czech MNOs are working with a number of companies to provide aggregated subscriber data for business use. Pilot projects have been conducted for tourism statistics.
O2 has individually provided the use of the data for opt-in advertising.

## Situation Assessment

Our results, based on public information and contacts from current projects, show that mobile positioning data has been used in some cases for statistical purposes, for scientific research and businesses in various fields. Good examples can also be noted in the fields of transportation and mobility studies and some business applications. Practical applications have been developed on national and municipal levels. Based on current developments, it can be said that this field is developing quickly and MNOs are collaborating with mostly private companies concerning the use of their data.

# Denmark

## Official Tourism Statistics

Statistics Denmark is interested in using mobile positioning data in tourism statistics; however, they state that currently the main barriers for the use are regulatory and legislation obstacles, high implementation and maintenance cost and technological issues.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Going DK associated to official agency VisitDenmark (http://www.visitdenmark.co.uk/en-gb/danmark/tourist-app-goingdk-for-smartphones-gdk615437).

| | |
|---|---|
| Key players | VisitDenmark |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

The engineering company Ramboll Group has been investigating the possibility of using mobile positioning data based on the experience from Estonian use cases. Mobile positioning-based

analyses give the company an advantage in feasibility studies in transportation planning projects.

See: Use case 12 – Estonian OD-Matrices

| | |
|---|---|
| Key players | University of Aalborg; Ramboll Ltd |

## Research

Researchers at the University of Aalborg (Prof. H. Harder) have been working on mobile phone-based traffic analysis (http://personprofil.aau.dk/110150).

| | |
|---|---|
| Key players | University of Aalborg |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- TDC 51%
- Telenor 23%
- Telia 17%
- "3" 10%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results based on available sources show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel guides, where the data can be used for analysis but we do not have information about any concrete cases. It is assumed that there are many barriers that need to be overcome before wider use of mobile positioning data is feasible.

# Estonia

## Official Tourism Statistics

Official country-level tourism statistics based on mobile positioning data (inbound and outbound) are used by the central bank (Bank of Estonia) for the purpose of calculation of travel accounts in the balance of payments. The same information is used by Statistics Estonia unofficially (via Bank of Estonia), as the data is published on the central bank's website monthly. The data provided includes inbound and outbound statistical indicators such as number of trips, days and nights spent, country of origin and destination, distinction between residents and tourists, transit trips and same and multi-day trips. Indicators are updated on a monthly basis for the previous month. Data is mediated by Positium LBS (partner of the current project), which has data usage agreements with Estonian MNOs. Positium LBS is also calculating domestic tourism statistics from mobile data and developing monitoring tools for tourism using the same data sources.

See: Use case 2 – Central Bank of Estonia – State Level Inbound and Outbound Statistics

| | |
|---|---|
| Key players | Central Bank of Estonia, Statistics Estonia – users of the data<br>Positium LBS – data brokerage company |

## Other Official Statistics

Use of mobile data in other official statistics has been under discussion for many spheres, such as planned register-based census, population dynamics, migration, travel and mobility, commuting (https://www.siseministeerium.ee/public/Regionaalse_pendelrandeuuringu_lopparuanne.pdf). Estonia is planning steps to use mobile positioning datasets as one source for transportation census.

See: Use case 19 – Regional Commuting

| | |
|---|---|
| Key players | Statistics Estonia, Ministry of Internal Affairs, Ministry of Economy and Communications – users of the data<br>Positium LBS – data brokerage company |

## Tourism

### Business

Mobile-based tourism statistics have been used in projects for municipalities, tourism promotion agencies, international (Interreg – http://www.euregio-heltal.org/wp-content/uploads/2011/03/Spatial-Mobility-between-Tallinn-and-Helsinki-in-Mobile-Positioning-Datasets.pdf) projects, etc.; for assessing the number of tourists, seasonal changes of tourism flows, effects from the investments and tourism development. Main reasons for using such data are the benefits compared to accommodation statistics and survey based data. Data can be presented on a smaller scale (daily, smaller locations) with a wider variation of indicators allowing more information and possibilities in the projects. Projects are mostly one-time with possible updates in future.

See: Use case 6 – Tourist attraction centres

See: Use case 7 – Mass Events Monitoring

See: Use case 8 – Helsinki-Tallinn International Commuting Study

| | |
|---|---|
| Key players | University of Tartu, Enterprise Estonia, various municipalities, City of Helsinki, Tallinn, Euregio (joint NGO) – users of the analysis<br>Positium LBS – data brokerage company |

### Research

Primary research using mobile phone data is conducted in the University of Tartu Mobility Lab (http://mobilitylab.ut.ee/eng/). The research, including tourism, has been conducted in the fields of human geography, demographics, economics, social sciences, computer sciences and GIS. The following research topics have been developed:

- Methodological aspects of processing mobile positioning data;
- Events tourism – a marketing aspect and measure of events' effect on countries' tourism;
- Loyalty of tourists to country/region/event;
- Movement patterns by tourists based on seasonality, country of origin and other characteristics;
- Destinations of tourism;
- Everyday activity spaces (anchor points, meaningful places);
- Long-term tourism and migration;
- Ethnic differences in leisure behaviour;
- International commuting and transnational connections.

| | |
|---|---|
| See: Use case 6 – Tourist attraction centres<br>See: Use case 7 – Mass Events Monitoring | |
| Key players | University of Tartu, Central Bank of Estonia (Statistics Department), Statistics Estonia (Enterprise Statistics Department, Services Statistics), Enterprise Estonia, various municipalities<br><br>Positium LBS – data brokerage company |
| Publications | Kuusik, A., Tiru, M., Varblane, U., Ahas, R. 2011. Process innovation in destination marketing: use of passive mobile positioning (PMP) for segmentation of repeat visitors in case of Estonia, Baltic Journal of Management 6(3), pp. 378-399.<br><br>Ahas R. 2010. From the Guest Editor: Mobile Positioning and Tracking in Geography and Planning, Journal of Urban Technology, 17(1), pp. 1-2<br><br>Ahas, R. 2010. Mobile positioning data in geography and planning, Editorial. Journal of Location Based Services, 4(2), pp. 67-69.<br><br>Tiru, M., Kuusik, A., Lamp, M-L., Ahas, R. 2010. LBS in marketing and tourism management: measuring destination loyalty with mobile positioning data. Journal of Location Based Services, 4(2), pp. 120-140.<br><br>Tiru, M., Saluveer E., Ahas, R., Aasa, A. 2010. Web-based monitoring tool for assessing space-time mobility of tourists using mobile positioning data: Positium Barometer. Journal of Urban Technology, 17(1), pp. 71-89.<br><br>Ahas, R. Aasa, A., Roose, A., Mark, Ü., Silm, S. 2008. Evaluating passive mobile positioning data for tourism surveys: An Estonian case study. Tourism Management 29(3), pp. 469-486.<br><br>Tammaru, T., Leetmaa K., Silm, S, Ahas, R. 2008. New residential areas in the Tallinn Metropolitan Area. European Planning Studies, European Planning. Stud 17(3), pp. 423-439.<br><br>Ahas, R., Aasa, A., Mark, Ü., Pae, T., Kull, T. 2007. Seasonal tourism spaces in Estonia: case study with mobile positioning data. Tourism Management 28(3), pp. 898-910.<br><br>Ahas, R., Aasa, A., Silm, S., Aunap, R., Kalle, H., Mark, Ü. 2007. Mobile positioning in space-time behaviour studies: Social Positioning Method experiments in Estonia. Cartography and Geographic Information Science 34(4), pp. 259-273. |

| | |
|---|---|
| | Ahas, R., Mark, Ü. 2005. Location based services – new challenges for planning and public administration? Futures, 37(6), pp. 547-561. |

## Mobility and Transport

### Business

There are several projects in mobility and transportation that have included the analysis based on mobile data: providing base data for transportation modelling, origin-destination matrices, commuting, demand side of public transportation planning and overall mobility description. Users of the data have been both government-based institutions mostly for wider-scale projects (commuting), and private companies. Benefits of the data have been its cost-effectiveness compared to traditional methods that would have required large-scale surveys and extensive fieldwork. However, in transportation, the quality of data (geographical and temporal accuracy and density) is a big issue as simple CDR-based data is often not usable in small-scale projects.

See: Use case 12 – Estonian OD-Matrices

| | |
|---|---|
| Key players | University of Tartu, Ministry of Interior (Regional Affairs Dept.), Ramboll Group; Ministry of Economy and Communications<br><br>Positium LBS – data brokerage company |

### Research

Studies of transportation flows and geographical distribution of transportation have been conducted using mobile phone data. Also space-time variability in travel behaviour and ethnic differences in travel behaviour have been studied.

See: Use case 12 – Estonian OD-Matrices

| | |
|---|---|
| Key players | University of Tartu<br><br>Positium LBS – data brokerage company |
| Publications | Silm, S., Ahas, R. 201x. Ethnic differences activity spaces: The study of out-of-home non-employment activities with mobile phone data, Annals of Association of American Geographers (in press).<br><br>Zhang, Q., Slingsby, A., Dykes, J., Wood, J., Kraak, M.J., Blok C.A., Ahas, R. 2013. Visual analysis design to support research into movement and use of space in Tallinn: A case study, Information Visualization 12:xxx, |

http://ivi.sagepub.com/content/early/2013/03/21/1473871613480062

Toomet, O., Silm, S., Tammaru, T., Ahas, R. 201x. Where do Ethnic Groups Meet? Copresence at Places of Residence, Work, and Free-time, American Journal of Sociology (submitted).

Novák, J., Ahas, R., Aasa, A., Silm, S. 2013. Application of mobile phone location data in mapping of commuting patterns and functional regionalization: a pilot study of Estonia, Journal of Maps, http://dx.doi.org/10.1080/17445647.2012.762331.

Silm, S., Ahas, R., Nuga, M. 2013. Gender differences in space-time mobility patterns in a post-communist city: a case study based on mobile positioning in the suburbs of Tallinn. Environment and Planning B (in press).

Järv, O., Ahas, R., Saluveer, E., Derudder, B., Witlox, F. 2012. Mobile Phones in a Traffic Flow: A Geographical Perspective to Evening Rush Hour Traffic Analysis Using Call Detail Records, PLoS ONE 7(11), http://dx.plos.org/10.1371/journal.pone.0049171.

Nilbe, K., Ahas, R., Silm, S. 201x. Evaluating the Travel Distances of Events and Regular Visitors using Mobile Positioning Data: The case of Estonia, Journal of Urban Technology (submitted).

Silm,S., Ahas, R., 2010. 'The seasonal variability of population in Estonian municipalities, Environmnet and Planning A, 42(10), pp. 2527-2546.

Ahas, R., Silm, S., Järv, O., Saluveer E., Tiru, M. 2010. Using Mobile Positioning Data to Model Locations Meaningful to Users of Mobile Phones, Journal of Urban Technology, 17(1), pp. 3-27.

Ahas, R., Aasa, A., Silm, S., Tiru, M. 2010. Daily rhythms of suburban commuters' movements in the Tallinn metropolitan area: case study with mobile positioning data. Transportation Research C, 18, pp. 45-54.

## Other Domains

Emergency management plans using mobile phone data and different analyses have been conducted for emergency authorities. Also studies of tourism events, extreme weather situations and emergency situations have been analysed with mobile data.

Research and pilot applications have been developed in geomarketing as retailers are interested in information about the geography of customers compared to their competitors. Applications based on mobile data are used in marketing campaigns, outdoor media, location analyses etc. Geomarketing

applications are in testing phase with key questions on public opinion and value for the end users.

Several pilot projects have been conducted for improving business intelligence within MNOs using aggregated roaming and other databases that are potentially usable outside the MNOs internal sphere. Currently, most of these projects have been introduced to MNOs from success stories of external use of the data, e.g. comparison of individual MNOs roaming service data to overall tourism indicators showing the approximate penetration rate of the MNOs in tourists' market. Most of the internal projects are within the marketing objectives of MNOs who are looking for new ways of using subscriber data to offer new values to subscribers and third parties (retails, marketing campaigns, etc.).

See: Use case 25 – Estonian Geomarketing Application

See: Use case 31 – GIS-112

| | |
|---|---|
| Key players | University of Tartu; Estonian Emergency Board; Ministry of Internal Affairs, retail shops, outdoor media companies, Reach-U<br>Positium LBS – data brokerage company |
| Publications | |

## MNO Background

- EMT 46%
- Elisa 28%
- Tele2 27%

All mobile MNOs in the country have been involved in at least some projects with mobile positioning data. Data from EMT (TeliaSonera) and Elisa is actively used for tourism statistics. Data from Tele2 has been used in pilots.

## Situation Assessment

Mobile positioning data has been used extensively in different domains since 2003; using mobile data for tourism statistics started in 2004 with inbound roaming data projects. Since 2009, the central bank has been using mobile positioning based statistics for the national balance of payment calculation (inbound and outbound tourism). The main driving force has been scientific research that has been followed by practical projects and continuous usage in tourism, transportation planning, urban planning, regional development, marketing, research, safety, and security. Because of the size of the country and the innovative IT atmosphere, many of the applications are easy to deploy and can be tested quickly.

# Finland

## Official Tourism Statistics

Initial interest, first steps within current project to get pilot data and assess the feasibility and usability of the methodology.

| | |
|---|---|
| Key players | Statistics Finland |

## Other Official Statistics

Finnish Transport Agency, earlier Finnish Road Administration (J. Kummala) used mobile statistics for traffic analyses. Test project (http://alk.tiehallinto.fi/julkaisut/pdf/3200707.pdf; http://virtual.vtt.fi/virtual/proj6/fits/impacts/Matka_aikapalvelu_loppuraportti_tulokset.pdf).

See: Use case 13 – Mobile Phone Positioning for Traffic Data Collection

| | |
|---|---|
| Key players | Finnish Transport Agency<br>Elisa (former Radiolinja) – provider of the data for pilot project |

## Tourism

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

Data from Estonian MNOs have been used in the study of the Helsinki-Tallinn International Commuting Study. However, Finnish mobile data was not used in this research.

See: Use case 8 – Helsinki-Tallinn International Commuting Study

| | |
|---|---|
| Key players | University of Tartu – analysis<br>City of Helsinki, Tallinn, Euregio (joint NGO) – users of the analysis<br>Positium LBS – data brokerage company |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Sonera 40%
- DNA 30%
- Elisa 29%

Elisa has been involved in the use of mobile data for the pilot of mobile statistics for traffic analyses by the Finnish Transport Agency.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics; however, there is interest and discussion as Statistics Finland is a partner of the current feasibility study and is interested in the potential use of the data in tourism statistics. Mobile Network Operators do not easily provide the data, mostly because of the legislation and public opinion. Data protection and public opinion are very important in Finland and thus mobile positioning data are not widely used.

The outlook for the future suggests that despite available methodological and technical know-how, there are many barriers that need to be overcome before a wider use of massive anonymous mobile positioning data is feasible in Finland.

# France

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Paris City Tour app (http://www.toursgps.com);
- Tour de France Mobile app (http://www.letour.fr/2011/TDF/LIVE/us/application-mobile.html);
- Camineo SAS – Producer of mobile travel guide platforms and contents (http://www.camineo.com/index.php?lang=en).

| | |
|---|---|
| Key players | |

### Research

Orange Labs France is a large research centre for mobile positioning data and has performed a number of tourist behaviour studies. Specific research based on mobile positioning data was conducted on tourists' behaviour in the Paris region (http://perso.rd.francetelecom.fr/smoreda/publications/2012_RIG_olteanu_etal.pdf).

See: Use case 5 – Paris Tourism
See: Use case 18 – Mobility Behaviour (active, passive)

| | |
|---|---|
| Key players | Orange Labs – provider of the data and analyser |
| Publications | Oltenau-Raimond, A-M., Couronné, T., Fen-Chong, J., Smoreda, Z. 2012. Le Paris des visiteurs étrangers, qu'en disent les téléphones mobiles? Inférence des |

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|---|---|
| | pratiques spatiales et fréquentations des sites touristiques en Ile-de-France. Revue Internationale de la Géomatique, 22(3). (see annex 4 Pub. 10) |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| Orange Labs has used mobile positioning data to study the space-time behaviour and mobility of people based on data from France and other countries (Portugal).<br>See: Use case 16 – Mobility Behaviour | |
| Key players | Orange Labs – provider of the data and analyser |
| Publications | Smoreda, Z., Olteanu-Raimond, A-M., Couronné, T. 2013. Spatiotemporal data from mobile phones for personal mobility assessment. In: Zmud, J. et al (eds.) Transport Survey Methods: Best Practice for Decision Making, Emerald. Sociology and Economics of Networks and Services department. Orange Labs R&D, Paris, France.<br>Csáji, B., Browet, A., Traag, V.A., Delvenne, J-C., Huens, E., Van Dooren, P., Smoreda, Z., Blondel, V.D. 2012. Exploring the Mobility of Mobile Phone Users. Cornell University Library. Preprint submitted to Physica A. (see annex 4 Pub. 5) |
| **Other Domains** | |
| Orange Lab cooperated in data use with many research organisations around the globe. | |
| Key players | Orange Labs – provider of the data and analyser |
| Publications | Calabrese, F., Smoreda, Z., Blondel, V., Ratti, C. 2011. Interplay between telecommunications and face-to-face interactions: A study using mobile phone data. PLoS ONE, 6(7).<br>Stoica, A., Smoreda, Z., Prieur, C. 2013. A Local Structure-Based Method for |

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|---|---|
| | Nodes Clustering: Application to a Large Mobile Phone Social Network. The Influence of Technology on Social Network Analysis and Mining. Lecture Notes in Social Networks. Vol. 6, pp. 157-184. |

## MNO Background

- Orange 41%
- SFR 32%
- Bouygues Telecom 17%
- Free Mobile 9%

Data from Orange networks have been used mainly by Orange Labs in tourism, mobility and other research.

## Situation Assessment

Our results, based on public information and contacts from current projects, show that mobile positioning data has been used for different purposes in France due to the innovativeness of Orange Lab. There are good examples about using mobile data for tourism, transportation and urban studies and applications. Orange Labs is cooperating with different research organisations around the globe. The data is not used for official tourism statistics, but there is growing interest on many levels as France is one of the largest tourism destinations in the world.

# Germany

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

There are no examples of the use of massive anonymous mobile positioning data of the MNOs in the German tourism industry. Talks with the tourism industry indicate that there is a growing awareness and interest in future use of information based on the analysis of the massive anonymous mobile positioning data.

German tour operators and destinations are offering mobile services to their guests. Tourism apps use the location data of the mobile phones to provide the users with location-based services. On the other hand the providers of the apps can analyse the movement patterns of their guests (http://www.germany.travel/en/towns-cities-culture/top-100/germany-travel-attractions.html).

See: Use case 29 – TOURIAS Travel Guide

| | |
|---|---|
| Key players | TOURIAS, GIATA, Thomas Cook, GNTB as well as other destinations and tour operators |

### Research

There are no examples of the use of the massive anonymous mobile positioning data in scientific projects dealing with tourism or other scientific tourism projects that are relevant for this feasibility study.

| | |
|---|---|
| Key players | |

| | |
|---|---|
| Publications | |

## Mobility and Transport

### Business

Until now, the only continuous use of massive anonymous mobile positioning data is in intelligent traffic guidance systems. One example is TomTom Traffic but there have been other consortiums offering basically the same service (e.g. http://www.traffictechnologytoday.com/news.php?NewsID=28344). As mobile positioning data is only one of many sources of data for these systems, it seems to be hard for the MNOs to make a successful business case out of this (background: the Telefonica/O2, BMW, IT IS cooperation has been terminated).

See: Use case 11 – TomTom Traffic

| | |
|---|---|
| Key players | TomTom, Daimler Benz, BMW, ITIS<br>Vodafone, Deutsche Telekom, Telefonica/O2 – providers of the data |

### Research

There are sporadic scientific projects in mobility and transport that have been analysing massive anonymous mobile positioning data. Especially the basic works dealing with methodological issues of using massive anonymous mobile positioning data to track mobility patterns are important for this feasibility study (http://www.isprs.org/proceedings/XXXVI/5-C55/papers/ramm_katrin.pdf).

See: Use case 20 – Fraunhofer GSM-GPS

| | |
|---|---|
| Key players | Fraunhofer IAIS, Nokia, University Stuttgart, University Braunschweig<br>Deutsche Telekom – provider of the data |
| Publications | Schulz, D., Bothe, S., Körner, C. 2012. Human Mobility from GSM Data – A Valid Alternative to GPS? This material was prepared for the Mobile Data Challenge 2012 (by Nokia) Workshop; Newcastle, UK. http://research.nokia.com/files/public/mdc-final458-schulz.pdf<br>Ramm, K., Schwieger, V. 2007. Mobile Positioning for Traffic State Acquisition. Journal of Location Based Services Vol.1 (2), pp. 133-144. |

## Other Domains

The MNOs seem to be eager to find new business models to market massive anonymous mobile positioning data. In focus are solutions for retail and geomarketing. Telefonica/O2 is trying to install the product Smart Steps, which is already running in the UK and Deutsche Telekom is preparing a similar product. This is important for this feasibility study as it again shows the interest of the MNOs to find applications for their data as well as the difficulties to launch products based on analysing massive anonymous mobile positioning data.

As in other European countries, Germany has implemented the EU Directive E112, which requires the MNOs to provide emergency localisations services. This is important for this feasibility study as it clearly shows that the MNOs have the technological capabilities of detailed geographic analysis of the locations of their subscribers.

See: Use case 24 – Telefonica Dynamic Insights

See: Use case 30 – LifeService112

| | |
|---|---|
| Key players | Allianz, nobisCum, Björn Steiger Stiftung, GfK,<br>Deutsche Telekom, Vodafone, O2, E-Plus, Telefonica/O2 – providers of the data |
| Publications | |

## MNO Background

- Telekom 32%
- Vodafone 30%
- E-Plus 21%
- O2 17%

All MNOs seem to be eager to market the use of their mobile positioning data and are thinking about products. Presently, there are no products available yet.

On July 23rd, 2013, O2 and E-Plus publicly announced their plans for a fusion of the two providers in Germany. The combined customer base of the two providers would reach 43 million subscribers and constitute rank 1 in the German market.

## Situation Assessment

At present, massive anonymous mobile positioning data is not used at all for official (tourism) statistics nor is there a detectable discussion about its use in the future. It is sporadically used, mostly in scientific projects dealing with mobility studies. The only business case for the MNOs so far is the use of mobile positioning data in intelligent traffic guidance systems. At the same time, the German MNOs are eager to market the assets of their subscribers' data. Probably due to barriers connected with regulatory and public opinion issues, there are no products so far relying on the use of the massive anonymous mobile positioning data on the market. The standards for data protection are very high in Germany and the public opinion is very touchy with this regard. The outlook for the future suggests that despite available methodological and technical know-how, there are many barriers that need to be overcome before the wider use of the massive anonymous mobile positioning data in Germany is feasible.

# Greece

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Athens Travel Guide (http://www.virtualtourist.com/travel/Europe/Greece/Prefecture_of_Attica/Athens-426812/TravelGuide-Athens.html)

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

The Hellenic Institute of Transport has been working on mobile, location-based advanced traveller information services, mobility data collection, fusion, and processing. Though this is not directly the use of mobile positioning data, this methodology is used in transport and mobility-related mobile applications (http://www.transport-tips.eu/uploads/files/ITS_workshop_26June13_Thessaloniki_GR/06_ITS_solutions_in_CERTH-HIT_Mitsakis.pdf).

| | |
|---|---|
| Key players | Hellenic Institute of Transport |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Cosmote 49%
- Vodafone 30%
- Wind 21%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. The economic crisis has had a strong impact on research and development in Greece and there is also limited information available publicly.

# Hungary

## Official Tourism Statistics

There is interest from official tourism statistics collectors (Hungarian Central Statistical Office) to investigate the possibilities of the use of such data, but so far no specific steps have been conducted. Privacy concerns, high implementation and maintenance cost, technological issues have been reported as main barriers.

| | |
|---|---|
| Key players | Hungarian Central Statistical Office |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Hungary Tourism app (http://www.wsa-mobile.org/winner/hungary-tourism-app-51220101104).

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

Researchers from the Hungarian Academy of Sciences have been involved in the research on exploring the mobility of mobile phone users (data from Portugal).

See: Use case 16 – Mobility Behaviour

| | |
|---|---|
| Key players | |
| Publications | Csáji, B., Browet, A., Traag, V.A., Delvenne, J-C., Huens, E., Van Dooren, P., Smoreda, Z., Blondel, V.D. 2012. Exploring the Mobility of Mobile Phone Users. Cornell University Library. Preprint submitted to Physica A. |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Magyar Telekom 46%
- Telenor 31%
- Vodafone 23%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There is interest from the official statistics collectors, but no specific steps have been made.

# Ireland

## Official Tourism Statistics

The Central Statistics Office Ireland (CSO) has started a legal procedure to obtain inbound roaming data from Irish MNOs for official tourism statistics. The procedure is currently still in progress. The aim of the initiative is to collect call detail records (CDR) of inbound roaming data from all MNOs and process the data. In case of success, this will be a good example of implementation of national statistics act to obtain highly unmodified "raw" data of MNOs. Besides legal obstacles, CSO has identified other, mainly technological barriers.

| | |
|---|---|
| Key players | Central Statistics Office Ireland |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

NGOs are interested and keen on the results of CSO to access MNOs data. There have been requests for roaming data from MNOs but so far the MNOs are not providing data for tourism statistics.

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Discover Ireland tourism app for mobile phones (http://www.discoverireland.ie/Info/Discover-Ireland-Mobile)
- Kilkenny Castle Mobile Tour (http://www.mobanode.com/index.php?go=app&id=29)

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

Researchers from the University of Ireland Maynooth (S. McLoone, J. Doyle and et al) have studied analytical tools for mobile phone based studies in mobility and transportation (http://callan.nuim.ie/people/JohnDoyle.php). Sample data – call detail records (CDRs), one week – from one MNO (Meteor) has been utilised in the research. This has been a project-based research and there is no continuous data flow.

The IBM research centre in Ireland in cooperation with MIT and AirSage has participated in projects for understanding individual mobility patterns using mobile phone data (CDRs from US). This has also been project-based research without currently known continuous implications in Ireland.

See: Use case 23 – Mobility Patterns in Urban Sensing Data

| | |
|---|---|
| Key players | University of Ireland Maynooth, IBM Research, Dublin, Ireland<br>Meteor – provider of the data in pilot project |
| Publications | Doyle, J., Hung, P., Kelly, D., McLoone, S., Farrell, R. 2011. "Utilising Mobile Phone Billing Records for Travel Mode Discovery". Proc. 22nd IET Irish Signals and Systems Conference (ISSC 2011), Trinity College Dublin, June 23.<br>Doyle, J., McLoone, S., McCarthy, T., Farrell, R. 2010. "Topography of Irish Mobile Telephony Activities: Visualising Human Dynamics on a Macro Scale" (2010) GeoVA(t) – Geospatial Visual Analytics: Focus on Time Workshop, AGILE, Guimaraes, Portugal, 10-11 May 2010.<br>Doyle, J., Farrell, R., McLoone, S., McCarthy, T., Hung, P. 2009. "Extracting Localised Mobile Activity Patterns from Cumulative Mobile Spectrum RSSI" (2009) China-Ireland International Conference on Information and Communications Technologies (CIICT 2009), Maynooth, Ireland, 19-21 August 2009, pp. 75-82.<br>Doyle, J., Farrell, R., McLoone, S., McCarthy, T., Tahir, M., Hung, P. 2009. "Utilising Mobile Phone RSSI Metric for Human Activity Detection" (2009) in |

| | |
|---|---|
| | Proceedings of the 20th IET Irish Signals and Systems Conference (ISSC 2009), Dublin, Ireland, June 2009. |

## Other Domains

The IBM research centre in Ireland is participating in smart city conceptual research that involves mobile positioning as one data source for smart city networks.

| | |
|---|---|
| Key players | IBM Research, Dublin, Ireland |
| Publications | |

## MNO Background

- Vodafone Ireland 39%
- O2 28%
- Meteor and eMobile 20%
- "3" 9%
- Tesco Mobile Ireland 3%

Meteor is one of the MNOs in Ireland that has provided the sample data for different research projects. Information about other MNOs' involvement is not known.

## Situation Assessment

Our results show that mobile positioning data is not yet used for official statistics; however, there is a discussion and legislative process underway for the statistical office to obtain inbound roaming data. If this process is successful, this will be a good example of how such data can be obtained officially directly from MNOs on a legal basis. As mobile data has also been used in some research projects, Ireland seems to be a rather innovative country for such projects; however, not without many obstacles.

| | |
|---|---|
| **Italy** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| Telecom Italia (TIM) has developed a software platform (LocHNESs) for the evaluation of statistics, such as real-time road traffic estimation, based on the anonymous monitoring of phone movements. This software has been used to provide real-time data feed for research as well as applications in traffic, but there is limited information concerning the actual use of the system. | |
| Key players | Telecom Italia – provider of the data |

## Research

The MIT research team has conducted an experiment with mobile data from TIM (Telecom Italia) "Real-Time Urban Monitoring Using Cellular Phones: a Case-Study in Rome" (http://senseable.mit.edu/papers/pdf/2007_Calabrese_Colonna_Lovisolo_Parata_Ratti_senselab.pdf). This project used TIM's LocHNESs software platform that was developed for the evaluation of statistics, such as real-time road traffic estimation, based on the anonymous monitoring of phone movements.

The Department of Computer Science University of Pisa has used several positioning experiments' data for analysing social networks and spatial mobility. GSM data was collected in the province of Pisa by one of the Italian mobile operators. The data consists of around 7.8 million CDR records collected from January 9th to February 8th 2012. The data contains calls corresponding to about 232 200 users with a national mobile phone contract.

| | |
|---|---|
| Key players | MIT Sensible City Lab, Department of Computer Science University of Pisa – analysers of the data, project participants<br>Telecom Italia – provider of the data |
| Publications | Barbara Furletti, Lorenzo Gabrielli, Salvatore Rinzivillo, Chiara Renso Identifying users profiles from mobile calls habits UrbComp Workshop at KDD 2012, August 2012, China. |

## Other Domains

The Polytechnic University of Milan (F. Manfredini et al) has conducted research based on data from antennae intensity (erlang), SMS counts, and MSC active client counts of Telecom Italia (2009 and 2010) for urban planning (http://www.irma-international.org/chapter/mobile-phone-network-data/69052/).

Researchers from the Fraunhofer Institute (Andrienko et al) have conducted a study of sporting events based in the city of Milan in 2008 (http://geoanalytics.net/and/papers/vast10.pdf). The dataset, provided by the Italian MNO WIND, contained positions of 2 956 739 phone calls made in Milan (Italy) during 9 days 30.10.2008-07.11.2008. This was a onetime project with no known follow-ups.

| | |
|---|---|
| Key players | Fraunhofer Institute, Department of Architecture and Urban Studies, Technical University of Milan<br>WIND – data provider |

| | |
|---|---|
| Publications | Manfredini, F., Tagliolato, P., Carmelo, Di R. 2011. Monitoring Temporary Populations through Cellular Core Network Data, COMPUTATIONAL SCIENCE AND ITS APPLICATIONS – ICCSA 2011, PT II Book Series: Lecture Notes in Computer Science Volume: 6783, pp. 151-161. |

## MNO Background

- TIM 38%
- Vodafone 26%
- Wind 25%
- "3" 11%

Two of four local MNOs are known to provide anonymous mobile positioning data for different projects.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics nor is there a detectable discussion about its use in the future. Mobile positioning data has been used in several event tracking experiments and tourism applications, and also in some art and planning projects, and research. At least two of four MNOs have provided data for relevant projects and Telecom Italia has developed special software for providing real-time aggregated data for external use. However, this is not widely used and MNOs seem to provide it to very limited partners for concrete projects and studies. This shows that there is potential for further developments in Italy. Extensive use of mobile positioning data for statistical purposes is limited because of public opinion and privacy concerns.

# Latvia

## Official Tourism Statistics

The Central Statistical Bureau of Latvia and Bank of Latvia have expressed interest in using such data in official tourism statistics, no specific steps have been taken except for initial consultations.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Travels of Latvian tourists to Estonia have been studied by the University of Tartu based on the data of Estonian MNOs (http://mobilitylab.ut.ee/eng/).

| | |
|---|---|
| Key players | University of Tartu Mobility Lab |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Latvijas Mobilais Telefons 42%
- Tele2 40%
- BITE Latvija 18%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. Although Central Statistical Bureau of Latvia and Bank of Latvia have expressed interest in using such data in official tourism statistics, no specific steps have been taken except for initial consultations. Regulatory and legislation obstacles, exposure of business secrets, and high implementation and maintenance cost are considered the biggest barriers to obtaining data from MNOs.

# Lithuania

## Official Tourism Statistics

There is small or no interest for using mobile positioning data by authorities.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

The Geography Department of Vilnius University (Vytautas Valatka) has been looking into the possibility of the use of data in official tourism statistics

| | |
|---|---|
| Key players | Vilnius University |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Omnitel 39%
- Tele2 39%
- BITĖ 22%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes.

| | |
|---|---|
| **Luxembourg** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

A work group from the University of Luxembourg (Mauw S.) has been working with private company iTrust on a system to prevent positioning data manipulations (http://uni.lu/snt/news_events/snt_and_itrust_aim_to_prevent_positioning_data_manipulations).

| | |
|---|---|
| Key players | University of Luxembourg<br>iTrust consulting |
| Publications | |

## MNO Background

- LuxGSM 77%
- Orange 23%
- Tango N/A
- LOL Mobile N/A

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. Because of the situation in Luxembourg (more than 40% cross-border commuting with many non-residents using local SIMs), there are reservations about the possibilities of mobile positioning data to provide adequate tourism statistics.

# Malta

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Tourism guide VisitMalta (http://www.visitmalta.com/en/mobile-apps).

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

Researchers from the University of Malta (Dr. Josef Bajada) have been working on mobile positioning systems; however, mostly from the point of view of individual phone tracking (active positioning system) (http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.59.7668).

| | |
|---|---|
| Key players | Department of Computer Science and AI, University of Malta |
| Publications | |

## MNO Background

- Vodafone MT 68%
- GO 32%
- MELITA N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

According to public information and contacts from the current feasibility study, mobile positioning data has not been used in Malta. Because Malta is a small island, tourism statistics is fairly well collected from entries (airport, port).

# Netherlands

## Official Tourism Statistics

Statistics Netherlands has worked with data from Dutch MNOs in conducting studies on all forms of tourism statistics (inbound, outbound and domestic). This has been a one-time project with a definite purpose of implementing continuous data in case of successful testing of the data.

See: Use case 1 – Netherlands Mobility Statistics

| | |
|---|---|
| Key players | Statistics Netherlands |

## Other Official Statistics

Similarly to tourism statistics, Statistics Netherlands are looking into other possibilities of mobile positioning data in the official statistics sphere. Domains like economic activity, population density, mobility, commuting and transport are evaluated based on available call detail records (CDR). (http://www.cbs.nl/NR/rdonlyres/010F11EC-AF2F-4138-8201-2583D461D2B6/0/201214x10pub.pdf).

See: Use case 1 – Netherlands Mobility Statistics

| | |
|---|---|
| Key players | Statistics Netherlands |

## Tourism

### Business

There is no reference on the use of mobile positioning data in the tourism domain outside official statistics. However, travel guides can potentially use the data from users to analyse tourism flows and statistics:

- Netherlands Tourism Guide by Mobile Travel (https://itunes.apple.com/sn/app/netherlands-tourism-guide/id519101831?mt=8);
- The Netherlands Travel Guide by Triposo (http://www.appannie.com/app/ios/the-netherlands-travel-guide).

| | |
|---|---|
| Key players | Mobile Travel, Triposo |

### Research

There has been research on mobile phone-based data collection methods for urban and outdoor activities studies (University of Utrecht Prof. Dijst) and data visualisation (University of Twente Prof. Kraak).

| | |
|---|---|
| Key players | University of Twente, University of Utrecht |
| Publications | |

## Mobility and Transport

### Business

There are use cases of using data from MNOs and other mobile sensors (TomTom) in traffic information.

See: Use case 11 – TomTom Traffic

| | |
|---|---|
| Key players | |

### Research

Researchers from the Department of Spatial Economics at Vrije Universiteit (E. Tranos et al) have studied the utilisation of high-resolution spatio-temporal data from mobile phone operators in urban and transport modelling (http://www.feweb.vu.nl/en/departments-and-institutes/spatial-economics/staff/tranos/index.asp).

| | |
|---|---|
| Key players | Department of Spatial Economics at Vrije Universiteit |
| Publications | |

## Other Domains

The University of Twente (Prof. M.J. Kraak and I. Kevaladze) uses mobile positioning datasets (mainly from other countries) for modelling and mapping the space-time movements of individuals (http://www.itc.nl/personal/kraak, http://www.itc.nl/about_itc/resumes/kraak.aspx).

| | |
|---|---|
| Key players | University of Twente |
| Publications | |

## MNO Background

- KPN 43%
- Vodafone Netherlands 30%
- T-Mobile 27%

Dutch MNOs have been involved in some projects where data has been used in different domains (also for Statistics Netherlands). The Netherlands is traditionally very sensitive about data protection and there have been use cases of data protection violations (http://www.telecompaper.com/news/dutch-mobile-operators-violated-privacy-laws-cbp--953579).

## Situation Assessment

Our results show that mobile positioning data is not yet used for official statistics; however, it is being tested and there is great interest in its usage in official tourism as well as other statistics. Statistics Netherlands has conducted a study most relevant to the current feasibility study where the usage of the mobile data in economic activity, tourism, population density, mobility, commuting and transport were studied thoroughly. Their findings confirm that this data source can be successfully used in different forms of statistics. MNOs have provided the data currently for onetime projects. As the Netherlands is a highly sensitive society in terms of data protection, it is expected to have regulatory and legislation obstacles and a threat of decrease of reputation both of MNOs and users of the data.

# Poland

## Official Tourism Statistics

No knowledge of the data use by official authorities is known, although the creators of the TelSKART system (see below) have the intention of presenting the work to the Ministry of Sport and Tourism and the Polish Tourism Organization.

CE-Traffic, a Czech-based company, has been extending the influence and its services to Poland, which also include MNO-based data for tourism. However, there is no knowledge of its official usage.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

The Czech company CE-Traffic has extended its services to Poland, which include information on tourists (http://www.ce-traffic.com/en.aspx).

See: Use case 15 – TrendIT People Analytics

| | |
|---|---|
| Key players | CE-Traffic |

### Research

Researchers from the Krakow Academy of Physical Education (W. Alejziak) have developed a TelSKART system (Telephone System for Cellular Analysis of Tourist Movement) whose main purpose is to facilitate measuring of the quantity of tourist movement (http://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=92103).

| | |
|---|---|
| Key players | Faculty of Tourism and Recreation at the Krakow Academy of Physical Education, Tourism Economics Department of the University of Information Technology and Management in Rzeszów |

| | |
|---|---|
| Publications | |

## Mobility and Transport

### Business

The Czech company CE-Traffic has extended its services to Poland, which include information on tourists (http://www.ce-traffic.com/en.aspx).

See: Use case 15 – TrendIT People Analytics

| | |
|---|---|
| Key players | CE-Traffic |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- T-Mobile N/A
- Orange N/A
- Plus N/A
- Play N/A

Although there are cases where mobile data has been used (and is being used) in research and commerce, it is not known which MNOs provide the data.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics. However, there are cases where mobile positioning data is utilised in tourism and other domains (by CE-Traffic). Practical applications have been developed in various fields both on the national and municipal levels. Based on current developments, it can be said that this field is developing quickly and MNOs are collaborating with mostly private companies concerning the use of their data.

# Portugal

## Official Tourism Statistics

Although there has been interest in using mobile data in tourism statistics, no specific steps have been made by official authorities so far.

| | |
|---|---|
| Key players | Departamento de Estatísticas Económicas |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

Researchers from the University of Ghent and University of Louvain (Belgium) have been using mobile positioning datasets from Portugal for traffic and mobility analysis.

See: Use case 16 – Mobility Behaviour

| | |
|---|---|
| Key players | University of Ghent and University of Louvain, Orange Labs France – analysers of the data |
| Publications | Csáji, B., Browet, A., Traag, V.A., Delvenne, J-C., Huens, E., Van Dooren, P., Smoreda, Z., Blondel, V.D. 2012. Exploring the Mobility of Mobile Phone Users. Cornell University Library. Preprint submitted to Physica A. |

## Other Domains

Research on social networks based on mobile positioning data from Portugal has been conducted in Newcastle University, United Kingdom and Orange Labs France (http://www.plosone.org/article/fetchObject.action?uri=info%3Adoi%2F10.1371%2Fjournal.pone.0039253&representation=PDF).

See: Use case 17 – Longitudinal Mobility Study

| | |
|---|---|
| Key players | Newcastle University, United Kingdom, Orange Labs France – analysers of the data |
| Publications | Phithakkitnukoon, S., Smoreda, Z., Olivier, P. 2012. Socio-Geography of Human Mobility: A Study Using Longitudinal Mobile Phone Data. PLoS ONE 7(6): e39253. doi:10.1371/journal.pone.0039253. (see annex 4 Pub. 13) |

## MNO Background

- TMN 45%
- Vodafone Portugal 39%
- Optimus 16%

Although several research projects use data from an unspecified Portuguese MNO, it seems its name (or names) are not revealed probably because of public opinion reasons.

## Situation Assessment

There are several research projects from other countries that are using data from Portuguese MNO(s). Although official authorities have expressed interest in the use of mobile data, no known steps have been taken so far. As MNOs that have provided data to researchers refuse to identify themselves, public image seems to be a major concern for MNOs.

# Romania

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

Romania Travel Guide by Triposo (http://www.appannie.com/app/ios/romania-travel-guide-by-triposo/).

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Orange 40%
- Vodafone 31%
- Cosmote 24%
- Digi.Mobil 5%
- Romtelecom N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

| | |
|---|---|
| **Slovakia** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Orange 45%
- Telekom 34%
- O2 22%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

# Slovenia

## Official Tourism Statistics

The Statistical Office has begun the process of acquiring data from local MNOs. The activities will begin in 2014. As of today, two main MNOs have been contacted. The Statistical Office states that mobile data will reduce the burden for the reporting units, but also obtain more data. The existing statistical data will be considerably enhanced regarding the temporal and spatial accuracy. The possibility to generate new statistics will be explored. The National Statistical Act is used to access the data and supposedly there is no need for approval of a Personal Data Protection Officer.

| | |
|---|---|
| Key players | Statistical Office<br>Mobitel and Si.mobil – potential providers of the data |

## Other Official Statistics

During the same process of data acquisition, other official statistics will be considered (transportation and other possible general statistics).

| | |
|---|---|
| Key players | Statistical Office |

## Tourism

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Mobitel 56%
- Si.mobil 32%
- Tušmobil 11%
- T-2 2%

Mobitel and Si.mobil have been contacted by the Statistical Office of Slovenia in order to obtain access to the tourism related data starting from 2014. No other indication of the use of mobile data by MNOs is known.

## Situation Assessment

The Statistical Office is planning the use of mobile positioning data in 2014 based on the National Statistical Act. There is no knowledge of what kind of data will be obtained (anonymous, aggregated, raw, inbound, outbound, domestic, etc.) and what methodology will be used.

# Spain

## Official Tourism Statistics

The National Statistics Institute has expressed interest in using mobile positioning data in tourism statistics and has been in contact with MNOs; however, there is no indication of any progress.

| | |
|---|---|
| Key players | National Statistics Institute |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

See Telefonica Dynamic Insights below.

See: Use case 11 – TomTom Traffic

See: Use case 14 – Deriving Origin–Destination Matrices

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

See Telefonica Dynamic Insights below.

| | |
|---|---|
| Key players | |

## Research

The Ministry for Public Works (Ministerio de Fomento) has financed earlier studies of the use of mobile data to generate origin-destination matrices (Caceres et al. 2007).

(http://www.esi2.us.es/GT/docs/iet_art1.pdf). (see annex 4 Pub. 3)

| | |
|---|---|
| Key players | Telefonica |
| Publications | |

## Other Domains

Telefonica (owner of Movistar, O2) has created the global division Telefonica Dynamic Insights (http://dynamicinsights.telefonica.com) that provides anonymous and aggregated data via a web-based interface to understand how segments of the population collectively behave. The data is used mainly in the field of geomarketing. Telefonica is cooperating with the global marketing research company GFK in launching the product Smart Steps.

The data also includes data about foreigners. There is little information on how and where these services are used because this division is in its initial phase. Telefonica is partnering with the global market research company GfK (http://blog.digital.telefonica.com/2012/10/09/big-data-will-power-the-digital-economy/).

See: Use case 24 – Telefonica Dynamic Insights

| | |
|---|---|
| Key players | GfK – marketing research company<br>Telefonica – provider of the data |

## MNO Background

- Movistar 42%
- Vodafone 29%
- Orange 23%
- Yoigo 6%

Telefonica seems to be the largest MNO in Spain that has utilised the location data of subscribers in different applications and research. There is also French-owned Orange whose research division (Orange Labs) often conducts research on the mobile positioning data in France. There is no indication of other MNOs utilising the data.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics in Spain. However, at least one MNO is utilising the data in research and commercial services (Telefonica Dynamic Insights).

# Sweden

## Official Tourism Statistics

The Swedish Tourist Authority (STA) and Statistics Sweden expressed the potential of using the data from MNOs to calculate tourism statistics in 2004 but there is no information on the actual steps or outcomes. Swedish society is very sensitive to privacy protection, so there are strong barriers to the use of any kind of sensitive data.

| | |
|---|---|
| Key players | Swedish Tourist Authority (STA) and Statistics Sweden |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

Researchers from the KTH Royal Institute of Technology have been working on mobile phone-based vehicle positioning and tracking and its application in urban traffic state estimation (http://kth.diva-portal.org/smash/get/diva2:459739/FULLTEXT01.pdf).

| | |
|---|---|
| Key players | KTH Royal Institute of Technology |
| Publications | |

## Other Domains

Cellular data from MNOs have been used by researchers at the Karolinska Institute in emergency solutions (Haiti earthquake) (http://ki.se/ki/jsp/polopoly.jsp?d=130&a=126488&l=en&newsdep=130).

| | |
|---|---|
| Key players | L. Bengtsson, X. Lu, A. Thorson, R. Garfield and J. von Schreeb. (2011). Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data: A Post-Earthquake Geospatial Study in Haiti. |
| Publications | |

## MNO Background

- Telia 46%
- Tele2 26%
- Telenor 17%
- "3" 11%
- Net 1 N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. The Swedish sense of privacy protection and legislation are the main barriers to overcome when using data from MNOs. There has to be a change in legislation and a wide positive campaign on the benefits and privacy protection methods used before such data can be used in Sweden.

# United Kingdom

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

JetSetMe is a visualisation of the almost real-time roaming habits of mobile phones using SIMs on O2's network while roaming in Europe.

See: Use case 4 – O2 jetsetme.com

| | |
|---|---|
| Key players | O2 – provider of the data and service |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

Researchers from the University of St Andrews have used sample data from one MNO to study migration, commuting and traffic monitoring. This was a onetime project with data for one week (call, SMS, data transfer). Because of a strict agreement with the MNO no results of the study can be published.

During the 2012 London Olympics there was a plan to use mobile positioning data in traffic management. However, the project was cancelled (http://trackingmobile.co.uk/the-cancellation-of-mobile-phone-tracking-system-for-the-london-olympics-an-overview).

| | |
|---|---|
| Key players | University of St Andrews |
| Publications | |

## Other Domains

Telefonica (owner of O2) has created the global division Telefonica Dynamic Insights (http://dynamicinsights.telefonica.com) that provides anonymous and aggregated data via a web-based interface to understand how segments of the population collectively behave. The data is used mainly in the geomarketing sphere. Telefonica is cooperating with the global marketing research company GFK in launching the product Smart Steps.

The data also includes data about foreigners. There is little information on how and where these services are used because this division is in its initial phase. Telefonica is partnering with the global market research company GfK (http://blog.digital.telefonica.com/2012/10/09/big-data-will-power-the-digital-economy/).

See: Use case 24 – Telefonica Dynamic Insights

| | |
|---|---|
| Key players | O2 – provider of the data and service |
| Publications | |

## MNO Background

- EE 34%
- O2 29%
- Vodafone 25%
- "3" 12%

O2 as subsidiary of Telefonica is most probably using subscribers' data in its Dynamic Insights services in the UK. Also jetsetme.com shows MNOs' openness to using its data in the sphere of tourism. It is not known if other MNOs are utilising the data in any other research or applications.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics. There are some cases where data has been used (or is being used) in research and commercial applications. However, there are strong privacy protection and legislation barriers to overcome before using the data.

# European Free Trade Association (EFTA) countries

| | |
|---|---|
| **Iceland** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Síminn 49%
- Vodafone Iceland 34%
- Nova 18%
- IceCell N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

| | |
|---|---|
| **Liechtenstein** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Mobilkom liechtenstein AG N/A
- Orange N/A
- Swisscom (Schweiz) AG N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information n about any concrete cases.

# Norway

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

Mobile travel guides can potentially use the data from users to analyse tourism flows and statistics:

- App from Visit Norway (http://www.visitnorway.com/app)

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

There are several studies on positioning techniques, but they have no direct relevance to current feasibility study (http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.11.4695&rep=rep1&type=pdf)

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Telenor Mobil 53%
- NetCom 28%
- Tele2 19%
- ICE.net N/A

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

# Switzerland

## Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

There are no examples for the use of the massive anonymous mobile positioning data of MNOs in the Swiss tourism industry. Talks with the tourism industry indicate that there is a growing awareness and interest in the future use of information based on the analysis of massive anonymous mobile positioning data.

Swiss tour operators and destinations are offering mobile services to their guests. Tourism apps use the location data of the mobile phones to provide the users with location-based services. On the other hand the providers of the apps can analyse the movement patterns and spatial behaviour of the users (e.g. http://www.myswitzerland.com/en/mobile-apps.html).

| | |
|---|---|
| Key players | Switzerland Tourism |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

Until now, the only continuous use of massive anonymous mobile positioning data has been in intelligent traffic guidance systems. One example is TomTom Traffic, but there have also been other applications, such as the Swiss Traffic Road Live, which is basically offering the same service (e.g. https://play.google.com/store/apps/details?id=com.idmobile.mogoroad).

See: Use case 11 – TomTom Traffic

| | |
|---|---|
| Key players | TomTom, Swiss Traffic, IDMobile |

### Research

An outstanding and widely used database was the Nokia Mobile Data Challenge, generating longitudinal mobile positioning data during one year from 200 volunteers in the Lake Geneva Region. Some interesting and relevant analyses rely on this source.

See: Use case 20 – Fraunhofer GSM-GPS

See: Use case 22 – Big Data for Mobile Computing Research

See: Use case 28 – Mobility Behaviour and Social Networks

| | |
|---|---|
| Key players | Nokia Research Center, Idiap, EPFL, Fraunhofer IAIS, Institute of New Imaging Technologies (iNIT) |
| Publications | Schulz, D., Bothe, S., Körner, C. 2012. Human Mobility from GSM Data – A Valid Alternative to GPS? This material was prepared for the Mobile Data Challenge 2012 (by Nokia) Workshop; Newcastle, UK. http://research.nokia.com/files/public/mdc-final458-schulz.pdf. (see annex 4 Pub. 8)<br><br>Laurila, J.K., Gatica-Perez, D., et al. 2012. The Mobile Data Challenge:<br><br>Big Data for Mobile Computing Research. This material was prepared for the Mobile Data Challenge 2012 (by Nokia) Workshop; Newcastle, UK. http://research.nokia.com/files/public/MDC2012_Overview_LaurilaGaticaPerezEtAl.pdf<br><br>Blom, J., Gatica-Perez, D. 2013. Discovering places of interest in everyday life from smartphone data. Multimedia Tools and Applications, 62(1), pp. 179-207. |

| | |
|---|---|
| | http://link.springer.com/article/10.1007%2Fs11042-011-0982-z.<br><br>Minh Tri Do, T., Gatica-Perez, D. 2013. The Places of Our Lives: Visiting Patterns and Automatic Labeling from Longitudinal Smartphone Data. IEEE Transactions on Mobile Computing, 04 Feb. 2013. IEEE computer Society Digital Library. IEEE Computer Society. http://doi.ieeecomputersociety.org/10.1109/TMC.2013.19.<br><br>Chittaranjan, G., Blom, J., Gatica-Perez, D. 2011. Mining large-scale smartphone data for personality studies. Proceedings of the International Symposium on Wearable Computers, San Francisco, California, June 2011. http://www.idiap.ch/~gatica/publications/ChittaranjanBlomGatica-puc12.pdf. (see annex 4 Pub. 11) |

## Other Domains

Urban time use statistics and spatial analysis by GIS group of ETH Zürich (Prof. Dr. M. Raubal). SFF grant in the same topic (http://raubal.cartography.ch).

| | |
|---|---|
| Key players | ETH Zürich Institute of Cartography and Geoinformation. |
| Publications | Yuan, Y., Raubal, M., Liu, Y. 2012. Correlating Mobile Phone Usage and Travel Behavior – A Case Study of Harbin, China. Computers, Environment and Urban Systems, 36(2), pp. 118-130.<br><br>Yuan, Y., Raubal, M. 2012. Extracting dynamic urban mobility patterns from mobile phone data. in: Geographic Information Science – Seventh International Conference, GIScience 2012, Columbus, Ohio, USA, Sep. 18-21 2012, Proceedings. Lecture Notes in Computer Science. Springer, Berlin. |

## MNO Background

- Swisscom 55%
- Sunrise 26%
- Orange 19%

No indication of the use of mobile data by MNOs.

## Situation Assessment

At present, massive anonymous mobile positioning data is not used at all for official (tourism)

statistics nor is there a detectable discussion about its use in the future. It is sporadically used, mostly in mobility contexts (ETH Zürich). The outstanding data source seems to be the Nokia Mobile Data Challenge, using opt-in data from 200 volunteers. Protection and public opinion are very important in Switzerland and thus, mobile operators do not share anonymous data. The outlook for the future suggests that despite available methodological and technical know-how, there are many barriers that need to be overcome before the wider use of massive anonymous mobile positioning data in Switzerland is feasible.

# European Union Candidate States

## Former Yugoslav Republic of Macedonia

### Official Tourism Statistics

No indication.

| | |
|---|---|
| Key players | |

### Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

### Tourism

#### Business

No indication.

| | |
|---|---|
| Key players | |

#### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

### Mobility and Transport

#### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- T-Mobile 49%
- Vip 27%
- One 23%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

# Montenegro

## Official Tourism Statistics

There is strong interest in obtaining the data from MNOs for the purpose of tourism statistics and national account. The Statistical Office of Montenegro has approached the National Agency for Telecommunications for further progress. As of now, there are sample data of a number of foreign SIMs by months.

| | |
|---|---|
| Key players | Statistical Office of Montenegro |

## Other Official Statistics

No indication.

| | |
|---|---|
| Key players | |

## Tourism

### Business

No indication.

| | |
|---|---|
| Key players | |

### Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Mobility and Transport

### Business

No indication.

| | |
|---|---|
| Key players | |

## Research

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- T-Mobile 49%
- Vip 27%
- One 23%

The Statistical Office of Montenegro has applied for access to the data and currently has obtained the pilot data of a number of foreign SIMs from MNOs. No specific MNOs have been identified.

## Situation Assessment

Our results show that mobile positioning data is not yet used for official statistics or any other purposes. However, there is interest from the Statistical Office to assess the quality of data and methodology in order to use it in tourism statistics and national account calculation.

| | |
|---|---|
| **Serbia** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- mt:s 51%
- Telenor 28%
- Vip 21%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

| | |
|---|---|
| **Turkey** | |
| **Official Tourism Statistics** | |
| No indication. | |
| Key players | |
| **Other Official Statistics** | |
| No indication. | |
| Key players | |
| **Tourism** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |
| Key players | |
| Publications | |
| **Mobility and Transport** | |
| **Business** | |
| No indication. | |
| Key players | |
| **Research** | |
| No indication. | |

| | |
|---|---|
| Key players | |
| Publications | |

## Other Domains

No indication.

| | |
|---|---|
| Key players | |
| Publications | |

## MNO Background

- Turkcell 52%
- Vodafone 28%
- Avea 20%

No indication of the use of mobile data by MNOs.

## Situation Assessment

Our results show that mobile positioning data is not used for official statistics or any other purposes. There are cases of mobile travel applications, where the user data can be used for analysis but we do not have information about any concrete cases.

# Annex 2. Use Cases

Listed use cases:

- Use Case 29: TOURIAS Travel Guide
- Use Case 30: LifeService112
- Use Case 31: GIS-112

| Use Case 1: Netherlands Mobility Statistics | |
|---|---|
| Title | Time patterns, geospatial clustering and mobility statistics based on mobile phone network data. |
| Countries | Netherlands |
| Aim | Evaluation of opportunities for an official statistical use of mobile phone data. |
| Key players | Statistics Netherlands, Division Methodology and Quality<br>(E. de Jonge, M. van Pelt, M. Roos) |
| Data source | Dataset from a mobile telecommunications provider containing records of all call-events (speech-calls and text messages) on their network in the Netherlands for a time period of two weeks. |
| Time | April 29, 2010 - May 9, 2010 (paper published 2011) |
| Case description | This case displays the exploration of a mobile phone call activity dataset for its possible use in official statistics. The dataset provides longitudinal, geospatial indicators that relate to economic and cultural activity. An analysis of regional clustering of call activity is conducted. The mobility of mobile phone users is analysed by using logged call-events and comparing the results with official mobility statistics.<br><br>Much of the activity that is associated with handling phone traffic, i.e. handling the localisation of mobile phones, optimising the capacity of a site, handling billing information, is stored by the mobile phone company. Therefore, mobile phone companies record data that is very closely associated with the behaviour of people; behaviour that is of interest to us as a statistical agency. Obvious examples are behaviour regarding tourism, mobility, commuting and transport. |
| Methodology | The dataset consisted of all call and text-message events during a two-week period from a leading phone network provider in the Netherlands. For each call the starting time, the site location and a scrambled version of the unique phone ID (IMSI) are available.<br><br>With some adjustments in its systems the mobile phone company was able to channel the selection of the data on a hard disk, which was subsequently encrypted. The data were then imported and decrypted onto a secured network. |

| | |
|---|---|
| | The data can relate an event (sending/ receiving call or text message) to a unique phone, a date and time, and to a site geo-location. It is important to note that each unique ID remains stable throughout the period contained in the dataset. This means that if a certain IMSI makes a call at a certain site 'x' and later during the day a call at site 'y', we are able to recognise this in the dataset.<br><br>The data were recorded during the period of April 29th 2010 until May 9th 2010. In this period, two significant events took place: Queen's Day on April 30th and Liberation Day on May 5th. School holidays were from April 30th until May 9th. Event data for all calls in the Netherlands for this period were recorded and made available.<br><br>The raw mobile phone data need to be processed for making statistics about population density and economic activity. The raw phone data contain calls per site location per unique (scrambled) phone ID per date time in seconds. Both time and location need to be transformed before statistics can be made.<br><br>The total size of unpacked data was about 67 Gigabytes. The data were processed using R. For our purposes we needed to create tables for each site and day with the total activity during a five-minute frame. Processing the data from raw CSV file format into usable tables was one of the most time-consuming aspects of the project.<br><br>The number of calls/text messages was 40 million a day, the total data around 600 million records. Initial scripts to transform raw data into R-format files and add site information took several days per MSC to run. |
| Comparison with official statistics | Mobile phone data relate directly to the behaviour of individuals. The data are anonymous, meaning that the IMSIs are scrambled and no direct relation to a specific person can be made. This is an absolute prerequisite for serious work with this kind of data.<br><br>Technical Challenges with Big Data: Several times statistics ran into memory and storage problems on the infrastructure (virtualised desktop and network storage) we used.<br><br>Comparisons with official mobility statistics show discrepancies between the mobile position data and the official results. The authors identify shortcomings of the representativeness of the mobile phone data and the censoring of location within their methodological approach. |
| Reasons for this | This Use Case is one of the few published examples where national statistical |

| | |
|---|---|
| Use Case to be selected for the EUROSTAT feasibility study | offices assess the use of mobile positioning data regarding the possibilities to use this data for official statistics. |
| Success/failure assessment | In the context of the feasibility study this Use Case can be considered a success, as it shows that mobile positioning data as a possible data source of the future is on the agenda of at least some national statistical offices. On the other hand, the results of this Use Case rather stress the shortcomings and problems of the use of mobile positioning data in official statistics. These are important learnings for the feasibility study. The fact that there are no published successive projects in the Netherlands show once more the obstacles that have to be overcome before a successful use of mobile positioning data in official statistics is feasible. |
| Links | http://www.cbs.nl/NR/rdonlyres/010F11EC-AF2F-4138-8201-2583D461D2B6/0/201214x10pub.pdf (see annex 4 Pub. 12) |

## Use Case 2: Central Bank of Estonia – State Level Inbound and Outbound Statistics

| | |
|---|---|
| Title | Inbound and outbound tourism statistics based on mobile positioning data for Balance of Payments travel account calculation in Bank of Estonia. |
| Countries | Estonia |
| Aim | New data source for calculating tourism statistics. As the border survey was discontinued in Estonia after 2008 due to budget cuts, new data sources were investigated and used by the central bank. |
| Key players | Central Bank of Estonia, Positium LBS |
| Data source | Estonian MNOs (EMT – TeliaSonera, Elisa) |
| Time | On-going since 2009 |
| Case description | Due to budget cuts and a deficiency in reliable and adequate statistics about inbound and outbound on the whole country scale, the Central Bank of Estonia has decided to use mobile positioning data as an alternative source for data. Result data provided by Positium have been processed according to the agreed methodology on calculating inbound and outbound trips, eliminating the possible bias (ship crew not entering the mainland, transit visits, long-term foreigners considered as residents) and segmenting visitor groups.<br><br>Data are calculated and provided to the Central Bank on a monthly basis for the data of the previous month. Both inbound and outbound data consists of the number of trips, duration of stay, and number of unique visitors. |
| Methodology | Call detail records (CDR) are used as a raw data source derived from MNOs' respective databases. Data are anonymous, quality checked and processed to individual trips to (inbound) and from (outbound) Estonia based on trip identification algorithms. Individual trips are profiled and segmented into ship crew (seamen), transit trips through country, residents, single-day, and multiday visitors. Number of visits to and from the country, country of origin (inbound) and destination (outbound) are calculated and the number of nights and days spent. Aggregated and referenced data are provided to the Central Bank on a monthly basis. |

| | |
|---|---|
| Comparison with official statistics | Aggregated and processed trip data from an MNO is compared to accommodation statistics (inbound) and data available for outbound travels. In both cases there is no "perfect" dataset to reference the data against. Comparison data from airports, ferries, border guard and foreign data are used to estimate the coefficients needed to extrapolate the MNOs' data to the whole congregation or general population. |

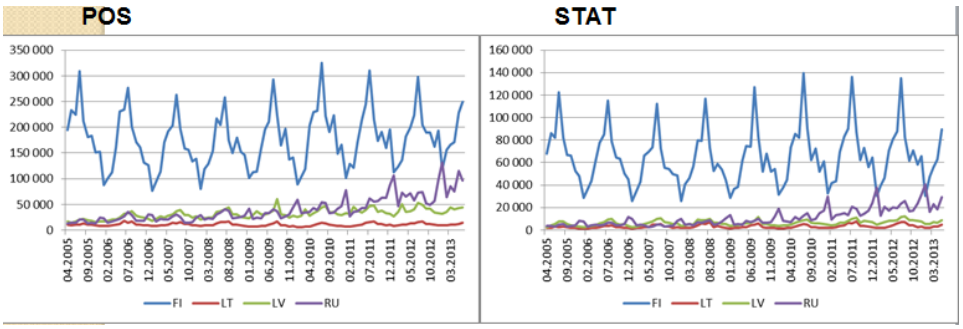



Figure 1. Comparison of inbound tourism indicators of 4 countries.

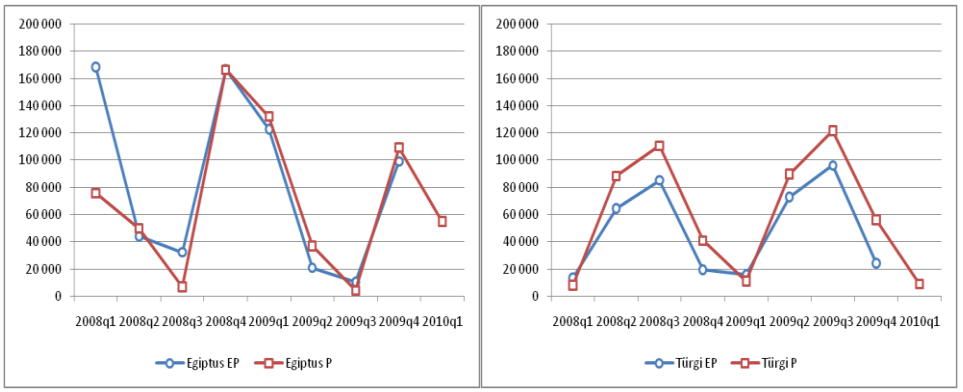



Figure 2. Comparison of outbound tourism indicators in well-correlated countries (Turkey, Egypt as main vacation destinations).

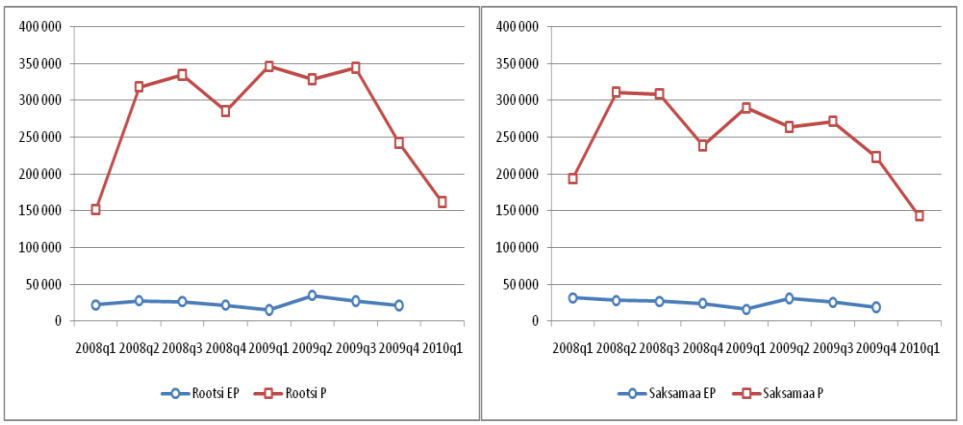



Figure 3. Comparison of outbound tourism indicators in week-correlated countries (Sweden, Germany).

| | |
|---|---|
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Direct use case of the mobile data in official tourism statistics. |
| Success/failure assessment | This case can be considered as a success story because mobile positioning data is used for official statistics and data service by Positium LBS is continuing. Methodological and legal issues were solved during step-by-step preparation process. Bank of Estonia is continuously using the statistics and Statistics Estonia is taking steps to integrate more thorough statistics into its database. |
| Links | http://statistika.eestipank.ee/failid/mbo/valisreisid_eng.html |

| Use Case 3: CzechTourism | |
|---|---|
| Title | Using residual positioning data from mobile networks for tourism monitoring. |
| Countries | Czech Republic |
| Aim | Monitoring of visitor volumes in tourist attractions. |
| Key players | CzechTourism (M. Vogelova), CE Traffic (J. Novobilsky) |
| Data source | Anonymous signal data from the mobile network of one mobile operator on the Czech market. |
| Time | Pilot phase: April 2012 - March 2013 |
| Case description | Due to the insufficiency of existing data about tourism flows in the Czech Republic, the Czech Tourist Authority – CzechTourism – has decided to look for new ways of tourism monitoring, which are innovative, cost-efficient and effective.<br><br>Using mobile positioning data in tourism is a tool for monitoring flows of visitors, and completes the traditional data collected by accommodation establishments and in households or other surveys.<br><br>CzechTourism started to use the mobile positioning data for monitoring tourism flows in April 2012. The data are collected for 45 locations with high tourism potential (UNESCO sites, mountain regions, spa towns). The combination with the existing data gives a comprehensive view of the number of visitors in the monitored locations, the country of origin (in case of domestic visitors the region of residence) and the seasonality of the tourism flows during the year. These are the relevant tourism data that are essential for developing tourism strategies and marketing planning. |
| Methodology | The system of population mobility and mobility based on the signal data of the mobile network in the Czech Republic is operated by the CE Traffic Company using the technology of TrendIT. The system was put into operation in the Czech Republic in September 2011.<br><br>Anonymous signal data from one MNO on the Czech market. This operator is one of the three biggest operators in the Czech Republic. The data are an essential source for dynamical changes of parameters in real time. |

| | |
|---|---|
| | Other data and map sets from various sources. These data allow the conversion of dynamic changes in final monitored characteristics.<br><br>Software for real-time geo-demographic monitoring recalculates residual data from mobile networks to data about the current distribution of the population and their mobility in space. It is based on the following principles:<br><br>• Residual signal data are a random representative sample of Czech population mobility. Anonymous residual signal data are recalculated to aggregated geo-demographic matrices about distribution and mobility in real time. All residual data are later deleted;<br><br>• Based on global calibration and local calibration of the system according to control localities, the system is set to recalculate the sample of residual signal data to a number of people;<br><br>• Sources of Czech tourism are derived from a so-called "home anchor point", which is loaded according to repeated occurrence in the same cell in the night-time check;<br><br>• Sources of foreign tourism are identified according to the roaming country;<br><br>• Accumulative counting is set to a basic unit for one day from 0:00 a.m. to 11:59 p.m. After one day, daily aggregation is deleted and the number of visitors is reloaded. |
| Comparison with official statistics | Just one example shows the comparison of the mobile position data and official tourism accommodation statistics: The share of foreign and domestic in both cases is about 30:70 for the time period May - July 2012.<br><br>The challenges are only very generally covered: Regarding the fact that this method of data collection often has negative reactions in the media and from the general public, we need to speak about its contribution for the whole branch of tourism in the Czech Republic. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | This use case is one of the few examples where massive anonymous mobile positioning data are actually used to measure tourism. It can be considered a best practice for this feasibility study as it shows that a business model can be working for a Destination Marketing Organisation, an IT provider and a MNO. In this context mobile positioning data is rather supplementing existing tourism statistics than replacing them. |

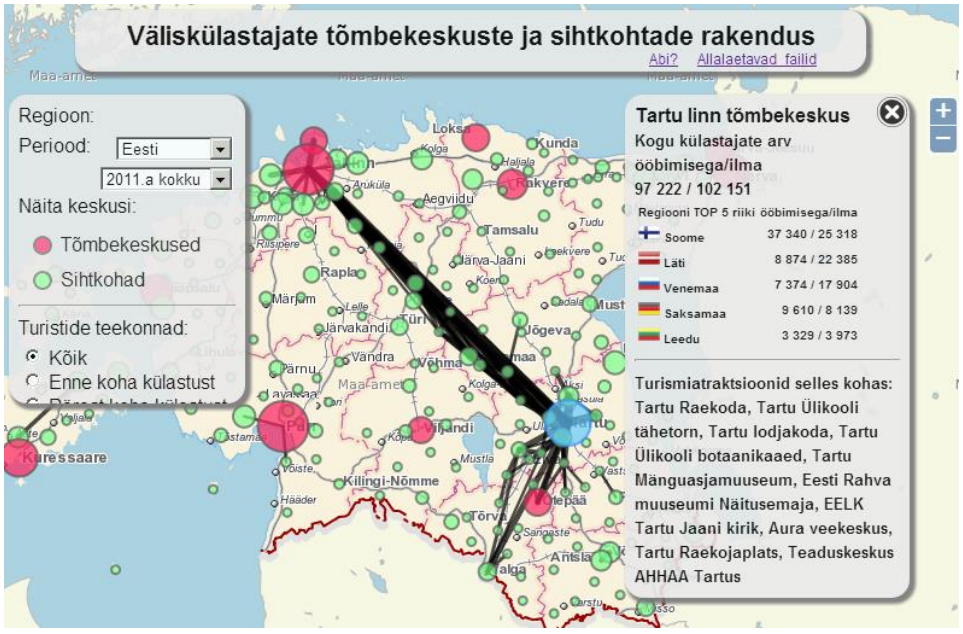
| | |
|---|---|
| Success/failure assessment | At present this use case seems to be quite a success: the obstacles of accessing mobile positioning data have been overcome, an adequate methodology has been developed and implemented to receive relevant results and the business model seems to work for all partners. The first available results imply that this use case is an excellent example of how mobile positioning data can supply meaningful supplementary information in addition to "classic" tourism statistics. It will be very interesting to see how/if this project/approach will continue after the pilot phase. |
| Links | http://www.congress.is/11thtourismstatisticsforum/presentations/Marketa_Vogelova.pdf (see annex 4 Pub. 18)<br>http://www.forum.czechtourism.cz/download/2011/6_Novobilsky_na_web.pdf<br>http://www.ce-traffic.com/ |

| Use Case 4: O2 jetsetme.com | |
|---|---|
| Title | jetsetme.com UK outbound roaming application. |
| Countries | UK based, Europe – O2 roaming customers |
| Aim | JetSetMe is a visualisation of the almost real-time roaming habits of mobile phones using SIMs on O2's network (including MVNOs) while roaming in Europe. |
| Key players | O2 |
| Data source | O2 roaming data. |
| Time | On-going |
| Case description | O2 The Lab has created a website with a visualisation of the roaming habits of mobile phones on O2's UK network, showing travel trends and data in near real time, by using anonymous and aggregated network data. The created JetSetMe API provides access to an O2 customers' travel information data on a strictly opt-in basis and will be available to developers very soon to encourage open innovation and creation of new products and services.   Figure 4. Source: jetsetme.com The Lab is already working with a number of travel and financial service companies (not listed) to trial innovative new products and services for the benefit of their customers and ours. From local information on arrival, to added functionality for financial security abroad, with open collaboration backed by a powerful network we believe the sky no longer has to be the limit. The data can be depicted as outbound tourism statistics available currently as not extrapolated single MNO data. |

| | |
|---|---|
| Methodology | No specific methodology is provided but assumed O2 UK subscribers' call activity (CDR) data are aggregated and used in the application. |
| Comparison with official statistics | N/A |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of initiative by MNO to utilise the data in the tourism sphere. |
| Success/failure assessment | In the context of the feasibility study this use case can be considered a success as it shows that mobile positioning data can be accessed by private businesses and prepared for future use by a diversity of end users. Official statistics authorities are interested in studying such data and seek opportunities to implement it to their official databases. |
| Links | |

| Use Case 5: Paris Tourism | |
|---|---|
| Title | Tourism in Paris according to mobile phone data. Spatial behaviour of foreign tourists in the Paris region. |
| Countries | France |
| Aim | Spatiotemporal analysis of foreign tourists in Paris from GSM data. |
| Key players | Orange Labs |
| Data source | Anonymous signal data from a mobile network (Orange). |
| Time | 30.03.2009 - 11.04.2009 |
| Case description | GSM technology can capture large amounts of spatiotemporal data. The trajectories inferred from these data provide additional information for analysing human mobility. In this context, this paper focused on modelling spatiotemporal trajectories from digital traces of mobile phone in order to study the human mobility. In this paper, a conceptual data model allowing to model spatiotemporal dimensions of GSM data and a first instance of this model, i.e. spatial behaviour of the foreign tourists and the estimation of visits for the most important Points of Interest in the Paris region are proposed. |
| Methodology | Then we come to a proposal for modelling trajectories using data from mobile phones. Finally, we describe methods and tools for analysis of spatial practices of foreign visitors in Ile-de-France and estimating attendance of interest by foreign visitors. By spatial practices we mean action spatial mobility or visits that fit into a given space. |
| Comparison with official statistics | They have proposed a conceptual data model from a mobile network and have applied to mobile data roaming in Ile-de-France. The instantiation of the model on a sample of foreign tourists has allowed a first estimate of foreign tourists' stay and analysis of the extent of their trips in the Paris region according to length of stay. They were also interested in places to visit cultural activities and leisure. Thus, using the method of detection stations (parking places), they did the estimation of the attendance of interest depending on length of stay.<br>This estimate was confronted with dating "official" data from the "Comité Régional du Tourisme" of Ile-de-France. |

| | |
|---|---|
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Usage of inbound data in tourism research. |
| Success/failure assessment | Objectives of the study – to analyse tourism in a specific area using mobile data – were successful. This case study shows that some MNOs (partly state owned) can be innovative and open to fulfil needs of public services. Advantages and disadvantages of the methodology were presented. |
| Links | http://perso.rd.francetelecom.fr/smoreda/publications/2012_RIG_olteanu_etal.pdf |

| Use Case 6: Tourist attraction centres | |
|---|---|
| Title | Usage of mobile positioning data in measuring the attraction centres for tourists based on the number of overnight stays in Estonian municipalities. |
| Countries | Estonia |
| Aim | Study and web application providing the number of total visits and TOP5 country of origins in Estonian municipalities. |
| Key players | Positium LBS, Enterprise Estonia |
| Data source | Estonian MNOs (EMT) |
| Time | One-time project in 2012 |
| Case description | Application and data for mapping the attraction points of foreign visitors within Estonia. The application is designed to be used as one part of the data input for the Estonian tourism development strategy where strategic tourism investments are planned and require adequate information about the situation on a small regional scale. The application provides information for the whole year 2011 as well as individual months. Presented are the number of visits to specific municipalities. Number of visits and number of overnight visits with the TOP 5 foreign countries are also presented.   Figure 5. Source: http://demo.positium.ee/eas_keskused/ |

| | |
|---|---|
| Methodology | Inbound roaming data from CDRs is processed geographically. Trip algorithms are divided between municipalities and places of night visits distinguished from single-day visits. |
| Comparison with official statistics | As the original data feed from Positium LBS is continuous, tourism statistics from MNOs are constantly compared and calibrated to reference data of accommodation and other data sources on the national and county levels. The application presents data on the municipal level that lacks any adequate statistics for comparison. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Mobile positioning data-based tourism statistics used in tourism. |
| Success/failure assessment | This case shows the possibility of using mobile positioning based tourism statistics for specific practical projects. There is need to learn how to use new data sources for developing statistical tools and monitoring systems. Automatically collected mobile data is part of this. This was a one-time project. The results were used in the creation of the Estonian tourism development plan. |
| Links | http://demo.positium.ee/eas_keskused/ |

## Use Case 7: Mass Events Monitoring

| | |
|---|---|
| Title | Monitoring tourism events with passive mobile positioning data in Estonia. |
| Countries | Estonia |
| Aim | Measuring number of visitors and visiting distances (catchment) of tourism events with passive mobile positioning data. |
| Key players | Mobility Lab of University of Tartu, Positium LBS |
| Data source | EMT (Estonian major MNO) |
| Time | 2006 - 2012 |
| Case description | The Mobility Lab of the University of Tartu developed methodology for measuring catchment areas of tourism events using passive positioning data. The objective is to make visitor flows and visiting distances measurable and to use this kind of statistics as descriptive statistics. All together there were 280 events detected in Estonia for the period of 2006 to 2012. The metrics of the events catchment area were used for marketing studies and different analysis.<br><br>Event tourism has become an important economic component of modern tourism, given the growing numbers of visitors and the development of local communities that it entails. This study examines whether the distances travelled by foreign visitors to events differ from those travelled by regular visitors, and which factors influence such distances. The results show that event visitors come from nearer locations than regular visitors; similarly to regular visitors, the distance decay principle applies in case of event visitors; and that events bring more visitors from more distant countries in the off-season (winter). Although mobile positioning data are suitable for monitoring visits, they must be combined with other research methods to examine the motivations of the visitors concerned. |

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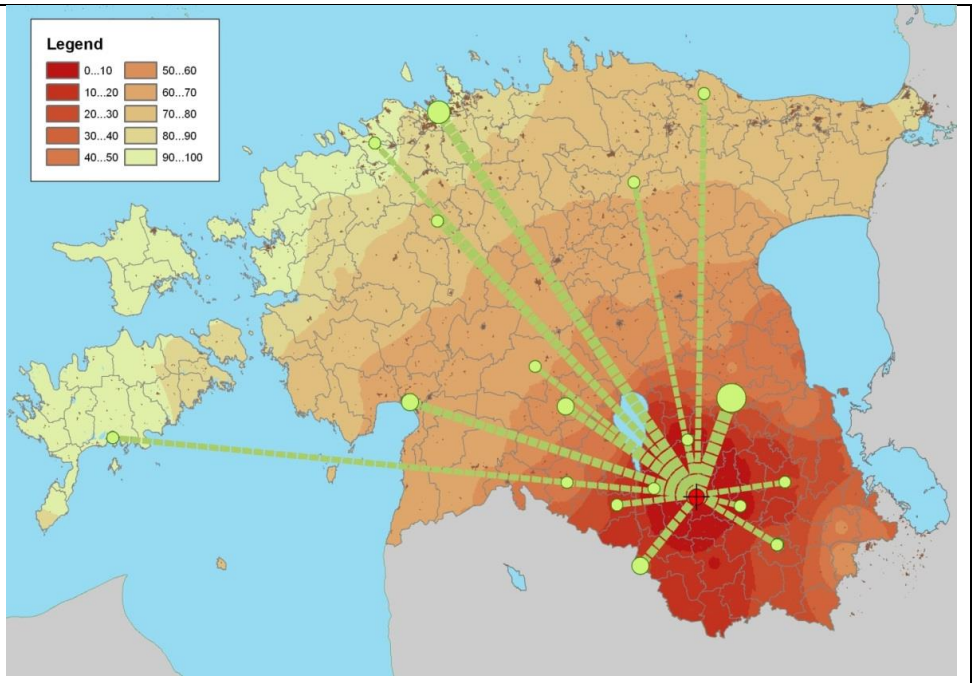
| |  <br>Figure 6. Metrics of catchment areas: visitor numbers to fishing competition "Goldfish 2009". Source: University of Tartu, Mobility Lab. |
| Methodology | Potential events were first identified from the passive mobile positioning database by examining short-term variations in the number of call activities performed by foreign visitors by mobile antennae. In the period 2006-2012, for each mobile antenna those days were identified when the number of foreign visitors who performed call activities was at least 30 percent higher than the rolling 31-day average. In the next step, we checked for an increase in the number of visitors in the neighbouring cells of the network cell in question and, in the case of a significant increase in the number of phone users, we obtained the same data from these nearby cells, thereby enabling us to identify potential events. For example, the number of visitors in one network cell increased by 49% on 27 July 2009 (i.e. 1221 visitors compared with the 31-day average of 867 visitors per day). This date was then compared with the Estonian calendar of events, and employees of tourist organisations and local governments were then interviewed in order to match this date with an event. A total of 145 events were eventually identified in this way during the four-year period of interest.<br><br>The IDs in the corresponding network cell at the time of the event were counted as event visitors. During the study period, 119,288 visits were made by 101,676 event visitors. |
| Comparison with | Data were compared to the survey results in different events with 600 |

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| official statistics | respondents. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of the use of mobile data in event tourism marketing. |
| Success/failure assessment | The project gave first results on the use of mobile data and methodology for analysing mass-events. This is a success case where collecting mobile phone based statistics about short term and very local frame can be a huge improvement in traditionally expensive and uncommon practice of studying mass-events. There is a potential for all tourism statistics to improve preciseness and therefore open up new insights and possibilities. The research on the subject is continuing as there were several advantages and disadvantages. For example small-scale events are very difficult to measure without an on-site survey. |
| Links | http://mobilitylab.ut.ee/eng/ |

| Use Case 8: Helsinki-Tallinn International Commuting Study | |
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| Title | Helsinki-Tallinn-Helsinki international commuting study. |
| Countries | Estonia |
| Aim | Studying international labour movement (cross-border commuting) with passive mobile positioning data. |
| Key players | Mobility Lab of University of Tartu in Cooperation with Positium LBS, city of Tallinn, city of Helsinki, Harju County, Uusimaa County. |
| Data source | EMT (Estonian major MNO). |
| Time | Project time 2012, data: 2009 - 2012 |
| Case description | The Mobility Lab of the University of Tartu composed study about international labour commuting between Helsinki and Tallinn using call detail record data:<br>"Spatial Mobility between Tallinn and Helsinki in Mobile Positioning Datasets. Statistical overview." Department of Geography of University of Tartu, Mobility Lab. Siiri Silm, Rein Ahas, Margus Tiru. All questions and comments: rein.ahas@ut.ee.<br>The work was part of the Helsinki-Tallinn Transport and Planning Scenarios project in Central Baltic INTERREG IV A Cross-Border Co-operation Programme.<br>This is one of the first papers studying transnational connections and commuting with mobile phone data. The labour mobility and tourism movement between Estonia and Finland is partly a shadow economy as people work and trade without legal status from both sides. This is a rising issue throughout the EU.<br>While various statistics have been used in the past to assess the movement of people between Tallinn and Helsinki, the integration of Finland and Estonia into the European Union resulted in the current situation where there is no systematic counting of border crossing data available. Although data from shipping companies enable assessment of traveller numbers and economic statistics in order to evaluate the number of tourists staying overnight, there are many transit and one-day visitors between the two cities. The overview presented in this report, which is based on mobile positioning, provides one additional angle to |

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| | the mobility and connections between the two cities. Certainly these statistics are problematic: the total number of visitors was evaluated based on the market share of one large mobile operator. It must be emphasised that the study includes people who actively use their mobile phone while abroad, i.e. they have maintained an active connection with their homeland. Clearly there are many persons who use much cheaper local mobile phone services or do not use mobile phones at all abroad. Nationality (country of origin) was determined by the country in which the phone is registered and usually people register their phones in a place with which they have a strong connection or where they stay longest. Certainly there is a need for a detailed phone use study in the future.<br><br>The data presented in this study is an alternative source for determining international mobility flows. We hope that this will add new knowledge to the research on international connections and relationships between the two cities.<br><br>**Estonians in Finland**<br><br>The results indicate that on average 328 152 Estonians visit Finland per year, making 1 368 120 visits to Finland, including 154 970 people from Tallinn, who make 535 589 visits on average. The number of visits Estonians make to Finland is slightly larger during summer months (July, August). In August, the month with the largest number of visits, Estonians make on average 137 318 visits to Finland, including 51 215 visits by people from Tallinn. The month with the smallest number of visits is most frequently February, when Estonians make on average 88 786 visits to Finland. There are more Estonians in Finland during the working days (Monday to Friday) and less on Saturday and Sunday. During the working days, there are on average 14 622 Estonians in Finland, compared to the 11 547 on Saturday and 1 213 on Sunday. Estonians travel from Estonia to Finland most often on Mondays and from Finland to Estonia on Thursdays and Fridays, which indicates that they work in Finland. 88% of all the visits are made to Finland as the country of destination and 12% as the country of transit; the importance of transit visits for people living in Tallinn is 14%. The relative importance of Estonians who visit Finland 5 or more times a year is 19% for the territory of Estonia, while the same indicator is 22% for the people living in Tallinn. From the people who travelled to Finland, the relative importance of the people who spent more than 30 days there is 15% in all areas. The number of the inhabitants of Tallinn who spend 183 days or more in Finland is 5 260 (3%), while for the entire territory of Estonia the indicator is 13 652 (4%). It is very likely that the majority of these people work or have family relations in Finland. |

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| | 24% of the visitors who spend 183 days or more in Finland live in Tallinn, 37% in Harju County (including Tallinn) and 63% other counties in Estonia.<br><br>**Finns in Estonia**<br><br>An average of 1 594 766 Finns visit Estonia per year, 64% of whom visit only Tallinn and 81% of whom only Harju County. Finns make an average of 2 520 377 visits to Estonia and 1 327 299 to Tallinn. A seasonal rhythm is apparent in the visits that Finns make to Estonia, including Tallinn: the number of visits is highest in July (an average of 326 848 visits) and lowest in January (an average of 96 616 visits). There are on average 19 575 and 22 022 Finns in Estonia on Friday and Saturday respectively, which is more than on other weekdays – this clearly indicates that the majority of the visits are made for leisure. An average of 15 224 Finns are in Estonia on working days and 19 570 on weekends. The respective numbers for Tallinn are 4 418 on workdays and 7 701 on weekends. Finns travel to Estonia most frequently on Fridays and Saturdays and from Estonia to Finland on Saturdays and Sundays. The percentage of visits made by Finns to Estonia as the country of destination is 92% and 8% as the country of transit (87% and 13% respectively, of the visits limited to Tallinn). The relative importance of Finns who visit Estonia frequently (5 or more times per year) is 4%. Approximately half of the Finns who have visited Estonia only stay in Estonia one day per year; the percentage of the Finns who stay in Estonia for more than 30 days is slightly over 1%. 1 155 Finns stayed in Estonia (including Tallinn), and 591 stayed in Tallinn for more than 183 days, which amounts to 0.1% of the visitors for both areas. |
| Methodology | Call Detail Records from Estonian MNO were used (inbound and outbound roaming). Same methodology as tourism data for the central bank of Estonia. |
| Comparison with official statistics | The University of Tartu used different data sources for evaluation of input data and for interpreting results of study. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of data used in tourism studies. |
| Success/failure | The project was a success. Mapping transnational lifestyle or cross-border commuting is great challenge for EU with open borders. Mobile data is a good |

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| assessment | source to study geographical and temporal characteristics of this phenomenon. Currently the interested groups are looking to continue the project with data from Finnish MNOs in the future. |
| Links | http://www.euregio-heltal.org/wp-content/uploads/2011/03/Spatial-Mobility-between-Tallinn-and-Helsinki-in-Mobile-Positioning-Datasets.pdf (see annex 4 Pub. 14) |

| Use Case 9: Israel travel study | |
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| Title | Evaluating Long-Distance Travel Patterns in Israel by Tracking Cellular Phone Positions. |
| Countries | Israel |
| Aim | Monitoring of long distance trips for a national transportation model. |
| Key players | Technion: Israel Institute of Technology, Civil & Environmental Engineering (S. Bekhor)<br>Matat: Transportation Planning Center Ltd (Y. Cohen); Ministry of Transport and Road Safety, Economics/Planning Department (C. Solomon); ITIS Traffic Services Ltd |
| Data source | Cellular phone positions provided by "Orange", one of the main three cellular phone providers in Israel. |
| Time | March 7 - July 2, 2007 (paper published 2009) |
| Case description | Long-distance trips (that is, trips longer than 2 km in urban areas and longer than 10 km in rural areas) are generally under-reported in typical household surveys, because of relative low frequency of these trips. This paper proposes to utilise location data from cellular phone systems in order to study long-distance travel patterns. The proposed approach allows passive data collection on many travellers over a long period of time at low costs. The paper presents the results of a study that applies cellular phone technology to assess trips at the national level.<br><br>The method was specifically designed to capture long distance trips, as part of the development of a national demand model conducted for the Economics and Planning Department of the Israel Ministry of Transport. The method allows the construction of Origin-Destination tables directly from the cellular phone positions. The paper presents selected results to illustrate the potential of the method for transportation planning and analysis. |
| Methodology | Assumptions: cellular phones remain open and with their owners; a single cellular phone is carried by the same person; a single person does not carry more than one cellular phone of the same provider at the same time; data from a single cellular service provider (as in our case) is representative of the entire |

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| | population.<br><br>The dataset was obtained from a survey performed by ITIS Traffic Services Ltd. The cellular phone positions were provided by "Orange", one of the main three cellular phone providers in Israel. The raw data were recorded for 16 consecutive weeks between March 7 and July 2, 2007. Every week, an average sample of 10,200 cellular phone numbers was randomly drawn from. The method is based on tracking cellular phone positions. The net sample contains information about 102 days, of 1.04 million person-days. This value is 7 times higher compared to the last National Travel Habits Survey (NTHS) performed in Israel in 1996/97.<br><br>The tracking system was based on recording events that contain a change in the position of the cellular phone with respect to a given antenna. The data collected contained the following information:<br><br>• Unique ID for a given telephone number (which is different from the real number in order to maintain privacy). This ID was given by the telephone provider;<br><br>• Coordinates of the antenna that is serving the cellular phone;<br><br>• Time stamp (date, hours, minutes, seconds).<br><br>The minimum recording frequency was set to 2 hours. This means that in case that no cellular phone movement is observed (and the phone is on), the company scans the phone and records its position every 2 hours. In case the cellular phone changes antenna, the movement is recorded. In addition, when a person speaks in the cellular phone, the recording frequency is very high. As a consequence, the data files were quite big, and to analyse the file several such entries were erased. In overall, 79.2 million phone displacements were recorded, which corresponds to an average of 775,000 displacements per day, or 76 movements per cellular phone.<br><br>The large amounts of data collected (79 million positions) were processed in a systematic way. In the first phase, the data were cleaned according to the following rules:<br><br>• Elimination of very frequent observations in which the same ID was in the same antenna location. Only the first and last observation was kept in the data;<br><br>• Elimination of frequent observations in which the same ID switched |

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| | close antenna locations in very short time intervals. It was assumed that such observations are not related to trips, but are related to the way the cellular phone provider handles the phone communications;<br>• Elimination of unreasonable movements performed in short time periods between antennas located far apart.<br>After performing the cleaning phase, the next phase consisted of a creation of a weekly "trip log" for each ID. The "home" was identified by the longest time periods without antenna changes (which occurred mostly at night). Given that the collection was performed on a weekly basis, there were sufficient days to verify the "home" assumption. Special attention was paid to weekends and holidays, in which the "home" assumption might be violated.<br>A trip start was identified by the first change in an antenna location, and a trip end was identified by the last change in an antenna location, and no movement was observed at least for 20 minutes. The coordinates of the first and last antenna respectively defined the origin and the destination of a trip.<br>These coordinates were geo-coded to 585 traffic analysis zones (TAZ) at the national level. |
| Comparison with official statistics | Comparison with NTHS: The average trip rate for weekdays (2.0) is higher in comparison to the 1996/97 NTHS (1.9). However, given that only trips longer than 2.5 km were analysed, this average is in fact significantly higher compared to the NTHS. This is explained by the fact that the NTHS data are 10 years old, and also because of non-response bias in conventional surveys. Trip rates calculated from cellular phone positions for trips with average distance greater than 25 km are significantly higher compared to the NTHS (38% more). The NTHS recorded trips for 3 consecutive days, and only 1% of the households were sampled. The short number of surveyed days and small sample is not enough to capture long trips.<br>Comparison for selected OD pairs between the cellular phone data and NTHS data: The average population increase between 1996/97 and 2007 is estimated at 25%, therefore it is expected that the cellular phone data will produce more trips compared to the NTHS. However, given that the cellular phone data are 72% higher compared to the NTHS, the difference cannot be explained only by the population and motorisation rate increase. The cellular phone data covers the entire population, while the NTHS survey is accurate at "regular" households. Special population groups such as students, soldiers, foreign workers and so on |

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| | were under-represented in the NTHS survey. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | This use case is an excellent and extensive example how mobile positioning data can be used to monitor human mobility. There are a lot of technical and methodological issues covered that have to be considered in the feasibility study. |
| Success/failure assessment | The use case itself is an important baseline study for the use of mobile positioning data to track human mobility. As such, it can be considered a success. The fact that there are no published succeeding studies since 2007 using the same methodology blurs the otherwise positive assessment. |
| Links | http://cee.technion.ac.il/eng/getfile.asp?LNGID=1&DBID=1&GID=699<br>http://itistrafficservices.com/ (see annex 4 Pub. 4) |

| Use Case 10: A1 Traffic Data Stream | |
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| Title | Movement Data in Mobile Telephone Network as Data Source for Marketing, Research and Planning. |
| Countries | Austria |
| Aim | Provide new service for Mobilkom Austria's partner companies offering valuable analysis material for geomarketing, market research and planning projects. |
| Key players | Telekom Austria (A1), WIGeoGIS |
| Data source | Telekom Austria (A1), anonymous passive data of domestic subscribers. |
| Time | 2009-2011. Stopped (until further notice) due to public opinion and data protection issues. |
| Case description | Austrian A1 mobile network operator started a data stream service that provides aggregated data location data of their subscribers. Data from ~4.7 million subscribers in 2G and 3G networks were aggregated in a data stream and refined using GPS data of individual devices. At the service start, A1 held 42.4% of the country's mobile subscribers, being the largest MNO in the country.<br><br>Sample data were tested by Statistics Austria and Positium LBS. However, as this data did not provide classification of domestic and foreign phones, it was not possible to distinguish between local and foreign tourists.<br><br>Due to public opinion and privacy protection, the service was discontinued. |
| Methodology | Real-time acquisition of data from network was done using modified A-BIS interface. All relevant events from the use of telephony, SMS and data services in the 2G and 3G networks of A1 were collected. Though only events from the use of phones were registered, a rather high number of location facts were stored (~3 events per hour). Collection of data was pseudonymised (MSISDN code replaced) with 24 hour re-pseudonymisation interval meaning internally in the MNO's system a single subscriber's data could be recognised over period of 24 hours. Only local subscribers were collected without identification of foreign SIMs (roaming service). This could, however, be improved as the service was only intended to measure the commuting of Austrians and not foreigners (or |

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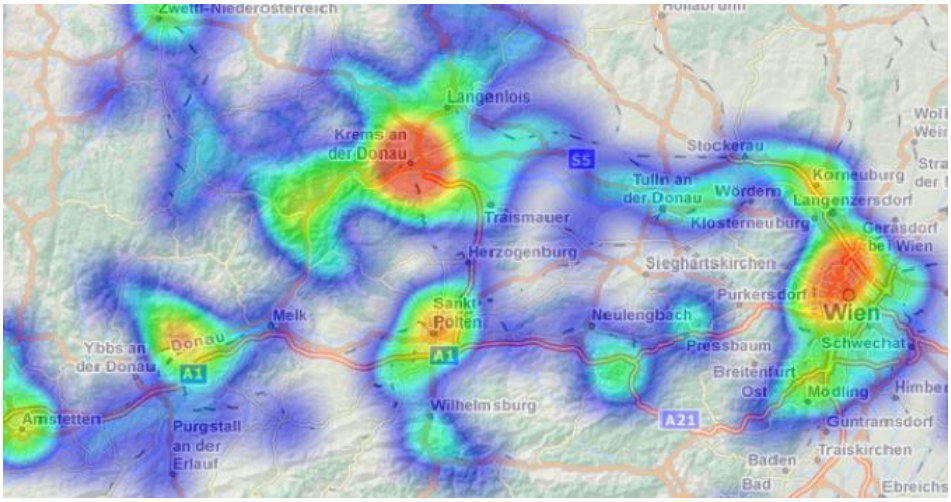
| | tourism statistics at all). WIGeoGIS, GIS company, was a primary partner in distributing and analyses of the data for end-users.<br><br>Data were processed within internal systems of A1 and only aggregated result data are provided to the users.<br><br>  <br><br>Figure 7. Source: http://www.wigeogis.com/en/pdf/news/NEWS17122009.pdf |
| Comparison with official statistics | No comparison to official statistics has been made available. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | An example of MNO providing relevant data as commercial service. |
| Success/failure assessment | The service was discontinued due to public opinion and privacy protection. Further development would have been required (from the aspect of tourism statistics) as the data did not distinguish the country of origin of the subscribers. The importance of this use case can be seen in the difficulty of MNO-based initiative to utilize the data and the number of problems that are met during the process. |
| Links | http://www.wigeogis.com/en/pdf/news/NEWS17122009.pdf (see annex 4 Pub. 1)<br><br>http://www.telecompaper.com/news/mobilkom-austria-launches-a1-traffic-data-stream-service--709478 |

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| | http://www.a1.net/business/a1traffic<br><br>http://www.wigeogis.com/en/home |

| Use Case 11: TomTom Traffic | |
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| Title | TomTom traffic information system. |
| Countries | Germany, the United Kingdom, Italy, France, Belgium, Spain, the Netherlands, Switzerland, Portugal, Denmark, Luxembourg and Austria + some countries overseas (USA, Australia, New Zealand, South Africa) |
| Aim | Travel Time Measurements using GSM and GPS Probe Data. |
| Key players | TomTom, Vodafone, Deutsche Telekom, Daimler Benz |
| Data source | Up to 80 million anonymous mobile phone users on the road, 1 million connected TomTom devices. |
| Time | Ongoing |
| Case description | Get the most up-to-date traffic information available for your route, live on your TomTom LIVE device with TomTom High Definition Traffic.<br><br>You receive detailed incident reports about the length and reason of the delays, the most accurate delay information, travel and arrival times, and alternative route proposals. All this information is sent directly to your TomTom navigation system. TomTom HD Traffic is a revolution in traffic information offering you the best coverage, the most updates from the best sources and it is fully automated.<br><br>Today, drivers using TomTom HD Traffic can already reduce their journey times by on average 15%. When 10% of people drive with TomTom's HD Traffic™ there is a real-time "collective effect", roads flow more efficiently and journey times will be reduced for everyone. |
| Methodology | TomTom HD Traffic uses a revolutionary new source of traffic information: the traffic flow of up to 80 million anonymous mobile phone users on the road, 1 million connected TomTom devices. From this anonymous data, TomTom knows exactly where, in which direction and at what speed all these mobile phone users are traveling throughout the road network. This real-time data are combined with other existing quality traffic information sources, resulting in the most complete and reliable traffic information.<br><br>The backbone of the HD Traffic service is a multi-source concept in order to |

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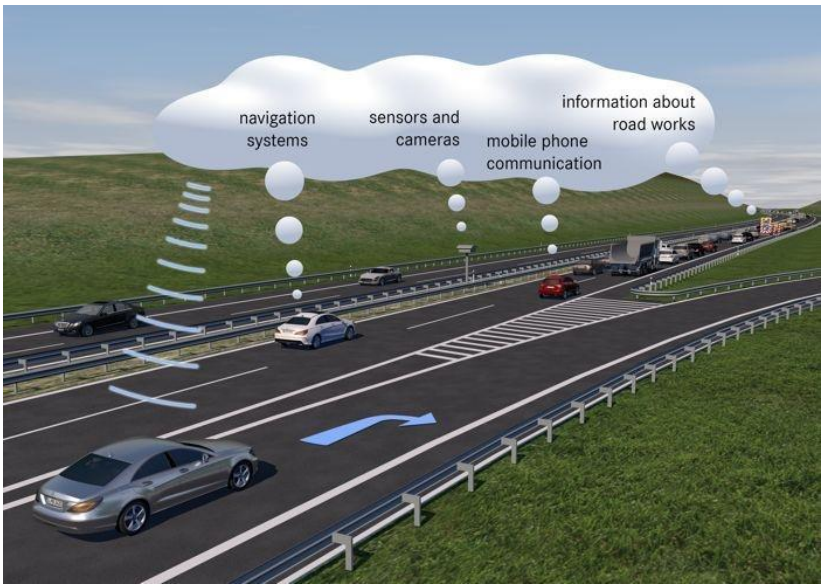
| | obtain both reliable speeds and incident detection data. The core traffic data collection technology, patented by TomTom, is a cellular floating car data (CFCD) system exploiting signalling data from the telecommunications operator network, which is enhanced by GPS-based probe data (both anonymously gathered) as well as conventional data feed from local detection by third parties like local authorities, with data from loop systems in the road.<br><br>The principle of the CFCD is based on changes of the Timing Advance measurement values while a handset is in an active call. Timing Advance (TA) is a measurement in the GSM network that is important to synchronise phone calls. The TA value is the distance between the cell phone to the serving base station. With knowledge of the base station location and the segment of the antenna's reach, the change of the TA value, can be used to set up virtual beacons at the TA sector cell boundaries with respect to the underlying road network. This means that the exact location of the cellular handset within the antenna segment can be triangulated.<br><br>  <br>Figure 8. Source: http://www.gpsbusinessnews.com/TomTom-Confirms-Our-Scoop-Mercedes-as-HD-Traffic-Customer_a4125.html |
| Comparison with official statistics | No comparison to official statistics has been made available. |
| Reasons for this Use Case to be selected for the EUROSTAT | Applications like TomTom HD Traffic are the only examples in countries such as Germany, where massive anonymous mobile positioning data are used on a wider scale, continuously and as a business model that seems to work for the participating MNOs. It shows that the MNOs have the means and the |

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| feasibility study | willingness to find interesting application for the use of their data. This use case also acts representatively for other similar cases (e.g. such as http://www.traffictechnologytoday.com/news.php?NewsID=28344). |
| Success/failure assessment | Massive anonymous mobile positioning data is one important information source for intelligent traffic guidance systems such as TomTom HD Traffic. As TomTom HD Traffics is still on the market, it can be counted as a success. To draw the full picture, it has to be taken into account that massive anonymous mobile positioning data is only an auxiliary data source in this context (as soon as there are enough cars with GPS/Floating Car Technology the mobile positioning data becomes redundant) and it seems to be hard for the MNOs to make a successful business case out of it (e.g. termination of cooperation between Telefonica/O2 and BMW). A lesson on the importance of public opinion and transparency can be learned from this use case. Creating transparency of the process (to the public) and raising the awareness takes time and effort. |
| Links | http://www.tomtom.com/en_gb/services/live/hd-traffic/<br><br>http://www.tomtom.com/lib/doc/download/HDT_White_Paper.pdf (see annex 4 Pub. 7)<br><br>http://www.tomtom.com/landing_pages/trafficmanifesto/content/pdf/Support%20Document_lid1.pdf<br><br>http://www.vodafone.de/business/firmenkunden/verkehrsinfo-hd-traffic.html<br><br>http://www.daimler.com/Projects/c2c/channel/documents/2295735_Daimler_IR Release_06032013_en.pdf (see annex 4 Pub. 9) |

| Use Case 12: Estonian OD-Matrices | |
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| Title | Calculating OD matrices from mobile data. |
| Countries | Estonia |
| Aim | Composing origin-destination matrices from mobile positioning data. |
| Key players | Positium LBS, Ramboll Estonia |
| Data source | EMT (Estonian major MNO) |
| Time | 2009 |
| Case description | Positium LBS developed methodology for generating OD matrices from call detail record data. This material was used for modelling traffic in process of selecting a new location for the Tallinn-Kose-Mäo highway. Modellers from Ramboll used mobile positioning based data parallelly to a questionnaire survey. |
| Methodology | For using CDR data in generating OD matrices it was important to apply the method of the anchor point model (Ahas et al 2010). CDR originates from the largest Estonian mobile network operator, EMT, which has over half a million active clients distributed throughout Estonia. The database consists of records of all outgoing call activities such as calls, SMS's, internet and data services initiated by the phone owner. Each record (i.e. outgoing call activity) in the database includes spatial and temporal parameters. Data are encrypted in order to preserve the anonymity and privacy of the studied mobile phone users, and the random identification code is generated by the network operator for every mobile phone to link call activities made by one person (mobile phone) during the study period. Data are recorded in accordance with Estonian legislation for billing purposes by the network operator and not for the purpose of this study. Data receiving, storage, processes and applications in this research observe the data security and privacy requirements specified in EU directives on handling personal data and the protection of privacy in the electronic communications sector.<br><br>For the sample, all mobile phone users who made at least one call activity from one of the four studied network antennae during the study period were selected and analysed. We located the two most important everyday anchor points in their activity space (i.e. home and work-time location) by using the anchor point |

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| | model based on their mobile phone call activity data. Several studies have adapted mobile phone call activity data for identifying an individual's important activity places. According to Ahas et al, the anchor point model in general finds the two most frequently used mobile antennas for every month where call activities are made as everyday anchor points, and further, the algorithm distinguishes everyday anchor points into home and work-time (work, or school-related) locations taking into account (i) the average of (outgoing) calling times and (ii) the standard deviation, and (iii) spatial neighbouring relationships of anchor points. Hereinafter, we use "workplace" as a synonym for a "work-time location" and it is defined as the most frequently visited place during office hours by a person besides home location. The anchor point model as well as others implementing a similar approach have obtained high accuracy of the algorithm verified in order to reveal the real home and workplace locations of individuals. The results of the anchor point model are a representative of the adult population of the country and therefore we are confident that the model is suitable for the current research.<br><br>For the movement analysis, every road user's (mobile phone user) locations of everyday anchor points (workplace and home) were identified, linked and transformed into a workplace-home movement vector that was downscaled to the roadway network. According to the shortest path analysis road users were classified by their home and workplace location into commuters and into other (non-commuter) road users. A commuter is defined as a road user whose home and workplace anchor points are located in separate municipalities and that, according to the shortest path analysis, most probably uses the studied road section for home-workplace-home movement. Commuting is assigned whenever a road user who is defined as a commuter uses his/her phone in a studied road section, i.e. when a commuter uses a mobile phone in the studied road section we define the movement as commuting. Note that we do not know with a 100% certainty whether it is actually work-related commuting or leisure travel (if a suburban commuter has a day off from work and uses the everyday route to return from shopping purposes instead), and in this sense we consider "commuting" as every movement in the studied road section. However, given the time span of the collected data (evening peak hours), and the methodology used, we may assume that commuters' traffic movement during evening peak hours is predominantly a commuting trip from the workplace to home. The use of a mobile phone by other (non-commuter) road users is assigned as other non-commuting movement. To some extent the latter movement can include non- |

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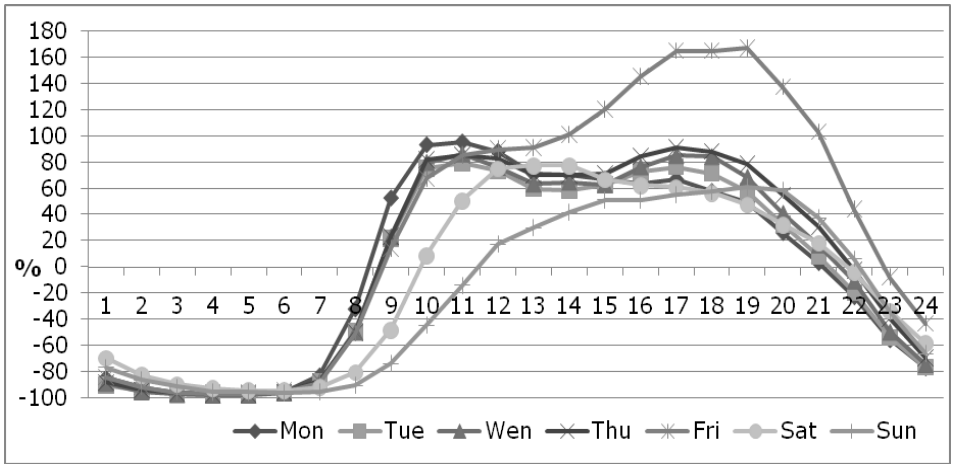
| | direct (trip-chaining) workplace-home movements, although considering the spatial context in our study area, this should be marginal (see Figure 9). The final destination of the day for road users passing the studied road section during the evening rush hour were defined as the locations of the last call activity at the end of the day. The distance between the final destination and home location is calculated using the shortest path analysis. The end of the day was set at 4:00 AM the next day, thus some movements ended in the first hours of the next day. |
| Comparison with official statistics | The results from mobile positioning data were compared to a parallel questionnaire survey and road counters.<br>  <br><br>Figure 9. Traffic intensity on a main highway measured by mobile positioning data. Difference from average intensity (days of week). |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of usage of the data in non-tourism domains. |
| Success/failure assessment | The project was a success; however, there were limitations for the analysis and conclusions as the mobile positioning data can produce biases on higher accuracy levels that are sometimes required in transportation analysis. |
| Links | http://tartutee.ramboll.ee/<br>http://www.tartu.ee/idaringtee/ |

## Use Case 13: Mobile Phone Positioning for Traffic Data Collection

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|---|---|
| Title | Mobile phone positioning for traffic data collection. |
| Countries | Finland |
| Aim | Evaluate the feasibility of cellular positioning for traffic management-related monitoring purposes. Implement a pilot system and study the technical performance. |
| Key players | Finnish Transport Agency, earlier Finnish Road Administration (J. Kummala) |
| Data source | Finnish mobile operator Radiolinja Ltd. (predecessor of current operator Elisa). |
| Time | 2001 (feasibility study), 2002 (pilot system) |
| Case description | The Finnish Road Administration needed to establish a more cost-efficient method for traffic management-related monitoring purposes. The conventional traffic monitoring systems are based on automated sensors such as loops and cameras.<br><br>In 2001 a feasibility study was conducted focusing on evaluating mobile phone positioning methods as a potential data source. A pilot study was done in 2002 where the Finnish mobile operator Radiolinja Ltd. implemented a traffic monitoring system based on mobile phone positioning on two main road sections in Finland.<br><br>For the needs of traffic monitoring, mobile positioning data can be anonymous and does not threaten the privacy of mobile phone users. Therefore, the Finnish legislative framework did not present any legal barriers for using the data. |
| Methodology | The conventional method measures travel time between two observation points by using a license plate recognition (LPR) method. Using mobile phone data the travel time is calculated based on the phone switching link towers.<br><br>The method is based on mobile phone data and measures travel times based on communications data in the cellular network in a certain area, at predetermined observation points. Operation of the system is based on the fact that a mobile phone travelling on a certain route always changes the base station at almost exactly the same place. |

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| Comparison with official statistics | The mobile phone positioning method proved to be suitable for measuring the travel time between two locations. The travel time calculated from the mobile phone data were coherent with the time calculated by the conventional method.<br>The key advantage of the mobile phone method is that it's not affected by traffic situations or environmental conditions. It can handle a large number of observations and be used to interpret the traffic situation at a given location.<br>The main challenges were related to handling the observations on parallel roads, such as traffic related to bicycles, pedestrians and public transport that cause noise in the data. The pilot study also revealed that the structure of the cellular network could cause incorrect observations on some links. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of the usage of the data in the transportation management sphere in Finland. |
| Success/failure assessment | The project was a success in terms of its objectives. Similar systems are used in many countries. |
| Links | Feasibility study: http://alk.tiehallinto.fi/julkaisut/pdf/3200707.pdf<br>Pilot study: http://virtual.vtt.fi/virtual/proj6/fits/impacts/Matka_aikapalvelu_loppuraportti_tulokset.pdf |

| Use Case 14: Deriving Origin–Destination Matrices | |
|---|---|
| Title | Deriving origin–destination data from a mobile phone network. |
| Countries | Spain (the trunk road between the Spanish cities of Huelva and Seville) |
| Aim | The possibility of creating an OD matrix automatically and, to a certain extent, immediately would represent a real revolution in the commissioning of mobility studies by administrative authorities – the flow of mobile phones in a cell-phone network is measured and correlated to traffic flow. |
| Key players | Transportation Engineering, Department of Engineering, University of Sevilla |
| Data source | A simulator tool that generates a synthetic database with the location data of mobile phones that are switched on during a 24-h period and travel along a road section is used that emulates a real GSM network database. |
| Time | Not mentioned |
| Case description | The method proposed in this paper exploits the characteristic, which means that an operator constantly has an updated database of the position of all cell phones that are turned on. |
| Methodology | The methodology proposed in this paper uses information on the locations of mobile phones in order to supply a type of OD data. If a mobile phone is present in a vehicle, switched on and belonging to a certain cellular operator, that vehicle becomes a "probe vehicle". |
| Comparison with official statistics | Comparison with traffic counts. According to the authors, the fundamental advantage of this new technique lies in the possibility of estimating traffic data with a certain degree of automaticity and immediacy and avoiding the need for installing ancillary devices along the road network or the use of other costly methods such as traffic surveys. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of theoretical approach to the use of mobile data in transportation and mobility. |

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| Success/failure assessment | This use case addressed a large theoretical work which was not yet implemented in real life. It shows the interest of different user groups from different countries that are ready to investigate the possibilities and start using the data. |
| Links | http://www.esi2.us.es/GT/docs/iet_art1.pdf |

| Use Case 15: TrendIT People Analytics | |
|---|---|
| Title | TrendIT People Analytics software platform. |
| Countries | Israel, Czech Republic |
| Aim | The company offers trend, location, market, and sales potential analysis solutions to homeland security, retail, municipalities, advertising agencies and cellular operators. |
| Key players | TrendIT, CE-Traffic |
| Data source | Undisclosed MNOs |
| Time | On-going since 2010 |
| Case description | People Analytics brings real-time, accurate information about people's characteristics, behaviour and movements in a given location such as retails shops, supermarkets and department stores. Trendit acts as a technology company providing infrastructure for handling mobile operators' data and processes it for specific results for users in traffic, geomarketing, governmental sectors. Currently active in Israel and implemented in Czech Republic (in cooperation with CE-Traffic). |
| Methodology | Trendit uses standardised location data combined with socio-demographic data from mobile operators. The specifics of the data source are not revealed but technology makes it possible to handle operators' logs in near-real time (5 min.). Trendit uses extrapolation algorithms to present data that represent actual population statistics, not just an operator's subscribers' representation. They use the national census bureau and other data sources in extrapolation algorithms.<br><br>Trendit offers partner mobile operators a number of ways to get value from providing the data:<br>• Leverage cellular data to create new revenue channels;<br>• Gain valuable insights regarding your subscriber base;<br>• Detailed competitive analysis;<br>• Comprehensive penetration analysis to the sub-neighbourhood level;<br>• Integration with value-added-services (i.e. navigation systems, location services, social media and more). |

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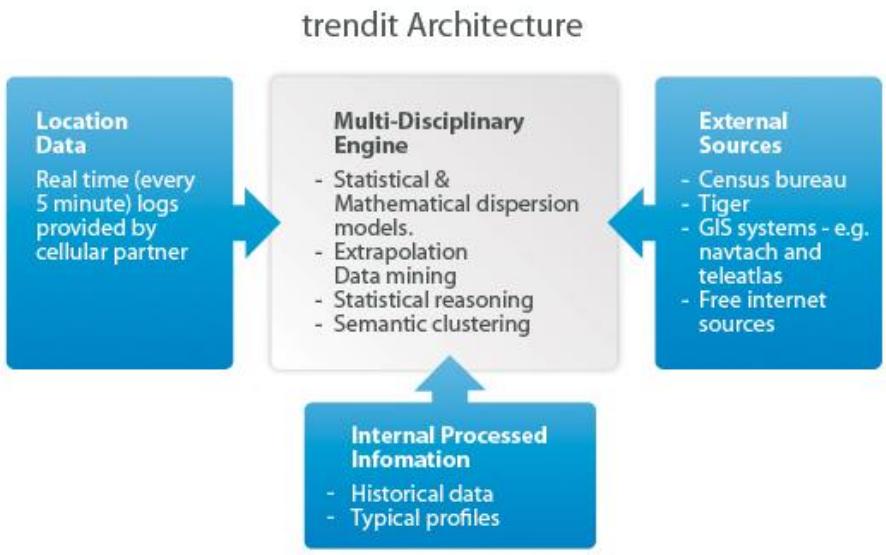
| |  <br>Figure 10. Source: http://trendit.net/en/ |
| Comparison with official statistics | Trendit uses national census bureau data to compare the aggregated data from mobile operators to the general population but the results are not revealed to public. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | TrendIT is a technological vendor for MNOs and third parties who require the processing of large-scale mobile positioning data for human mobility and other domains. |
| Success/failure assessment | The company's technology is used in Israel and the Czech Republic. The company is continuing to expand. This is a success story because we can see that private businesses can access and process the data. Using big data, such business models can be successful alternatives to state regulated data collection methods. In many cases it takes a long time to change regulation and to put pressure to MNOs to deliver data. A possible alternative to that would be using data brokerage companies to access the data. |
| Links | http://trendit.net/en/<br>http://nocamels.com/2012/03/trendit-mapping-population-movements-through-mobile-signals/ |

| Use Case 16: Mobility Behaviour | |
|---|---|
| Title | Exploring the Mobility of Mobile Phone Users. |
| Countries | Portugal |
| Aim | In this paper the authors explore the connections between various features of human behaviour extracted from a large mobile phone dataset. |
| Key players | University of Melbourne; Hungarian Academy of Sciences; ICTEAM Institute, Université catholique de Louvain, Belgium; Namur centre for complex systems (NAXYS), Facultés Universitaires Notre-Dame de la Paix; Sociology and Economics of Networks and Services Department, Orange Labs, France; Center for Operations Research and Econometrics (CORE), Université catholique de Louvain, Belgium. |
| Data source | Data from a telecom operator in Portugal. |
| Time | Not mentioned |
| Case description | In this paper, the authors analysed the behaviour of mobile phone customers based on their calling habits. With a random sample of 100 000 customers with filtered locations, as these are based on associated antenna locations, which are subject to disturbances. |
| Methodology | The authors:<br>• Defined and computed 50 features that describe the calling behaviours of the customers;<br>• Performed a correlation analysis on these features, which showed that movement and location-related features are correlated with many other features;<br>• Analysed the data using principal component analysis (PCA). This showed that the original features are highly redundant and can be efficiently compressed if some reconstruction error (e.g. 5%) is allowed;<br>• Computed the relative importance of each feature in the PCA and the cluster analysis and found that location and movement-related features are especially important in both cases and therefore |

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| | analysed the users' most common locations. |
| Comparison with official statistics | According to the authors, further research into the frequent locations and associated user behaviour should be undertaken. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of the use of passive mobile positioning data in mobility studies. |
| Success/failure assessment | This use case can be seen as a success because it shows very high scientific interest in mobile positioning data and its potential. Academia is one of the most important domains for this data and is a driving force for implementing the data in other domains. The more important scientific projects are conducted, the more demand for practical implementations is seen. Fundamental research provides possibilities for new applications' new value. For official statistics authorities, research projects are good examples of implementing, processing and validating such ICT based datasets. |
| Links | http://fr.arxiv.org/pdf/1211.6014v1 |

| Use Case 17: Longitudinal Mobility Study | |
|---|---|
| Title | Socio-Geography of Human Mobility: A Study Using Longitudinal Mobile Phone Data. |
| Countries | Portugal |
| Aim | New light on the socio-geography of human mobility. |
| Key players | Orange Labs France, Newcastle University |
| Data source | The authors used an anonymous dataset of over 1.3 million mobile phone users (1,318,905) in Portugal that provides both fine-grained longitudinal mobility traces and communication logs over one year between 2006 and 2007. |
| Time | One year between 2006 and 2007 |
| Case description | According to the authors, the call logs and location traces allow researchers to undertake large-scale objective studies of social phenomena. For this study, they used one year's data for over one million mobile phone users in Portugal to investigate the relationship between human mobility and social networks. |
| Methodology | The authors defined travel scope as the set of distinct locations visited and found that 80% of people's travel scopes are within just 20 km of their nearest social ties, and that based on their travel scope people are 15% more likely to be physically closer to their weak ties than strong ties.<br>They defined geo-social radius as the geographical distance from social ties and found that area population density is a key indicator for the geo-social radius where denser areas imply shorter geo-social radii.<br>They founded that the likelihood of travel scope being within some geo-social radius increases with area population density where shorter geo-social radii increase at a faster rate.<br>The authors talk about 3 limitations of their study:<br>• The discontinuous nature of the location traces in our dataset. Since individuals are only located when connections with the cellular network are established, we can only identify a subset of all the locations visited in the course of a day; |

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| | • Another potential limitation is the effect of population migration (i.e. people moving home from one location to another);<br>• Last limitation relates to the extent to which our findings are applicable beyond Portugal. |
| Comparison with official statistics | N/A |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of the use of passive mobile positioning data in mobility studies. |
| Success/failure assessment | This use case represents another good example of scientific research with potential to expand to practical applications. |
| Links | http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0039253 (see annex 4 Pub. 13) |

| Use Case 18: Mobility Behaviour (active, passive) | |
|---|---|
| Title | Spatiotemporal data from mobile phones for personal mobility assessment. |
| Countries | France |
| Aim | The authors are considering cellular network location data as a useful complementary source for human mobility research. |
| Key players | Orange Labs |
| Data source | Operator's commercial location platform to periodically localise participants' mobile phones. |
| Time | Different cases studies has been described / 6-minute mobile phone localisation over a period of five weeks in December 2011 / |
| Case description | This paper describes many ways to collect data for the analysis of mobility. Cellular network data, although limited in terms of location precision and recording frequency, offer two major advantages for studying human mobility. First, the wide adoption of mobile phones by populations around the world makes it possible to study the behaviour of a very large number of individuals.<br>The main advantage of active data collection is the fact that the quality of the raw data can be improved in terms of location and semantic information by asking subjects to validate or change certain recorded locations and add information about their movements, stops, modes of transportation, etc.<br>Passive data collection can be used to record data on a significant portion of the population over a long period of time. Its main disadvantage is the lack of semantic information (i.e. reasons for travel, modes of transportation, stops, and personal characteristics).<br>No less important, this type of data allows researchers to choose a specific data collection methodology (active or passive), depending on the objectives of their research. |
| Methodology | Automatic data recording also generates privacy issues. The use of geolocation means that traditional user anonymisation no longer offers adequate privacy protection. |

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| Comparison with official statistics | N/A |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of mobility study based on data from MNOs in France. |
| Success/failure assessment | The study points out the methodological and technical advantages and disadvantages of active and passive mobile positioning techniques. For this objective, the study was successful. |
| Links | http://perso.rd.francetelecom.fr/smoreda/publications/2013_Smoreda_et_al.pdf (see annex 4 Pub. 15) |

| Use Case 19: Regional Commuting | |
|---|---|
| Title | Regional commuting study in Estonia. |
| Countries | Estonia |
| Aim | Studying commuting with passive mobile positioning data. |
| Key players | Mobility Lab of University of Tartu, Positium LBS, Ministry of Regional development |
| Data source | EMT (Estonian major MNO) |
| Time | 2007 - 2009, 2013 |
| Case description | The Mobility Lab of the University of Tartu composed a study about commuting in Estonia. Using call detail records for the years 2007-2009, home-work and home-leisure connections for different time scales were mapped. The results of the study were used for a new regional development strategy and for mapping the major catchment areas of Estonia.<br>In 2013 a continuous study about the development of the commuting was conducted. |
| Methodology | Using Call Detail Records of local phone users, locations of home and work places were determined using the monthly calling data of the individual and anchor point detection model developed by Positium LBS. Commuting connections were mapped using linear connections between home and work anchors and home and leisure anchors. |

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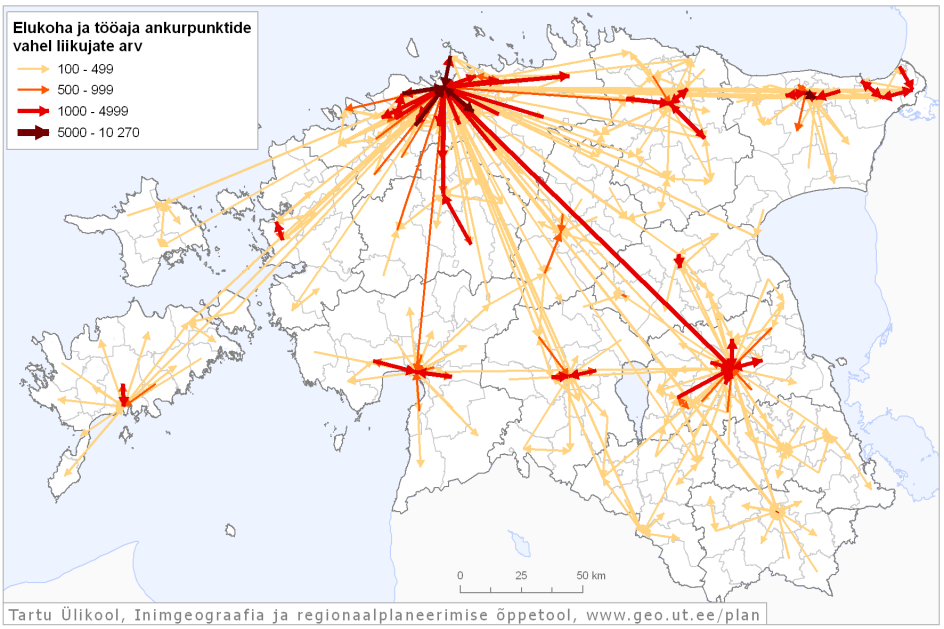
| |  <br>Figure 11. Daily commuting patterns between Estonian municipalities. Source: University of Tartu, Mobility Lab. |
| Comparison with official statistics | The University of Tartu used the population census 2000; residential register data and a questionnaire survey by TNS Emor for calibration of the model. The actual locations of individuals were very different from population register data and census data. This is also a problem of the Estonian regulation. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of the use of mobile positioning data in mobility studies. |
| Success/failure assessment | The project was a success, with continuous updates in the future and a planned monitoring system development (automated updates of the results). This use case is a good example of the implementation of the data in a new domain in official statistics (commuting, registry-based censuses). |
| Links | https://www.siseministeerium.ee/public/Regionaalse_pendelrandeuuringu_loppa ruanne.pdf |

| Use Case 20: Fraunhofer GSM-GPS | |
|---|---|
| Title | Human Mobility from GSM Data – A Valid Alternative to GPS? |
| Countries | Germany/Switzerland |
| Aim | Comparing findings on human mobility from GPS and GSM probes. |
| Key players | Fraunhofer IAIS: D. Schulz, S. Bothe, C. Körner<br>Nokia Research Centre, Lausanne |
| Data source | Mobile Data Challenge (MDC) data set of the Open Track, which contains a parallel GPS and GSM survey of 38 participants in Lausanne, Switzerland, for over one year. |
| Time | Data from 2009 - 2011 (paper published: 2012) |
| Case description | Characteristics of human mobility are a valuable source of information in many applications. In this paper we evaluate the usability of call detail records for the extraction of mobility quantities. We derive several quantities from the simultaneously collected GPS and GSM mobility data of the Nokia Mobile Data Challenge (MDC).<br>We performed four types of analyses, comparing (1) average daily travel distance and (2) radius of gyration for long and short-term observation. Further, we (3) calculated the correlation between mobile phone usage and the first two quantities and finally (4) analysed typical call locations.<br>While our analyses confirm that long-term GSM activity data are well suited to identify typical stop locations, they also show that a straightforward derivation of average daily travel distance and radius of gyration from GSM activity data underestimates the respective quantity. In addition, our analyses indicate that the correlation between mobile phone usage and movement quantities is biased when using GSM activity data. |
| Methodology | Our analysis is based on the MDC data set of the Open Track, which contains a parallel GPS and GSM survey of 38 participants in Lausanne, Switzerland, for over one year.<br>The MDC data set contains regularly recorded GPS positions and GSM cells as well as call activities. During pre-processing we use the GPS and GSM data to |

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| | approximate the cell geometry of the mobile phone network and to obtain call detail record (CDR) like data. In addition, we perform stop detection on the GPS records.<br><br>We approximate the cell geometries by constructing Voronoi polygons based on the median of GPS positions within up to 15 minutes of recorded GSM cells.<br><br>In order to produce a data set similar to CDRs, we reduced the continuously collected GSM cell data to records during call activities. To achieve this we selected the closest GSM record within a time window of 2 hours around a call activity. Not all call activities could be matched to a GSM record, resulting in a data set with about 77.6% of all call activities. The reason for this difference is not clear. However, it means that in our analyses we potentially underestimate mobility quantities from call activities. We will call the resulting set the GSM activity data set in the following.<br><br>Finally, we performed stop detection on the GPS data in order to identify spatial locations where the user has no or little movement. We consider a location in which the user remains within a radius of 300 meters for at least 1800 seconds as a stop. In a second step we clustered the obtained stops using the DBSCAN algorithm in order to identify frequently visited locations using a distance threshold of 300 meters and a minimum number of MinPts = 3 neighbours. |
| Comparison with official statistics | The results have to be confirmed in further work as our data set contained only 38 persons. In addition, we were able to assign only 77.6% of all call activities to GSM cells, which will partially have caused the underestimation. Nevertheless, our analyses underline the necessity to evaluate GSM activity data with other mobility data sources and to assess the advantages and shortcomings of this data source. Especially further analyses of simultaneously collected mobility data will contribute to such an evaluation and are required in order to obtain objective results. We are confident that such studies will allow for developing methods for the reliable estimation of movement quantities from GSM activity data. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | This use case serves as base-line information about methodological implications of the use of mobile phone positioning data relying on the GSM cell location. It gives clues about the accuracy of measuring a person's location based on the GSM cell location and compares it with other technologies such as GPS. |

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| Success/failure assessment | This use case can be considered a success, as it gives methodological clues that are important for everybody who is planning to use GSM cell location data to measure human mobility. |
| Links | http://research.nokia.com/files/public/mdc-final458-schulz.pdf (see annex 4 Pub. 8)<br>http://research.nokia.com/page/11367 |

| Use Case 21: Graz in real time | |
|---|---|
| Title | Graz in real time: mobile landscape. |
| Countries | Austria |
| Aim | Mobile Landscape Graz in Real Time harnesses the potential of mobile phones as an affordable, ready-made and ubiquitous medium that allows the city to be sensed and displayed in real-time as a complex, pulsating entity. Because it is possible to simultaneously 'ping' the cell phones of thousands of users – thereby establishing their precise location in space at a given moment in time – these devices can be used as a highly dynamic tracking tool that describes how the city is used and transformed by its citizens. |
| Key players | SENSEable City Lab, MIT, City of Graz, A1 – Mobilkom Austria |
| Data source | A1 – Mobilkom Austria |
| Time | Oct. 01, 2005 - Jan. 08, 2006 |
| Case description | A one-time project for the exhibition that presented real-time maps of mobility of humans in the city of Graz, Austria.<br>The project was shown at the M-City exhibition, Kunsthaus Graz, Oct. 01, 2005 - Jan. 08, 2006. |
| Methodology | The Real-Time City Map registered and visually rendered the volume and geographic source of cell phone usage in Graz, thus showing a different layer in the use and experience of the city. Furthermore the statistics from the A1 Mobicom Austria network was used to anonymously compute location by 'pinging' cell phones as they move through the city. The tracking application is based on a deliberate location system, initiated and agreed upon by the end customer. By sending an SMS, a customer could request to be tracked on the map of Graz. The customer can also stop it at any time, otherwise his/her trace will be automatically stopped 24 hours after activation. The record of this movement was collected, processed and finally displayed as a set of dynamic traces showing their paths through the city on the same map. However, visitors at the exhibition had the opportunity, if they wish, to register while buying their tickets. Their traces were then highlighted on the overall background on the |

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| | general map with their profiles and names. |
| Comparison with official statistics | Comparison was not made. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of the usage of mobile positioning data in "art" form. |
| Success/failure assessment | The project as an art experiment with the help of ICT was a success. This use case is one of the first experiments with mobile positioning data. It was presented well with good publicity. It is also a good example of technical processing of the data. |
| Links | http://senseable.mit.edu/graz/ |

| Use Case 22: Big Data for Mobile Computing Research | |
|---|---|
| Title | The Mobile Data Challenge: Big Data for Mobile Computing Research. |
| Countries | Lake Geneva region, Switzerland |
| Aim | This paper presents an overview of the Mobile Data Challenge, a large-scale research initiative aimed at generating innovations around smartphone-based research, as well as community-based evaluation of related mobile data analysis methodologies. |
| Key players | Nokia Research Centre, Lausanne, Switzerland; Idiap and EPFL, Switzerland |
| Data source | Collect a longitudinal smartphone data set from nearly 200 volunteers in the Lake Geneva region over one year of time. |
| Time | The data collection campaign was running in 2009 - 2011 |
| Case description | The Lausanne Data Collection Campaign (by Nokia), an initiative to collect a unique, longitudinal smartphone data set for the basis of the Mobile Data Challenge. |
| Methodology | The Lausanne Data Collection Campaign aimed at designing and implementing a large-scale campaign to collect smartphone data in everyday life conditions, grounding the study on a European culture. The overall goal was to collect quasi-continuous measurements covering all sensory and other available information on a smartphone. This way the authors were able to capture phone users' daily activities unobtrusively, in a setting that implemented the privacy-by-design principles. |
| Comparison with official statistics | No comparison with official statistics. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of an alternative smartphone based study of mobility. |
| Success/failure | This use case can be considered a success, as it gives methodological insights |

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| assessment | that are important for everybody who is planning to use mobile positioning data to measure human mobility. For official statistics it is an important lesson about the use and validation of active and passive mobile positioning data. |
| Links | http://research.nokia.com/files/public/MDC2012_Overview_LaurilaGaticaPerezEtAl.pdf (see annex 4 Pub. 19) |

| Use Case 23: Mobility Patterns in Urban Sensing Data | |
|---|---|
| Title | Understanding individual mobility patterns from an urban sensing data: A mobile phone trace example. |
| Countries | USA |
| Aim | According to the authors, this study represents a first step towards building a methodology whereby mobile phone data can be more usefully applied to transportation research. |
| Key players | SENSEable City Lab, Massachusetts Institute of Technology, USA + Department of Real Estate, National University of Singapore, Singapore + Department of Urban Studies and Planning, Massachusetts Institute of Technology, USA + IBM Research, Dublin, Ireland + Institute of Real Estate Studies, National University of Singapore, Singapore. |
| Data source | Anonymous location estimations collected by AirSage (http://www.airsage.com) from about 1 million mobile phones in East Massachusetts generated each time a device connects to the cellular network – The available dataset consists of 829 million anonymous location estimations – latitude and longitude. |
| Time | Not mentioned |
| Case description | The authors have developed techniques to extract useful mobility information from the mobile phone traces of millions of users to investigate individual mobility patterns within a metropolitan area. The mobile-phone-based mobility measures are compared to mobility measures computed using odometer readings from the annual safety inspections of all private vehicles in the region to check the validity of mobile phone data in characterising individual mobility and to identify the differences between individual mobility and vehicular mobility. |
| Methodology | In this study, the authors analyse mobility represented by two measures: individual mobility measured by the average daily total trip length that mobile phone users make, and the vehicular mobility measured by the average daily VKT per vehicle. To understand intra-urban mobility patterns, they map each mobile phone user and vehicle owner to an estimated home zone, compute the zonal average daily trip length for mobile phone users and vehicles respectively, and relate them to the built environment and demographic characteristics of the |

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| | home zone. |
| Comparison with official statistics | N/A |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of a US-based data brokerage company providing mobile positioning data for transportation and mobility studies. |
| Success/failure assessment | According to the authors, this study demonstrates pervasive datasets such as mobile phone traces and vehicle safety inspection records providing rich information to support urban modelling and metropolitan planning, which can serve as a useful alternative data source and a compliment to the traditional travel surveys in mobility research. A good example of data processing. Scientific research is an important driver for the use of new data sources. |
| Links | http://www.ires.nus.edu.sg/workingpapers/IRES2012-026.pdf (see annex 4 Pub. 17) |

| Use Case 24: Telefonica Dynamic Insights | |
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| Title | Telefonica Dynamic Insights for geomarketing. |
| Countries | Spain, UK, Portugal, Germany |
| Aim | Geographical profiling based on behaviour of subscribers. |
| Key players | Telefonica, GFK |
| Data source | Telefonica owned MNOs |
| Time | First product launched in Nov. 2012 |
| Case description | Telefonica collects mobile data, anonymous and aggregated, to understand how segments of the population collectively behave. Telefonica traces trends and the behaviours of crowds, not individuals. Results are used as insight to crowd behaviour for geomarketing purposes. Telefonica is cooperating with global marketing research company GFK in launching the product Smart Steps.<br><br>Telefonica created a special unit – Dynamic Insights, dedicated to identifying and unlocking the potential opportunities for creating value from "big data".<br><br>  <br>Figure 12. Source: http://blog.digital.telefonica.com/?press-release=telefonica-dynamic-insights-launches-smart-steps-in-the-uk |
| Methodology | Telefonica does not reveal the actual source for location information, but presumably active telephone usage is used to track the location and movement of mobile phones. Data are anonymous and aggregated by which privacy protection issues are handled.<br><br>"This is not about analysing surfing behaviour; the anonymisation and |

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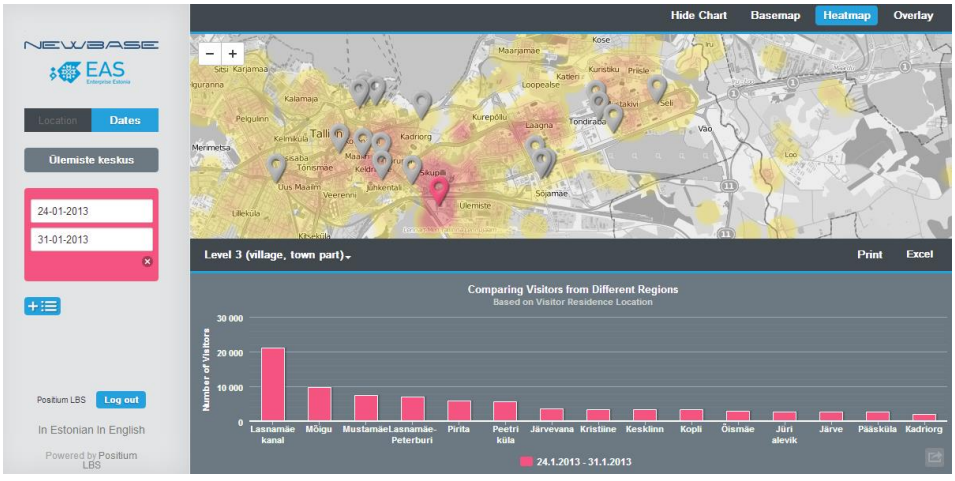
| | aggregation process protects privacy." – Telefonica. A spokesperson for the UK Information Commissioner's Office, which polices the Data Protection Act, told the BBC: "So long as an individual's personal information cannot be identified from this service, we don't have any problem with it." – BBC.<br><br>The data are provided as heat-maps, graphs and tables for users. Aggregated data are presumably not extrapolated to the general population – only aggregated data for Telefonica customers are used and presented - though this is not definitive. |
| Comparison with official statistics | Not known if the results were / are compared to any reference data. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | An example of MNOs initiative on providing data for geomarketing and other services. |
| Success/failure assessment | This is success story, as it shows business value of such new data sources as seen from the MNOs point of view. (Geo)marketing has a huge business potential and very often statistical services fail to address the needs of marketing industry. Although very far-reaching, this use case can show the new private user groups who would benefit if such data were provided by the official statistical services.<br><br>Another aspect is the initiative from MNO who see the potential in using such data. If MNOs start services based on such data, access to the data by users such as statistics authorities becomes much easier. |
| Links | http://dynamicinsights.telefonica.com/<br><br>http://blog.digital.telefonica.com/2012/10/09/big-data-will-power-the-digital-economy/<br><br>http://blog.digital.telefonica.com/?press-release=telefonica-dynamic-insights-launches-smart-steps-in-the-uk<br><br>http://blog.digital.telefonica.com/?press-release=telefonica-launches-telefonica-dynamic-insights-a-new-global-big-data-business-unit<br><br>http://www.bbc.co.uk/news/technology-19882647 |

| Use Case 25: Estonian Geomarketing Application | |
|---|---|
| Title | Mobile positioning data used in web-based geomarketing application |
| Countries | Estonia |
| Aim | Business product for shopping malls and outdoor media. This application helps plan and analyse marketing activities based on added value from geographical information. |
| Key players | Positium LBS, Newbase |
| Data source | Positium LBS |
| Time | 2012 (discontinued in 2013 until further developments) |
| Case description | Business locations such as shopping centres, gas stations, and fast-food chains rely on varied information about the customers. Traditionally, the geographical information is retrieved from loyalty cards' address input. Mobile positioning allows additional information about flows of people in the near proximity of the shop location. Based on the home anchor points of the data, a probabilistic origin of the visitors of the shops is presented visually on the map and in figures. Retail shops can compare data from their shops to the competitors' data to geographically plan better marketing campaigns, outdoor media locations, etc.   Figure 13. Screenshot of the web application visualising the home anchor heat maps of visitors of one retail shop. This was a pilot project to identify the needs of the users and value of the data to the marketing community. The pilot phase has finished and will be continued |

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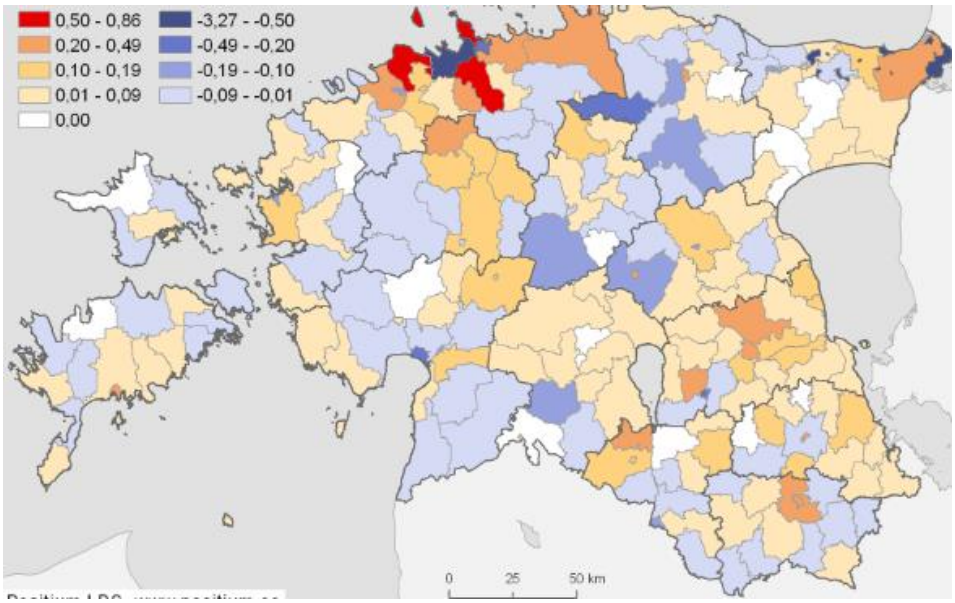
| | after development of the system. |
| Methodology | Anonymous CDR-based data processed to identify the activity spaces of the subscribers compared to various retail shop locations. |
| Comparison with official statistics | Data was compared to population data (census 2011 and residential register).<br>  <br>Figure 14. Difference of home anchor points compared to census data. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | An example of the use of mobile positioning data in domains other than tourism. |
| Success/failure assessment | Although this service is currently discontinued (pilot project finished, further development under way), this case can be seen as a practical implementation of mobile positioning data in the private sphere (marketing). Marketing is seen as one of the biggest potential domains of this data source to gain value from large datasets and fast data processing and delivery. Official statistics providers often fail to meet the needs of this domain, however, new data sources such as mobile positioning based statistics can change that. |
| Links | |

| Use Case 26: O2, Telefonica Global Advertising Solution | |
|---|---|
| Title | Telefonica/O2 Opt-in push messaging. |
| Countries | Czech Republic |
| Aim | Opt-in SMS advertisement with geographical profiling based on geographical behaviour of subscribers. |
| Key players | O2 Czech |
| Data source | O2 Czech |
| Time | Ongoing since 2010, geographical profiling will be initiated in 2013 |
| Case description | SMS/MMS advertising – O2 has created Mobilni, an opted-in database of over 1.5 million people. With an inventory of around 4 million sent SMS a month and around 1 million MMS; targeting available includes sex, age, handset type, geography, tariff, and a range of customer behavioural attributes (roaming, data tariff, etc.). Geographic attributes such as average driving distance per day, commuting, daily activity area, location of work and home places will be included in this service. |
| Methodology | Subscribers join the system for rewards and allow profiled advertisements via SMS/MMS based on the interests of subscribers. O2 is applying profiling algorithms to filter out subscribers that offer specific interests to advertisers. Geographical statistics are collected as a side product. All aspects of this service are used for marketing purposes and O2 is holding a strict policy on privacy protection as no specific identity of subscribers is given out to advertisers.<br>Location data are collected from passive databases (locations from Call Detail Record) and combined with profiles given by subscribers. Geographical algorithms include calculation of meaningful places, movement routes, periods of activity, etc. |
| Comparison with official statistics | The database has not been compared to population or other statistical data sources. |
| Reasons for this Use Case to be | Although this is a commercial opt-in solution, a number of profiling activities is conducted for the purpose of filtering out the specific subscribers of interest. |

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| selected for the EUROSTAT feasibility study | There are similar processes in tourism statistics methodology (especially in domestic tourism – e.g. for assessing the everyday activity spaces). |
| Success/failure assessment | This case is one example of how marketing services are using the potential possibilities of ICT data in marketing analytics and advertisement tools. Possibilities of the new services from official statistics authorities can be seen with insights to a new business model (official authority as pro-active statistics provider). |
| Links | http://www.globaladvertisingsolutions.telefonica.com/content/czech-republic/index.html<br>http://www.globaladvertisingsolutions.telefonica.com/content/opt-in-push-messaging/index.html |

| Use Case 27: Sense Networks | |
|---|---|
| Title | Retail Retargeting™ – the first retargeting solution for mobile advertising. |
| Countries | USA |
| Aim | Mobile Geomarketing – Reach shoppers of the top 1,000 retail brands to influence future purchase decisions. |
| Key players | Sense Network |
| Data source | 170 billion mobile phone location points per month. |
| Time | Ongoing since 2006 |
| Case description | "Your audience is moving from online to mobile – how will you reach them? Sense Networks helps advertisers reach their target audiences on mobile with our proprietary Sense targeting technology and Retail Retargeting™. These flagship products are built on top of our platform that creates behavioural segments from location data and uses the data to anonymously match users to ads with sophisticated prediction models. The company's technology platform, MacroSense®, builds proprietary mobile user profiles that incorporate over 1,000 behavioural attributes that are extracted from location data. MacroSense receives streaming location data from mobile phones in real-time, processes the data in the context of billions of historical data points, and analyses it to better understand human activity and apply the insights to mobile advertising."<br><br>"Reach consumers when they are ready to buy: With Sense Targeting, advertisers can reach their most coveted audiences at the perfect time within their shopping cycle. Sense targets ads individually to consumers based on 1) behavioural attributes that are extracted from historical location data, 2) current location context (what's nearby), and 3) impression characteristics."<br><br>"We have access to 90 million users and 10 billion impressions each month. In addition to delivering shopper audiences, our unique approach to predictive location targeting allows us to find people who live, work or spend time near retailers and deliver ads even when they are not next to the store. Retail Retargeting is available for the top 1.000 retail and QSR brands." |
| Methodology | The MacroSense Technology Platform has been transforming raw location data |

into actionable intelligence since 2006. The MacroSense technology platform is central to Sense Networks' scientific approach to analysing vast amounts of mobile location data and applying them to useful and engaging products and services.

Mobile location data offers a completely new view of consumer behaviour based on places people go. Sense Networks' founders – leading computer science professors at MIT and Columbia University – were fascinated by the prospect that one could understand human behaviour through looking at location data, understanding the patterns of where people go and how much they move around.

"We saw that mobile phone usage was growing at double digit rates every year, and soon everyone would have one. (Remember, 2006 was pre-iPhone!) Increasingly, these phones give off location data both actively (e.g. Foursquare check-ins) and passively (e.g. app usage). We saw that this data would provide a way to empirically test hypotheses about human behaviour. MacroSense turns massive amounts of mobile location data into actionable, predictive behavioural data. In fact, we process 4 billion location points per day (as context: Twitter handles 400 million tweets per day)."

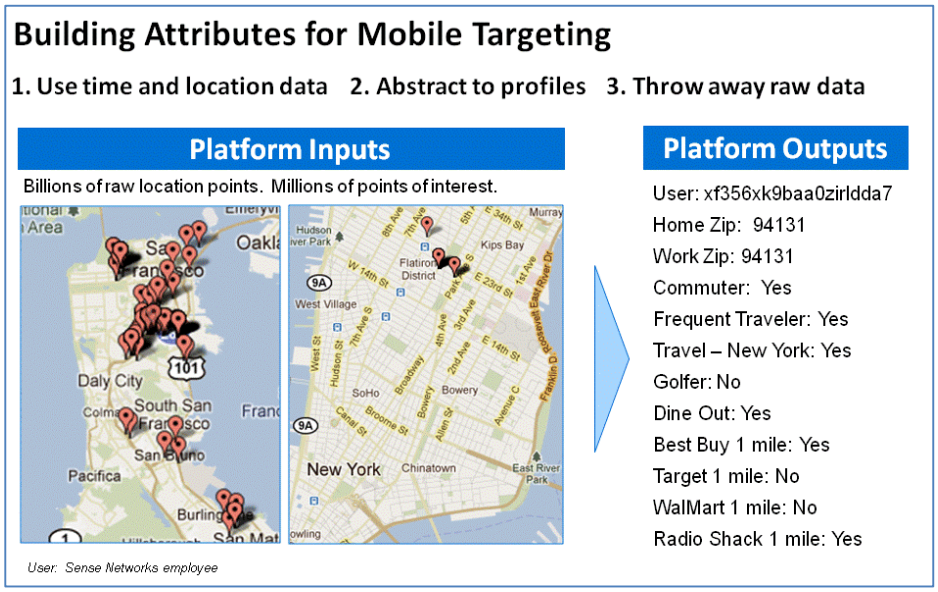


Figure 15. Source: http://www.sensenetworks.com/products/macrosense-technology-platform/what-does-macrosense-do/

"We turn all data into abstract, anonymous profiles in order to serve the most relevant ads. These profiles do NOT identify you personally (e.g. name, address, financial data, etc.) and cannot be reverse-engineered. We look at things like the context of where your phone has travelled (type of neighbourhood, nearby stores) to predict your interest in certain types of deals or offers. We also build

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| | anonymous profiles for 3rd party mobile publishers based on location data they provide us." |
| Comparison with official statistics | N/A |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | An example of an advertising application using massive location data (big data). |
| Success/failure assessment | The company exists and is expanding. This case is one example of how new data and analytical tools have been used with new media and new marketing tools. State statistical services can be a part of this business model and such use cases can teach new insights about value chain, data processing and business models. State statistical services can be a part of such business models because of better/neutral access to data. |
| Links | http://www.sensenetworks.com |

| Use Case 28: Mobility Behaviour and Social Networks | |
|---|---|
| Title | Analysis of Smartphone User Mobility Traces for Opportunistic Data Collection. |
| Countries | Lake Geneva Region |
| Aim | Through analysing the dataset from Mobile Data Challenge by Nokia, the authors validated the feasibility of opportunistic data collection and identified several important characteristics of smartphone users' mobility, such as the strong spatial and temporal localities that should be considered when designing the related protocols and algorithms. |
| Key players | Nokia; Department of Computer Science; University College Cork, Ireland |
| Data source | 893 920 GPS readings from 37 smartphones users are used in our analysis |
| Time | 05.09.2009-07.01.2011 (the time span is 70 weeks) |
| Case description | Instead of using smartphones to access the services provided by various wireless sensor networks, they focus on using smartphones to collect data from sensor nodes opportunistically. |
| Methodology | Considering that the main point of opportunistic data collection is to exploit the uncontrolled mobility of smartphone users, the authors analyse the mobility with traces for answering the following important questions.<br>1. In opportunistic data collection, is the smartphone's overhead (energy consumption, etc.) low enough to motivate user participation?<br>2. For each encounter, does a smartphone stay in the communication range of a sensor node long enough for collecting data opportunistically?<br>3. Could smartphone users access a sensor node frequently enough to support a variety of applications?<br>4. How does the smartphone users' mobility distribute in time and space? How do these distributions influence the design and operation of the related protocols and algorithms? |

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| Comparison with official statistics | Not compared |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of an alternative smartphone-based study of mobility. |
| Success/failure assessment | This use case can be considered a success as it gives methodological clues that are important for everybody who is planning to use GSM cell location data to measure human mobility. Smartphone/GPS-based studies give good quantitative information, but the sample size (and cost) of such studies enables only small-scale studies (compared to the size of passive mobile positioning data) to be conducted. However, such studies combined with passive positioning data can present several solutions to problems of passive data. |
| Links | http://research.nokia.com/files/public/mdc-final144-wu.pdf (see annex 4 Pub. 2) |

| Use Case 29: TOURIAS Travel Guide | |
|---|---|
| Title | GIATA TOURIAS Travel Guide. |
| Countries | Germany |
| Aim | Mobile Guides for Travel Agencies, Portals and Tour Operators. |
| Key players | TOURIAS, GIATA, Thomas Cook |
| Data source | Thomas Cook |
| Time | On-going since 2012 |
| Case description | GIATA TOURIAS Travel Guide offers you smartphone travel guides to more than 100 of the most sought-after travel destinations. After completing a travel booking, travellers can load useful country information, descriptions and images of famous sites and attractions, as well as nightlife and restaurant tips onto their smartphone.<br>  <br>Figure 16. Source: http://www.tourias-mobile.com/en/for-travel-agents-portals-tour-operators.html<br>On request important information on the holiday that has been booked can be included – e.g. arrival and departure data (optionally bookable feature). Personalised accommodation data such as a description and the address of the accommodation are always included. For the use of this information the Mobile Travel Guide does not need to be connected to the internet and can therefore also be used free of charge abroad.<br>You can now offer your customers the possibility of adding their personal content to the travel guides. With the MyGuide feature all it takes is a few steps to integrate individual entries, for example restaurant recommendations and insider information, which can be recorded and saved directly in the app. This |

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| | makes every travel guide a personal holiday memory, and by "sharing" the content on Facebook the community can also participate in these holiday experiences. The best part is that your travel guide continues to grow organically. With MyGuide this user-generated content can be fed back into your app, which means that your own individual travel guide is gradually built up, enhanced with images, useful tips and valuable contributions from your customers.<br><br>Using the optionally bookable feature 'Your travel details' the relevant accommodation data can be supplemented with further individualised travel data. Via an interface details of the holiday that has been booked are integrated into your customer's travel guide: arrival and departure data, car rental, etc. In addition travellers receive a 'personal' guide because they are addressed by name in the main menu direct.<br><br>On request your own content and individual functions can be added to GIATA TOURIAS Travel Guides. In addition to maps, augmented reality, weather information and an individual itinerary it is also possible without any difficulty to integrate travel agency data, information about the courier and details of attractions at the holiday destination into the basic guide. |
| Methodology | Consumer information including location data based on the use of the travel guide app. |
| Comparison with official statistics | No links or possibilities to compare with official statistics. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | This use case serves as an example how tour operators and destinations are offering mobile services to their guests. Tourism apps use the location data of mobile phones to provide the users with location based services. On the other hand the providers of the apps can analyse the movement patterns of their guests. |
| Success/failure assessment | Basically all tourism destinations, tour operators and other providers of tourism services are offering or are planning to offer mobile apps that are using the mobile positioning data of the tourists. This is an up-to date technology and its use will definitely increase in the future. This case shows that user data from such tools and guides is used more and more for analysis and generating statistics. This is a lesson for researchers and statistical services to see the |

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| | variety of methods for data collection. |
| Links | http://www.tourias-mobile.com/en/for-travel-agents-portals-tour-operators.html<br><br>http://www.tourias-mobile.com/uploads/media/Travelguide_EN.pdf (see annex 4 Pub. 6) |

| Use Case 30: LifeService112 | |
|---|---|
| Title | LifeService112 (E112) |
| Countries | Germany |
| Aim | Emergency localisation GSM/GPS |
| Key players | Allianz, nobisCum, Björn Steiger Stiftung |
| Data source | Deutsche Telekom, Vodafone, O2, E-Plus |
| Time | On-going since 2006 |
| Case description | Today, most emergency calls are made via mobile phones. Unfortunately, callers often do not know where they are. Before the Public Service Answering Point (PSAP) can arrange the necessary assistance, they first need to try and define the exact location. This takes valuable time that can be lifesaving. Similar to eCall, the enhanced emergency mobile phone locating system allows the PSAP or call centre to quickly locate the caller. Depending on the technical equipment of the mobile phone, there are basically two technologies available. These are:<br><br>On behalf of Allianz OrtungsService, nobisCum has developed the positioning platform "Life Service 112". The "Life Service 112" platform is available for free to Public Service Answering Points (PSAP) and is the first Enhanced 112 system in Europe. The system allows the PSAPs to locate mobile phones in case of an emergency and therefore lead the rescuers to the exact emergency site in a faster manner. Currently, the E112 system is being used by the German PSAPs.<br><br>E112 means:<br>• Positioning via GPS or cell location;<br>• No prior registration or special phones needed;<br>• Forwarding of coordinates to rescue centre;<br>• Eliminate a time-consuming search for the location.<br><br>In addition, mobile phone users have the possibility to add an online "Life Sensor 112" emergency health file. Benefits of the Emergency file:<br>• The emergency services are already informed about the health situation |

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| | on the way to the accident;<br>• Best possible primary care, since it is known about medications and incompatibility;<br>• Family members and family physicians can be notified quickly.<br>The telecom operator transmits the location information to the emergency centre. The EU Directive E112 (2003) requires mobile phone networks to provide emergency services with whatever information they have about the location a mobile call was made. This directive is based on the FCC's Enhanced 911 ruling in 2001. |
| Methodology | A special SPACE mobile application will be installed on mobile phones that are equipped with a GPS receiver. If an emergency call is being received, the current location of the caller is shown – if allowed by the caller – by pressing a button.<br>Mobile phones that do not support GPS tracking can be located through the so-called GSM network cell localisation. In this case, the network cell the user is using is determined. This method of localisation is less accurate than the GPS; however, it requires no further technical requirements other than the mobile phone. Today, both types of positioning based on SPACE Tracker are used by the German PSAPs through the Enhanced 112 (E112), to locate people in distress.<br>In addition the system also offers the option to create a health file listing all current illnesses, allergies and intolerances, medications, previous surgeries or any other relevant information. This file is stored and is always at your fingertips to be accessed in an emergency by the PSAP. The enhanced cell phone emergency location-based SPACE Tracker meets all privacy and data security requirements and guarantees a rapid service – worldwide.<br>The telematics platform SPACE Tracker is based on the SPACE technology from nobisCum. SPACE is a geographical information system (GIS) that allows an individual and effective use of GIS technology. The core of the SPACE technology consists of an Oracle database with spatial extension for processing geographic data and NAVTEQ MapTP, a map applet for visualisation and analysis of geographic information in map format.<br>The separation between front end and back end enables a versatile use of the sophisticated SPACE-server technology. SPACE Tracker can be used as a |

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| | standalone web system with or without external connection, or as a pure back-end system with interfaces to existing systems. |
| Comparison with official statistics | As it is the intention of this Use Case to localise individuals, there is no link to official statistics |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | This use case shows that MNOs have the technological capabilities and "willingness" to cooperate in using mobile positioning data for localisation purposes, if regulated to do so by legislation. |
| Success/failure assessment | Lessons from this use case can be presented as follows:<br>1. There is a good example of technical and legal framework to access the data from MNOs;<br>2. There are a number of obstacles (implementation costs on MNOs as well as the user side);<br>3. The use case shows that all four MNOs work with IT providers and sponsors in this on-going project, so it can be considered a success. |
| Links | http://www.allianz-ortung.de/ls112.php<br>http://www.space-tracker.com/en/technology.html<br>http://www.steiger-stiftung.de/Handy-Ortung.441.0.html |

| Use Case 31: GIS-112 | |
|---|---|
| Title | GIS-112 Estonia |
| Countries | Estonia |
| Aim | Integrated mobile positioning system for rescue services. |
| Key players | Estonian Emergency Respond Centre (ERC), Estonian Rescue Board, Estonian Ambulance |
| Data source | Active mobile, telephone and GPS device positioning from a mobile and telephone operator on Estonian territory. |
| Time | Development 2010 - 2012, in use since 2012 |
| Case description | The information system was developed according to: DIRECTIVE 2002/22/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive).<br>The project was part of "E-Call" project, initiated and supported by European Communication Committee. "E-Call" is a system which allows transferring information about the accident to 112 over GSM network from cars equipped with special equipment.<br>The project was financed by the Estonian-Swiss Cooperation Programme.<br>The general aim of the project was to shorten the time taken from answering the emergency call to the arrival of the ambulance brigade and/or the rescue team at the scene of the accident with the aim of decreasing the number of fatalities, damage to environment and property.<br>Project outputs:<br>1. Office software – GIS-112 – geographical information system module integrated with existing information system modules and other national registers for data exchange. The main functionality:<br>• Electronic map and main GIS functionality. Developing the electronic map and GIS functionality and integrating the map data;<br>• Departure plan and logistics module. Manage the rescue and |

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| | ambulance teams resources. Find the optimal resources and logistics to the location;<br>• Callers' location positioning. Interfaces are created with the telecommunications companies to retrieve the position of the 112 callers' location. The telecommunications companies have the ability to give the information over the interfaces;<br>• Integration and interfaces. Integration to ambulance mobile systems and interfaces to retrieve data from ambulance databases;<br>• Analyse module. Saving and analysing the vehicles logistics data to improve the departure plan and logistics. Risk analysis and prevention.<br>2. Mobile software – M-GIS-112 – for command and control vehicles and emergency vehicles. Mobile software is also provided to ambulance vehicles. The main functionality:<br>• Mobile electronic map and architecture. Developing the electronic map and GIS functionality and integrating the map data;<br>• Logistics and fastest way integration. Find the fastest time way to the location and give directions during the journey;<br>• Interfaces and ambulance module integration. Required interfaces to systems and integrating the ambulance module.<br>3. Electronic geographical raster and vector maps – office and mobile electronic geographical raster and vector maps are delivered and introduced in the software. The map data are based on the Estonian Land Board raster and vector data, which can be used without license, but must be analysed and compiled for GIS-112 project needs in office and mobile software. The map data are renewed in the Estonian Land Board and the renewed data are accessible to GIS-112.<br>4. Installed mobile hardware (mobile computers) in command and control vehicles and in emergency vehicles; installed GIS server and other necessary servers and licences.<br>5. All the ERC personnel and emergency teams' trainers are trained to use the office and mobile software. |
| Methodology | Callers' location positioning – location of all emergency calls are displayed on |

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| | the digital map as precisely as possible. Smart phones provide GPS coordinates, older generation mobiles' location is of nearest mobile cell tower. Desk phone callers' location accuracy is of the apartment number and floor level. The accuracy of the locations depends on the detail of the database and use of technologies of the telecommunications enterprise. As a result it is much easier and faster to locate the caller, especially if the caller is not in inhabited localities and does not know where he is currently located or has got lost.<br><br>Planning of resources – rescue and ambulance vehicles are equipped with built-in GPS radio communications equipment capable of sending status messages, the location coordinates are sent after a certain period of time or distance. Locations of all ambulance and rescue equipment with status information can be monitored in ERC on a digital map in real time. The rescue organiser can quickly decide the location of the closest free rescue or ambulance team.<br><br>Logistics plan – the information system generates a unique plan for each incident including information on free and the closest / fastest resources. The nearest / fastest way is calculated using the information on distances and the maximum speed limit as well as the information on necessary resources according to incident type.<br><br>Smart monitoring – necessary information can be found by using filters. As a result, it is possible to look at one of the incidents and related resources, or to display all incidents taking place in the area, or create a query that displays events in a period of time, etc. The emphasis is on real-time monitoring of the situation. |
| Comparison with official statistics | New software GIS-112 and M-GIS-112 with the geographical maps and installed vehicle hardware gives opportunity to:<br><br>1) investigate potential risks for peoples' lives or property;<br><br>2) make quick decisions in assistance process;<br><br>3) decrease time-to-location of all the emergency teams including ambulances, managed by Emergency Respond Centre and in this way decrease the risk or extent of possible consequences;<br><br>4) significantly improve the positioning of the callers' location;<br><br>5) enhance the effectiveness of whole risk prevention or elimination process. |

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| | Case is not linked to statistics. |
| Reasons for this Use Case to be selected for the EUROSTAT feasibility study | Example of state implementation of a system that includes involvement of MNOs. |
| Success/failure assessment | Lessons from this use case can be presented as follows:<br>1. There is a good example of technical and legal framework to access the data from MNOs;<br>2. There are a number of obstacles (implementation costs on MNOs as well as the user side).<br>The use case shows that all four MNOs work with IT providers and sponsors in this on-going project, so it can be considered a success. |
| Links | Press release (in Estonian), Project contract (in English) and introductory video (in Estonian): http://www.fin.ee/?id=81828<br>GIS-112 Press release (in English): http://www.rescue.ee/vvfiles/1/GIS-112%20kodukale%20(IK).pdf<br>Project description (in Estonian): http://www.rescue.ee/hairekeskus/projekt-gis112<br>DIRECTIVE 2002/22/EC: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:108:0051:0051:EN:PDF |

# Annex 3. Literature list - Mobile positioning data in scientific studies

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# Annex 4. Publications

Listed publications:


- Publication 1: WIGeoGIS. 2007. A1 Traffic Data Stream: Movement Data in Mobile Telephone Network as Data Source for Marketing, Research and Planning. http://www.wigeogis.com/en/pdf/news/NEWS17122009.pdf

- Publication 2: Wu, X., Brown, K.N., Sreenan, C.J. 2012. Analysis of Smartphone User Mobility Traces for Opportunistic Data Collection. This material was prepared for the Mobile Data Challenge 2012 (by Nokia) Workshop; June 18-19, 2012; Newcastle, UK. http://research.nokia.com/files/public/mdc-final144-wu.pdf

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- Publication 13: Phithakkitnukoon, S., Smoreda, Z., Olivier, P. 2012. Socio-Geography of Human Mobility: A Study Using Longitudinal Mobile Phone Data. PLoS ONE 7(6): e39253. doi:10.1371/journal.pone.0039253 http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0039253

- Publication 14: Silm, S., Ahas, R., Tiru, M. 2012. Spatial Mobility between Tallinn and Helsinki in Mobile Positioning Datasets. Statistical overview. Department of Geography of University of Tartu, Mobility Lab. Helsinki-Tallinn Transport and Planning Scenarios. Central Baltic INTERREG IV A Cross-Border Co-operation Programme. http://www.euregio-heltal.org/wp-content/uploads/2011/03/Spatial-Mobility-between-Tallinn-and-Helsinki-in-Mobile-Positioning-Datasets.pdf

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