



Nordic
Innovation

Nordic development
project on Mobile
Positioning Data
for Tourism Statistics

Feasibility study

IN ASSOCIATION WITH



Executive summary

The aim of this feasibility study is twofold; to investigate the prerequisites for a Nordic development project on mobile positioning data for tourism statistics, and to present a proposal for such a project.

The project proposal is based on two levels where each level builds a fundament necessary for the other level. Information and learnings flow between the levels creating an iterative process and a learning eco-system. The proposal is organised in the following two sub-projects:

Level 1 Establish a Nordic network for knowledge sharing and cooperation related to tourism statistics based on mobile positioning data.

A network for Nordic cooperation on mobile positioning data for tourism statistics provides the foundation for setting up and running a use-case project solving the key questions. The network also enables a more efficient and structured platform for knowledge sharing and learning across the Nordics.

Level 2 Challenge and clarify the legal framework, and establish efficient and sustainable business models, by running a use-case.

In this project the learnings and advancement with regards to the legal framework and business model are central. A use case is essential to reach these aims. As part of the project statistics will be produced but this is considered a bonus rather than an aim in itself. The feasibility study has identified mapping of intra-Nordic travels as most relevant. This would preferably be specified further, for example by focusing on long-haul tourists or/and Nordic inhabitants.

Illustration of the project proposal.

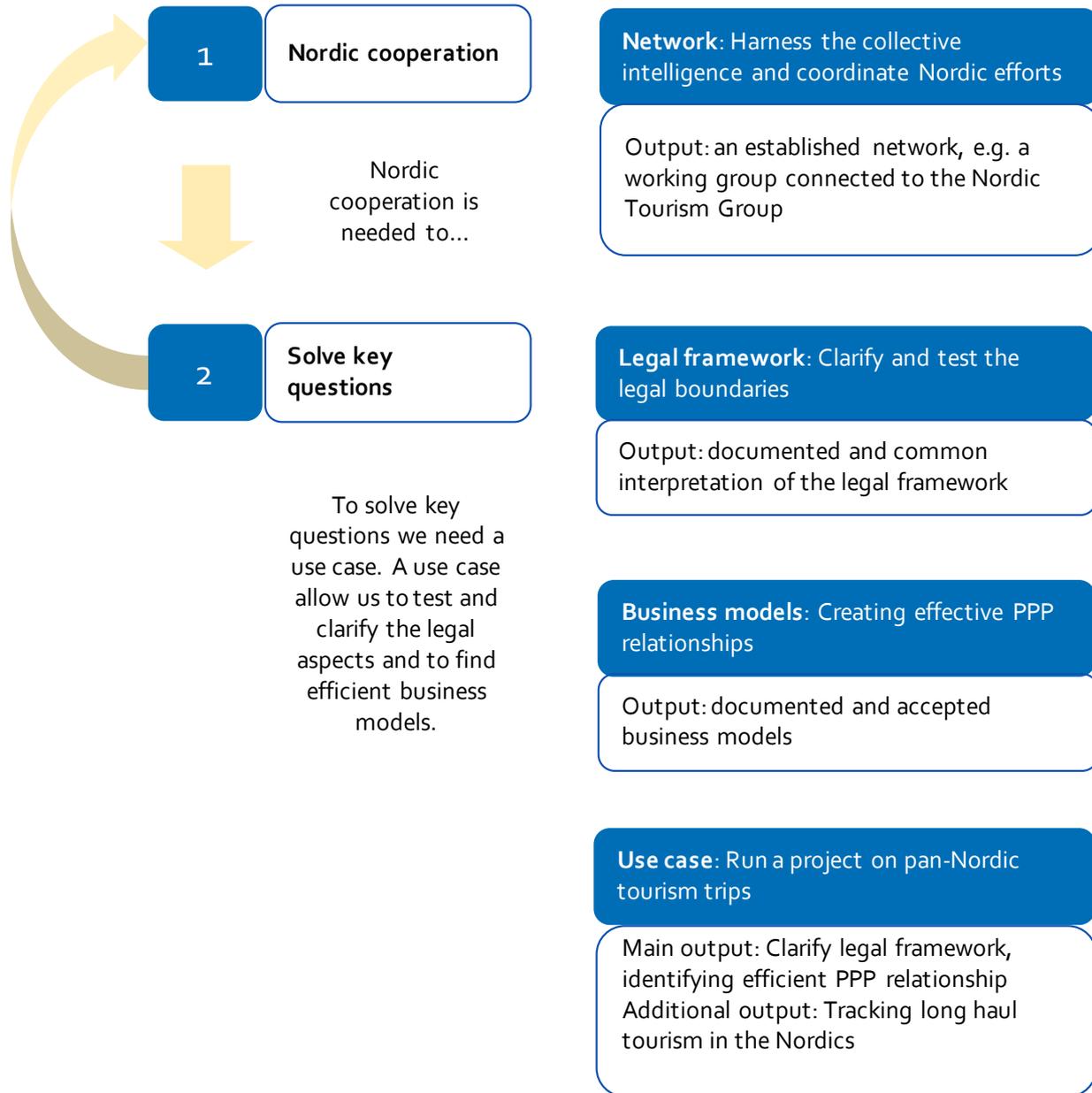


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Definitions and abbreviations

- Tourism is by United Nations World Tourism Organization (UNWTO) defined as: Tourism comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes
Tourism statistics is the collection and analysis of numerical and geographical data regarding the activities classified as tourism
- Domestic tourism implies visits within a country by visitors who are residents of that country
- Inbound tourism implies visits to a country by visitors who are not residents of that country
- Outbound tourism implies visits by residents of a country outside of their country of residence
- Statistical office (SO) is used to represent a broader group of public organizations that produce, or is responsible for, official statistics and other statistics production. National statistics offices such as Statistics Finland is one example, the Swedish agency for economic and regional growth is another example. Eurostat, Visit Denmark and the Icelandic tourism board are other examples.

- Legal framework refers to the legal and regulatory aspects that have an impact on how mobile positioning data can be used to produce statistics. This is for example
 - General Data Protection Regulation (GDPR)
 - European statistics Code of Practice, and its national implementations
 - Regulatory framework set by national agencies responsible for electronic communications
- Business models refers to, if the context doesn't imply other, the structure through which the statistical offices and mobile network operators could cooperate and conduct business.
- Mobile network operator (MNO) is a service provider operating networks to which mobile phones and other mobile units connect.
- Mobile positioning data (MPD) is within this project referred to as data concerning the location of call activities or handovers in network cells stored by the mobile network operators. I.e. information about where a certain mobile phone, or other mobile unit, has been at a given time.
- Data subject is the person using a mobile phone or other mobile unit which movements are tracked.

Introduction

- Background
- Process and methodology

Background

Project initiated by the Nordic Council of Ministers

At the Nordic Council of Ministers' meeting in Stockholm on May 15, 2018, it was decided to instruct the Nordic Committee of Senior Officials for Business Policies to, in cooperation with Nordic Innovation, investigate the possibility of strengthening Nordic cooperation in tourism statistics and preparing a specific project in the area.

This resulted in project proposal of a feasibility study that should investigate the conditions for implementing a major Nordic development project for use of mobile positioning data in tourism statistics and to prepare a proposal for the implementation of such a project. The Swedish agency for Economic and Regional Growth was offered the role as lead partner in the project. Analysys Mason, a global consultancy and research firm specialising in telecom, media and technology, was selected to conduct the study.

Tourism statistics is a relevant Nordic area of cooperation

Using Big Data, and more specifically mobile positioning data, has long been highlighted as a realistic opportunity to meet challenges in today's statistics production. Increased costs for data collection, falling response rates and increased drop-out in traditional surveys have generally led to an increasing need to find alternative and more cost-effective methods. The Nordic countries as one region is considered to present favourable conditions for international cooperation within the field of mobile positioning data for tracking both national and international movement of tourists to, from and between the Nordic countries.

Previous pilot studies

Several pilot studies within the field of mobile positioning data have been carried out internationally in recent years and a number of conclusions and patterns are emerging from the results. The pilot projects have shown good results regarding the conditions for using mobile positioning data to get answers to the questions the statistics should answer. However there are still work to be done to make the transit from being merely ad-hoc studies to instead function as long-run reliable official statistics.

Purpose

This feasibility study investigates the prerequisites for carrying out a Nordic development project for the use of mobile positioning data in tourism statistics and presents a proposal for the set up and implementation of such project.

The purpose of the feasibility study is to map out obstacles and opportunities for using mobile positioning data to produce tourism statistics in the Nordic countries. The relationship between the Statistical Offices (SOs) and Mobile Network Operators (MNOs) are a fundamental aspect, and functioning models for cooperation are of essence. Another important aspect is the legal framework since it has a great impact on what data that can be shared between SOs and MNOs. The feasibility study also provides a review of the Nordic countries' different starting points and the possibilities for participating in a future main project.

Deliverables

- Project proposal for a Nordic development project on mobile positioning data for tourism statistics
- Answers to the key aspects listed below:
 - In-depth understanding of the legal framework for mobile positioning data as a basis for the development of tourism statistics and simplified reporting. Identification of any legal barriers that hinder harmonised data management in the Nordic countries. An important element of this is the analysis of the integrity aspect and ensuring that rules and guidelines regarding privacy are taken into account.
 - Understanding of the stakeholders and their relationships– which actors are concerned and need to be involved in the development work and what roles and tasks they have, as well as knowledge of which relationships need to be built between mobile operators, statistical authorities and any other relevant actors.
 - In-depth understanding of market opportunities and possible business models, for the use of mobile positioning data as a basis for the development of tourism statistics and simplified reporting, through public private partnerships.
 - Knowledge of the Nordic countries' different competencies and ongoing work in the field of mobile positioning data as well as ambitions and opportunities to contribute to further development work in a future joint Nordic main project, as well as knowledge of the value of increased cooperation across national borders.

Delimitations

This feasibility study, including the proposal for a main project, focus on mobile positioning data collected by mobile network operators. It is possible to collect geographical data about mobile phone users via the owners of operating systems, e.g. Google and Apple, or application providers such as Facebook and Twitter. This is however out of scope for this project.

Process and methodology

1. Data collection through interviews with stakeholders, including expert groups
2. Analysis of interview results and complementary desk research
3. Workshop with Nordic expert group
4. Workshop with a wide range of tourism organizations during a workshop at the Nordic tourism conference in Copenhagen in May 2019. Mostly representatives from regional and local tourism promotion organizations
5. Analysis of workshop results and complementary interviews
6. Formulation of project proposal
7. Dialog regarding project proposal with expert groups and steering committee
8. Edit of project proposal and report writing
9. Project delivery

Project stakeholders and interview subjects

Internal expert group at the Swedish Agency for Economic and Regional Growth

- Sofi Sjöberg
- Erika Rosander
- Martin Daniels
- Michael Heuman

Steering committee at the Swedish Agency for Economic and Regional Growth

- Helena Nyberg Brehnfors
- Kristian Viidas

Nordic expert group

- Ossi Nurmi, Statistics Finland
- Jarle Kvile, Statistics Norway
- Else-Marie Rasmussen, Statistics Denmark
- Daði Guðjónsson, Promote Iceland
- Henrik Boesgaard Sørensen, Visit Denmark

Representatives from following organizations have been interviewed

- Statistics Finland
 - Statistics Denmark
 - Statistics Norway
 - Statistics Sweden
 - Icelandic tourism board
 - Promote Iceland
 - Visit Denmark
 - Eurostat
 - Nordic Innovation
 - Transport Analysis, Sweden
 - The Swedish Post and Telecom Authority
 - Telia
 - Tre
 - Telenor Sweden
 - Telenor Norway
 - A wide range of tourism organizations
- during a workshop at the Nordic tourism conference in Copenhagen in may 2019

Using mobile positioning data for tourism statistics

- The Statistical Offices perspective
- The demand on data varies depending on the stakeholder
- The Mobile Network Operator perspective
- Granularity affects personal integrity
- Statistics production and the level of sensitivity/granularity
- Statistics production and responsibilities
- Eurostat's framework for the processing of Mobile Network Operator data
- Secure multi-party computation
- The General Data Protection Regulation
- European Statistics Code of Practice

The Statistical Offices perspective

Big Data, and more specifically mobile positioning data, has long been highlighted as an interesting field for developing new complementary sources for statistics production. Several pilot studies within the field of mobile positioning data have been carried out internationally in recent years. The pilot studies have shown good results regarding the conditions for using it to get answers to the questions the statistics should answer. However there are still work to be done to make the transit from being merely ad-hoc studies to instead function as long-run reliable official statistics.

The majority of the pilot studies carried out so far have had most of the data processing done by the Mobile Network Operator, (MNO). This has caused challenges for the Statistical Offices, (SO) and other producers of tourism statistics, since that approach often entails a lack of transparency in the delivered data. In general, the SOs need answers to questions like:

- What definitions are used?
- How is a tourist differentiated from a commuter?
- What constitutes a trip?
- What algorithms are used to identify different means of transportation?
- What measures are taken to avoid double counting?
- How is the data weighted to achieve representation?

SOs are in general reluctant to use data that have been produced through what is often referred to as “a black box”, i.e. statistics where input values are analysed and packaged by the MNO or a third party. In a more regular and long-term use of mobile positioning data as a basis for tourism statistics, it is crucial that the SO receives information on how data is aggregated, only then can the SO compare and merge data from other MNOs and/or other data sources.

The demand on data varies depending on the stakeholder

The needs of different stakeholders, and hence their demand on data, varies depending on their organisation's main purpose. Official statistics need long-run reliability and high control while organisations conducting business development often are more focused on valuable ad-hoc insights.

An SO has its unique selling point in having highly reliable data measured over a long period of time. More specifically, SOs require that;

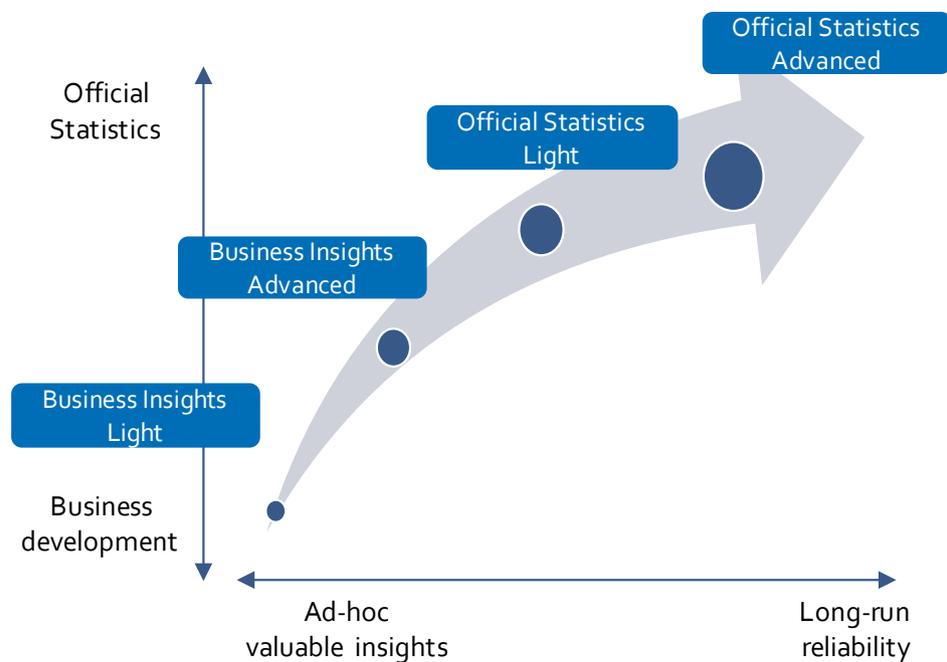
- Studies are repeatable
- The collection and analysis is transparent
- It is possible to substitute data provider, i.e. change which MNO that supplies data, and still be able to compare the statistics from one year to another
- Confidence interval and uncertainties must be presented

Organisations working with business development, such as promotion organisations or private SMEs, are partly interested in the statistics described above but do also have an interest in ad-hoc studies. General insights about current conditions are of high value even if it's only indications.

To make future discussions easier this slide introduces two different categories with two subcategories each, in total four different levels of complexity¹:

- Business insights light
- Business insights advanced
- Official statistics light
- Official statistics advanced

Illustration of how data demand varies depending on the stakeholder



The categorisation suggests, which is illustrated in the figure above, that when the demands for long-run reliability and precision increase, so does the complexity to produce the statistics. Business insights light is least complex to produce where MNO:s to a greater extent can “own” the process. Official statistics advanced is the most complex because of greater demands on transparency, reliability and transfer of privacy sensitive data.

¹ When complexity is mentioned the focus is on relationship between SOs and MNOs as well as the legal framework affecting how mobile positioning data can be shared. This process is easier when MNOs produce the statistics in-house and less cooperation is needed. However, the MNOs internal processes and the actions needed to produce the statistics might still be complex.

The Mobile Network Operator perspective

The Mobile Network Operators (MNOs) have a central role when discussing mobile positioning data use as part of tourism statistics. Several questions of relevance for the MNOs arise when discussing mobile positioning data as basis for official statistics:

- GDPR* breaches can cost companies up to 4 percent of global revenues or €20 million, whichever is greater. A fine of this magnitude could put some Nordic MNOs out of business. The MNOs will therefore need clear assurances that the mobile positioning data statistics are well within the GDPR framework.
- The MNOs will want to minimize the risk of data mismanagement. Even if a project is fully GDPR compliant there is always a risk of data leaks, and such leaks can have direct and negative impact on MNO operations.
- The MNOs need to understand the commercial opportunities associated with mobile positioning data statistics. The MNOs may see mobile positioning data statistics as a way of generating recurring revenue. Should public authorities insist that the MNOs need to share this data without any compensation, the MNO motivation may be reduced.

Note: In the USA, MNOs can sell their customers' data (including location and browsing history) to advertisers without the users' consent. Operators in the USA are therefore increasing their efforts in the advertising market. However, in Europe, the introduction of GDPR makes similar initiatives less likely.

Many of the MNOs are today running initiatives within mobile positioning data and are, to different extent, selling insights based on analyses of customer movement patterns. The maturity level varies however as some MNOs have larger divisions which sell more or less standardised reports while others runs exploratory projects with selected partners.

A common denominator seems to be the MNOs view that processing is allowed but anonymization is of essence. The MNOs use different means to make sure the personal privacy of there customers is safeguarded. Normally this is done by working with one or multiple of the following parameters:

- Timespan
- Geographical precision
- Number of units in a specific area

For example, MNOs refrain from sharing statistics on areas where there are less than a certain number of people, this number usually varies from 5 to 20 dependent of the size of the geographical area and for what timespan the statistics concerns. The topic of granularity is further described on the next page.

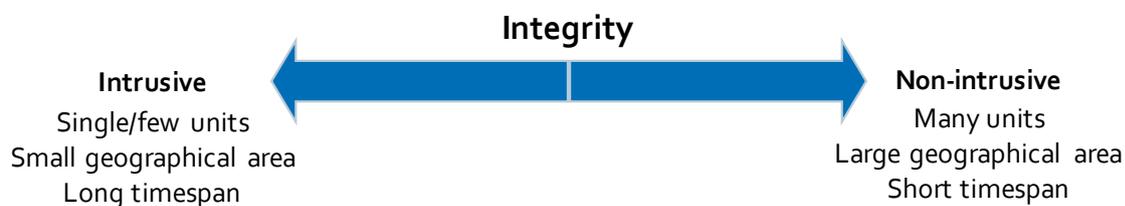
Granularity affects personal integrity

The level of detail of the statistics is closely correlated to how sensitive it is in terms of personal integrity. The personal integrity of the users in the mobile network used for creating statistical reports are to a large degree affected by following:

- number of data subjects in each group
- for how long time the data subject is tracked
- the size of the geographical area that's logged (base station cell vs a region)

One extreme on the scale is where a single data subject is tracked with great precision, reported for example as a cell on a base station, for a long consecutive period of time. Its opposite is when a snapshot is taken on how many data subjects there are in a specific area, for example a municipality or region, and later a new snapshot is taken to identify difference in total amount of data subjects but without any display of which data subjects that has moved where.

Illustration of data granularity's effect on privacy



In general terms, a dataset can only be called anonymized when there is no possibility to identify the data subject by using backtracking.

- Backtracking is a method where de-identified data is decrypted by for example cross-reference with other data sources. In the case of mobile positioning data this could be done by looking where a data subject is situated most of the nights and workhours and then compare it to the civil register and office addresses.

To protect the personal privacy, MNOs often work with pseudonymization and/or anonymization.

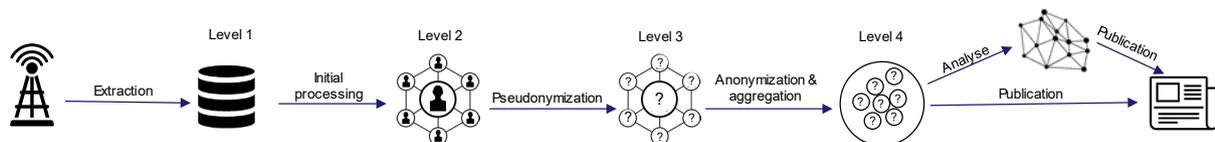
- Pseudonymization is a data management and de-identification procedure by which personally identifiable information fields within a data record are replaced by one or more artificial identifiers, or pseudonyms. Where a pseudonym is used, it is often possible to identify the data subject by analyzing the underlying or related data.
- Anonymization on the other hand, is created by algorithms utilizing one or more of the parameters of timespan, number of units and size of the geographical area, to make it impossible to re-identify the data subject.

In conclusion, it's not sufficient to only substitute the subscriber id (e.g. sim-card number and connected phone number) of the logged events with a random id to ensure the integrity of the unit's owner. Some type of aggregation has to take place to make the data anonymized, which means that the statistics that's published can't be on the extreme end of the scale in terms of detail. Therefore, it's a key aspect to balance the need of detailed statistics with the data subjects right to integrity in such a way that both interests are fulfilled.

Statistics production and the level of sensitivity/granularity

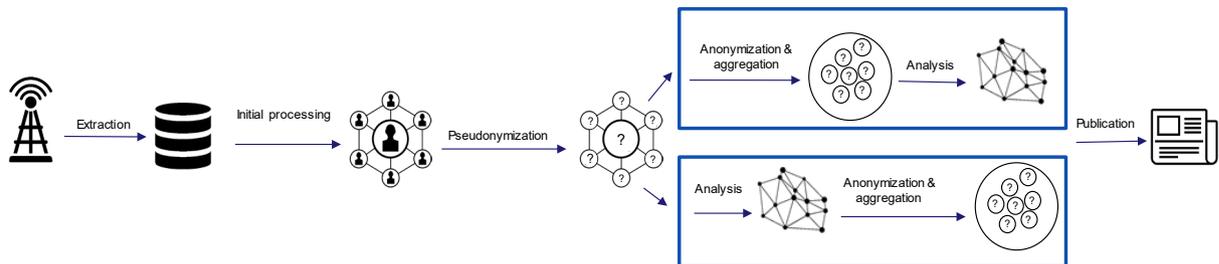
During the production of statistics the data is processed in multiple ways. This changes the characteristics of the data and thereby the level of sensitivity of the data in terms of integrity. The figure and table below describes the characteristics of the data during different stages in the process.

Illustration of the process for statistics production.



Level	Description	Personal integrity	Granularity
Level 1	Raw data from MNOs mobile network. Unique for each MNO, needs formatting and cleaning for SOs to be able to understand and work with the data. At this level the data also contains very business sensitive information about the MNOs network configuration and traffic levels.	Very low	High
Level 2	Raw data are structured, formatted and cleaned in such a way that statisticians could be able to understand and work with the data. Here is a possibility to cooperate with multiple MNOs so the initial processing is done in a similar way and thereby makes it possible to merge data from multiple MNOs.	Very low	High
Level 3	Data are stripped of personal attributes in such a way that the data can no longer be attributed to a specific data subject without the use of additional information. I.e. personal records within the data are replaced by one or more artificial identifiers, or pseudonyms. Indirect identification via back tracing is still possible.	Medium	High
Level 4	Anonymization is created through algorithms utilizing one or more of the parameters of timespan, number of units and size of the geographical area to make it unable to re-identify subjects. At this stage, when the data are not re-identifiable it's no longer considered personal data and are thereby outside of GDPR's scope. Since one or more forms of aggregation have taken place the data are less detailed, it's important to keep the details needed for the specific statistics that are to be produced.	Medium / High	Medium / Low

Statistics production and responsibilities



	Extraction	Initial processing	Pseudo-nymization	Anonymization & aggregation	Analyse	Publication
MNO deliver insights	MNO	MNO	MNO	MNO / 3rd party	MNO/ 3rd party	SO
MNO deliver aggregated data	MNO	MNO	MNO	MNO / 3rd party	SO / 3rd party	SO
SO analyse and anonymize	MNO	MNO	MNO	SO / 3rd party	SO / 3rd party	SO
SO gets raw-data	MNO	SO / 3rd party	SO / 3rd party	SO / 3rd party	SO / 3rd party	SO

1. Both positioning data and other network data are extracted from MNOs' networks.
2. The extracted data are processed to be structured in a format easier to handle.
3. The data are pseudonymized to remove the possibility to direct identification of data subjects.
4. In most cases, there are also aggregations made before further analysis of data. This is illustrated by the upper blue box in the figure.
5. The result of the analysis is published.

If SO are responsible for the anonymization, they could receive non-aggregated data and are thereby able to make the analysis on more detailed data (the lower blue box in the figure). The same technical opportunity exist for the MNO, analysis can be made before the anonymization/aggregation of the data. There are however some uncertainties regarding the legal aspects of processing non-anonymized data (more on this matter in the section about the legal framework).

Eurostat's framework for the processing of Mobile Network Operator data

Eurostat is currently working on a Reference Methodological Framework for the processing of MNO data with solutions to make it easier to merge data from multiple MNOs as well as facilitating the communication between statisticians and representatives from the MNOs, such as network and database engineers.

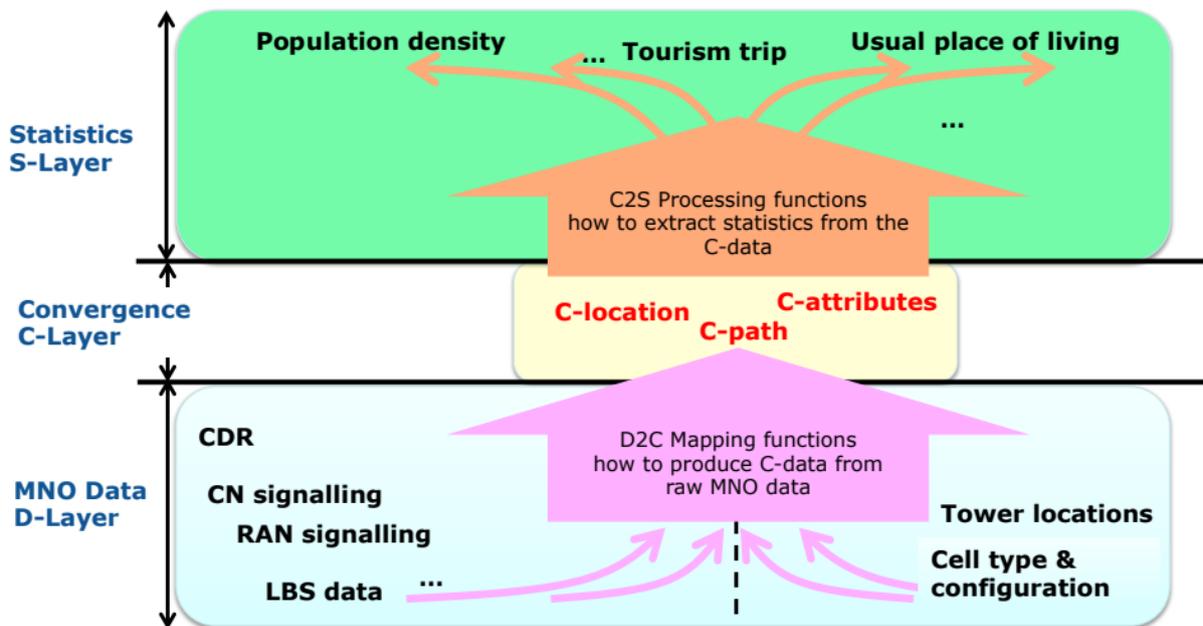
The following text and figure are an extracted from Eurostat paper "Processing of Mobile Network Operator data for Official Statistics: the case for public-private partnerships"¹ which explains how a reference methodological framework could be designed: The design of the RMF is inspired by the principles of "layering" and "hourglass model" that lie at the foundation of the Internet. A key component of RMF is the conceptualization of a unified "convergence layer" (C-layer) between the lower "data layer" (D-layer) and the upper "statistics layer" (S-layer), as depicted in Fig. 1. The role of the C-layer is analogous to that of the Internet Protocol in the Internet: by providing a logical interface between the upper and lower layers it effectively decouples them, enabling their independent development and evolution. A parsimonious number of common data structures are defined in the C-layer whose semantic should be (i) simple enough to be understood by experts from both knowledge domains; and (ii) general enough to capture the information relevant for SO across different kinds of MNO data (CDR and signalling data), different technologies (2G, 3G, 4G and in the future also 5G) and different network-specific configurations.

1. Fabio Ricciato, EUROSTAT Big Data Task Force, Freddy De Meersman, Proximus (2018), Processing of Mobile Network Operator data for Official Statistics: the case for public private partnerships, link.

With the C-layer in place, statisticians can then focus on the development of statistical methodologies in the S-layer (including inference, aggregation, record selection etc.) taking in input C-layer structures, while telecom engineers can focus on the transformation of their raw network data into C-layer structures.

Thanks to the common format of C-layer structures, algorithms and processing components that are developed at the S-layer by one institution (e.g. a national statistical institute or university research team) can be adopted by other institutions and/or run on data from other MNOs. In this way, the RMF will contribute to grow an “ecosystem” for the development, exchange, validation and adoption of software components for processing MNO data across different organizations.

Illustration of methodological framework for statistics production and cooperation



Secure multi-party computation

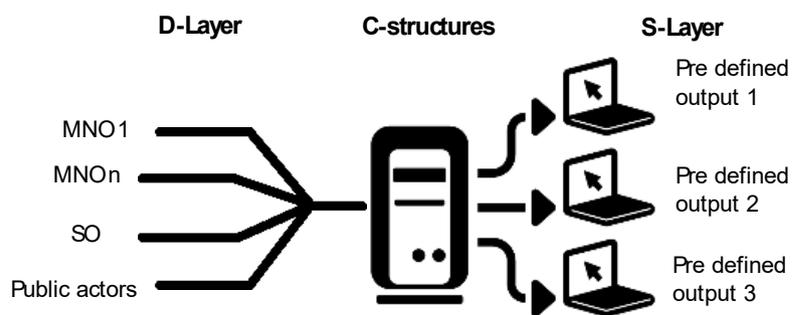
Eurostat's paper "Processing of Mobile Network Operator data for Official Statistics": the case for public-private partnerships"¹ is handling the question of how a database and the process of analysing the data could be managed when its preferable to conduct joint processing of input data from multiple MNOs. Eurostat propose the use of a Secure Multi-Party Computation (SMPC) methods, which makes it possible to "process confidential input data across administrative domain (e.g. MNOs and SOs) without disclosing the input data nor leaking any related information other than the desired output". In summary, a SMPC makes it possible to let one party do the analysis of another party's data without the possibility to see or extract the data itself. The party making the analysis is only able to extract the in advanced agreed output-information.

This would make it possible to merge data from multiple MNOs as well as from other sources, such as both open and secure data from public actors. In this way, MNOs could get a value in return for their participation (statistics and benchmarks providing insight to their current situation and market opportunities). A prerequisite is that data from different sources are structured in the same way.

¹ Fabio Ricciato, EUROSTAT Big Data Task Force, Freddy De Meersman, Proximus (2018), Processing of Mobile Network Operator data for Official Statistics: the case for public private partnerships, link.

SMPC could also be a solution to the issue where MNOs are less willing to share low-level data since it could decrease the demand for their products (i.e. reports on movement patterns). By clearly stating what output SOs can get, and thereby are able to publish, the possibility of a sustainable MNO/SO relationship increases.

Illustration of secure multi-party computation



The figure exemplifies “the Reference Methodological Framework for the processing of MNO data” which is under development by Eurostat and presented on slide 16. The D-layer is the MNOs domain and handles network data, while the S-layer is used by the SOs to analyze the data. The middle layer (C) is used to map the data layer to functions and demands in the S-layer, creating a common ground that can be understood by experts within both domains.

The General Data Protection Regulation

The General Data Protection Regulation (GDPR) came into force in all EU and EEA countries during May 2018, and regulates data protection and privacy for all individual citizens in those territories. The GDPR is considered by many experts to be an important step in catering for the individual integrity. GDPR applies any to personal data and mobile positioning data in its raw form is personal data. As such, any MDP statistics project should presume that GDPR will apply.

‘Personal data’ means any information relating to an identified or identifiable natural person (‘data subject’); an identifiable natural person is someone who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person.

Article 5(2) states that data processing is lawful when “processing is necessary for the performance of a task carried out in the public interest or in the exercise of official authority vested in the controller.”¹

As long as the processing and publication of mobile positioning data-based statistics is deemed to be in the public interest, GDPR provides a lawful basis for such activities.

1 GDPR, Article 5 - <https://gdpr.eu/article-5-how-to-process-personal-data/>

Article 89(9) regulates the processing of personal data for statistical purposes: It states that safeguards shall be put in place to ensure "that technical and organisational measures are in place in particular in order to ensure respect for the principle of data minimisation."¹ This means that one can only process data that is necessary to achieve a specific purpose.

Article 4(5) of the GDPR defines pseudonymization as "the processing of personal data in such a way that the data can no longer be attributed to a specific data subject without the use of additional information."²

Pseudonymous data still allows for some form of re-identification (even indirect and remote), while anonymous data cannot be re-identified. In that case, when data are anonymized, it will no longer be considered personal data and are outside of GDPR's scope.

1 GDPR, Article 89 - <https://gdpr.eu/article-89-processing-for-archiving-purposes-scientific-or-historical-re-search-purposes-or-statistical-purposes/>

2 GDPR, Article 4 - <https://gdpr.eu/article-4-definitions/>

European Statistics Code of Practice

Through their membership of the European Free Trade Association (EFTA) and the European Union (except Norway) the so-called "European statistics Code of Practice" apply to the Nordic countries. In this document, official statistics is defined using three criteria:

- Statistics describing on a representative basis phenomena of public interest to policy makers, the economic agents and the public at large.
- They are developed, produced and disseminated by the statistical authorities in compliance with the provisions of the Union and national law and the European statistics Code of Practice/National Codes of Practice.
- They shall be referred to as 'official statistics' in the statistical programme.

Review of the Norwegian and Swedish Statistics laws shows that they include a clear legal mandate for the authorities to collect data for statistical purposes from private enterprises such as MNOs. Information from the other Nordic countries indicates that the statistics law gives a similar mandate.

However, it should be noted that it is unclear how far reaching the mandate is. Indications from one SO suggests that the mandate makes it possible to request data on company information, e.g. number of customer and sales, but not detailed information about the customers and their behaviour.

Mobile positioning data in a Nordic context

- Tourists use their mobile phone frequently when travelling
- Mobile positioning data can show over night visits but can't replace accommodation statistics
- Nordic stakeholders in mobile positioning data
- Mobile Network Operators are present in multiple Nordic countries
- Finding a way forward - Business Models
- Business model design depend on the type of statistics
- Four levels of data and business model complexity
- Moving forward on the legal issue

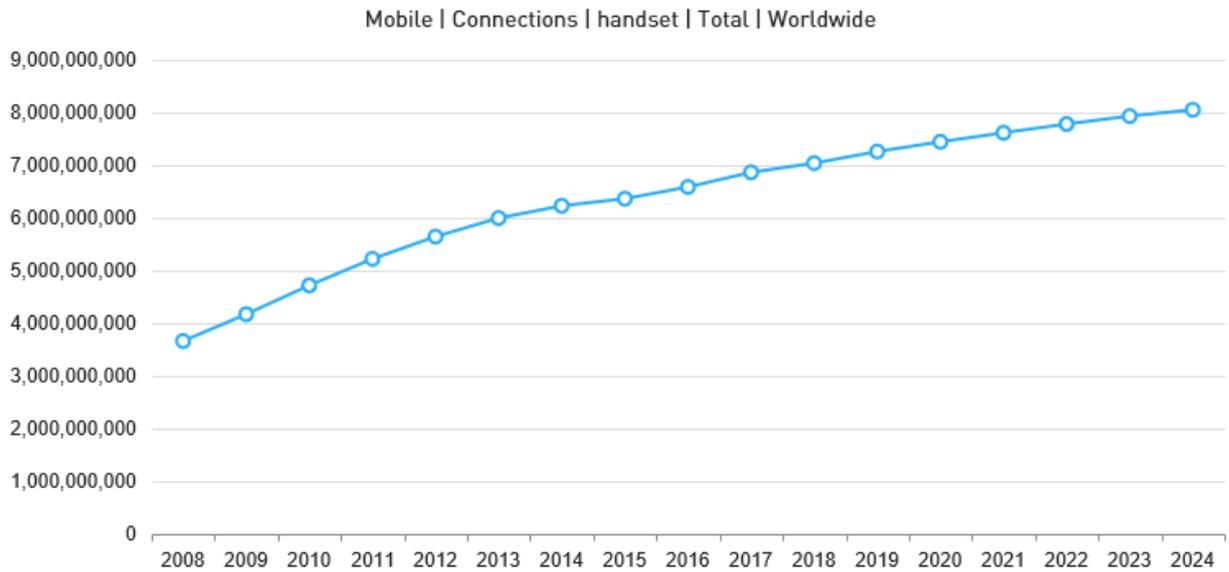
Tourists use their mobile phone frequently when travelling

The number of connected headsets (mainly mobile phones) are rising worldwide and Analysys Mason predicts that the number of connected headsets worldwide will increase from today's estimate of around 7 billion to 9 billion in 2023. The Nordics markets are saturated since early 2010s, with number of connected headsets steadily above 100% of population.

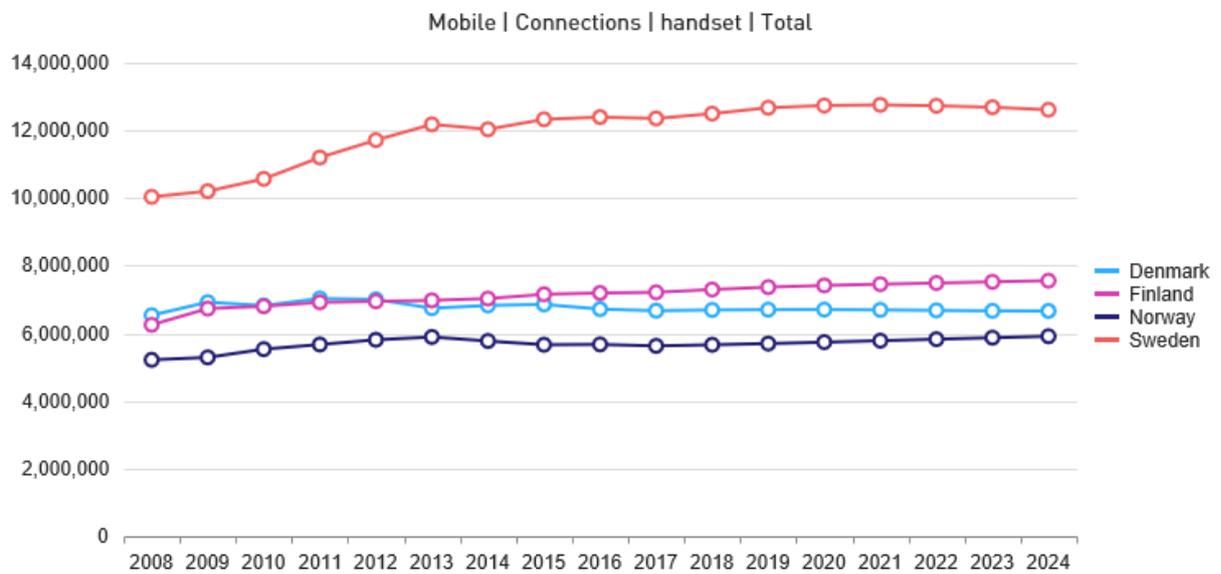
In 2018¹ Analysys Mason analysed real-world smartphone usage data to answer questions about mobile usage when roaming. The results showed that overall smartphone engagement levels were similar when abroad and at home. In numbers, the average time spent on smartphones was 150 minutes per day while abroad and 155 minutes per day while at home. Hence, people in general do not turn off their devices when travelling abroad. Rather, screen time usage of both map and camera applications increased while abroad compared to at home. This indicates that mobile phones are an integrated part of travels, partly replacing earlier separate equipment such as maps and cameras.

In summary, tourists' active use of mobile phones when travelling supports further work on developing strategies and processes for how to use MPD to produce tourism statistics.

¹ Analysys Mason, (2018), Consumer smartphone analytics: roaming usage, link. ² Data extracted from Analysys Mason's DataHub with telecom statistics and forecasts



Source: Analysys Mason



Source: Analysys Mason

Mobile positioning data can show over night visits but can't replace accommodation statistics

MPD consists of logs of activities for a device, such as calls, texts, data usage and information on the device entering and leaving an area. Every activity is logged with date, time, and which cell the device is connected to. The positioning accuracy is thereby determined by the size of the cell in question. This can be a radius of 50-100 meters in urban areas and 1000 meter in rural areas.

From a technical viewpoint, MPD is suitable to use when producing statistics of movement patterns from one area to another. By combining MPD with location data on for example roads, streets and tourist attractions it is possible to gather information on paths travelled and sites visited. Given the level of precision, or rather lack thereof, MPD are not suitable to produce statistics where the location of the subjects need to be exact.

MPD may thereby be useful to track the number of day and/or night visits in a certain area. MPD can however not be used to determine at which hotel (an owner of) a mobile phone spends the night. There are hence limitations in how much of the current tourism statistics that may be replace by MPD.

There are methods to enhance the precision of MPD, such as active positing and more detailed analysis of signal-strength. However, the high cost and complexity associated with these options make them challenging to use for the purpose of producing official tourism statistics.

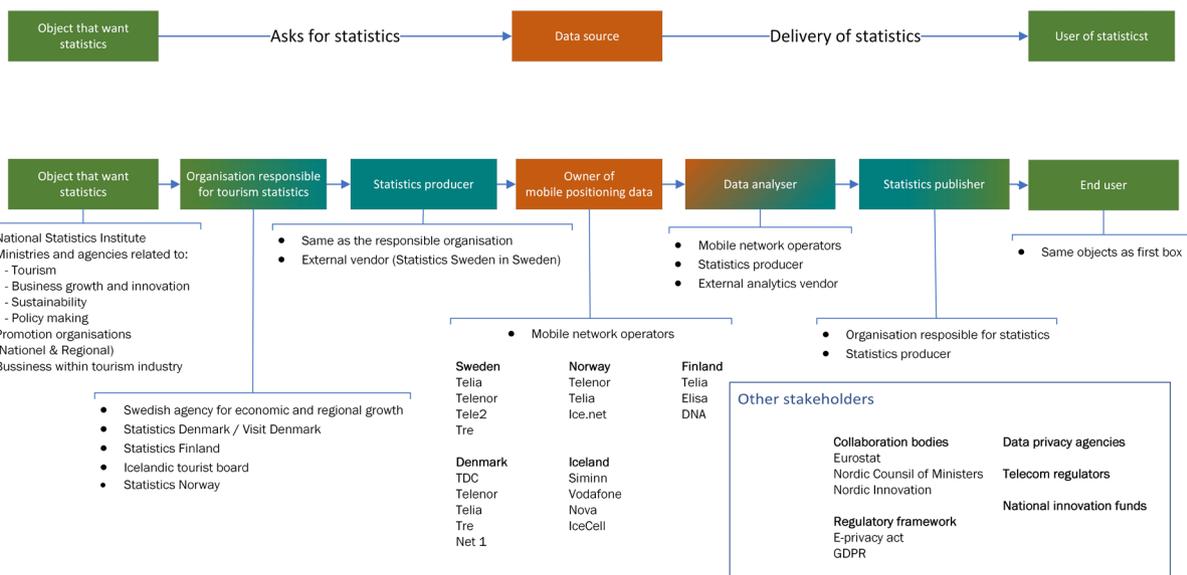
MPD is not as exact as GPS-positioning

All mobile phones are today using GPS for navigation services, with a precision of about 5-15 meters. This is however difficult to use as a source for official tourism statistics since historical GPS-data per default isn't saved in such a way that SOs can access it. This kind of data is mainly saved in applications that the user have installed on the phone.

If SOs would like to use GPS-data for statistical purposes, they either need to convince tourists to install a certain application to which the SO has access, or buy data from companies whose application is already installed on the user's phone (e.g. Google Maps or Facebook).

This study focuses on MPD and the possibilities and challenges with using GPS-data are therefore not further explored.

Nordic stakeholders in mobile positioning data



Mobile Network Operators are present in multiple Nordic countries

Several MNOs operating in the Nordics have a market presence in more than one country. In general however, the MNOs have a separate legal entity in each country and it varies between the MNOs how closely they cooperate with their Nordic counterparts. In terms of using MPD for producing tourism statistics, working with an MNO present in multiple countries could ease coordination efforts.

The operators present in the Nordic countries are:

Sweden: Telia, Telenor, Tele 2 and 3

Norway: Telia, Telenor, Ice

Denmark: Telia, Telenor, TDC and 3

Finland: Telia, Elisa, DNA

Iceland: Siminn, Vodafone, Nova

The MNOs in the Nordic countries are currently looking at business models for usage of MPD and some have already such products on the market. Several MNOs have structures in place for processing and analysing MPD. In addition, since MPD usage is field under development, MNOs are generally open to, and interested in, new services and cooperation.

Finding a way forward - Business Models

When MNOs are trying to monetise their positioning data their primary interest is the intersection between the top left circle and the bottom circle (see figure to the right). This is the area where they have information that potential customers are willing to pay for. This is primarily highly specific or detailed information. To prevent competition or revenue loss, MNOs are likely to be reluctant to share this data with SOs. Alternatively, they are likely to charge a high price. The area where all three circles intersect is therefore the most complex in terms of business relationships.

The area where only the two upper circles intersect would on the other hand be a suitable place for SO and MNO cooperation and/or business relationships. This area represents information based on mobile positioning data that MNOs do not aim to sell directly to customers, but that is of value for the production of official statistics.

To make advancements and foster sustainable relationships, future mobile positioning data initiatives may gain from focusing on producing statistics within the dotted line: "Official statistics based on mobile positioning data that don't compete with MNOs' products". Preferably, this area should be defined in close dialog between MNOs and SOs, presumably also tested during a use-case.

Preferably, SOs should clearly distinguish between what data they need to make the analysis and what data/insights they are to publish. There are indications that MNOs are willing to share data on a lower-level if they are assured that the published data will be on macro level.

On way to give MNOs control of what data and insights that are published, even if they give SOs access to low-level data, is through secure multi-party computation, (see page 29).

Illustration of intersection between different information demands



Business model design depend on the type of statistics

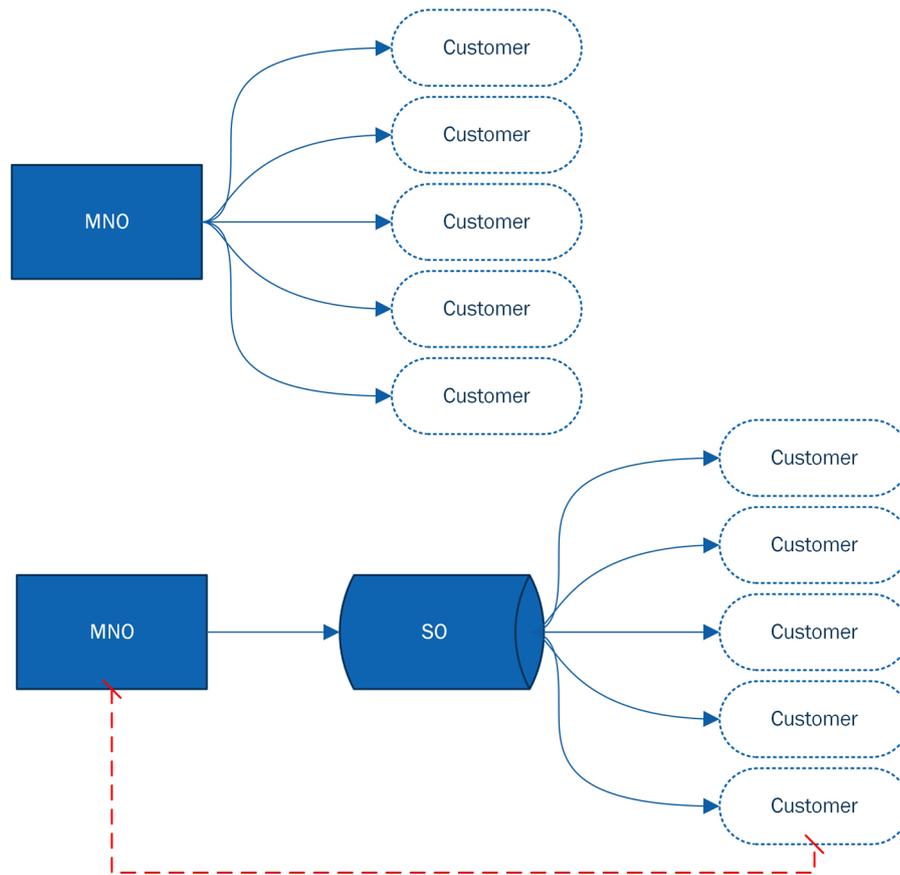
The process of producing statistics varies greatly depending on what statistics to be produced.

- When official statistics is the goal the process is rather complex, this is due to the fact that multiple MNOs might have to be involved and the SOs have high demands on transparency.
- If it's business insights that are the primary focus, the process is fairly straight forward and many MNOs have processes in place to deliver insights to buyers.

The main difference in the two cases 'Official statistics' and 'Business insights' is that in the first SOs need access to actual data. This may create a situation where the SO is able to make analysis and draw conclusion which may compete with products MNOs find interesting to sell. The differences between the two cases 'Business insights' and Official statistics' hence requires different designs in terms of business models.

- Business insights: Since there is no sharing of data the MNOs sells standardised or customised reports for a specified area/subject directly to the end-user. This makes it possible to sell insights to a wide customer base, a business model also know as 'one to many'.
- Official statistics: SOs need data or analysis covering a large area or wide topic. This may lead to the MNOs being reluctant to share low level data, or asking for a (too) high price to compensate for potential revenue loss.

Illustration of differences in business models dependent of who is the customer



Moving forward on the legal issue

The result of this feasibility study suggests that the easiest solution for SOs to incentivise MNOs is to point out the learning potential for MNOs by having statistics experts working with their data, provided that the SOs share findings and/or pay for data. This suggestion is mainly based on the two following two aspects:

- It is unclear if the SOs have a legal mandate to demand secondary data from MNOs.
- Voluntary participation and mutual interest will likely benefit an efficient and sustainable cooperation between MNOs and SOs, and thereby also facilitate fast advancements in terms of mobile positioning data use for tourism statistics.

To access data quickly, SOs could cooperate with MNOs in such a way that the transferred datasets are anonymized via a transparent and commonly defined procedure. This removes the barrier of MNOs being reluctant to share data because they are concerned with the legal framework and to protect the privacy of their customers.

In the long run, it would be beneficial for all parties to get a clearer understanding of practical implications of the legal framework. The two questions listed to the right are identified as key questions to investigate and solve.

Key questions in relation to the legal framework

1. Does the European Statistics Code of Practice give SOs a mandate to demand mobile positioning data (i.e. secondary data) from MNOs? If not, how could the framework be changed?
2. Does the European Statistics Code of Practice and GDPR allow for MNOs to share personal data (non anonymized mobile positioning data) with SOs? If not, how could the framework be changed?

This feasibility study shows that there are no generic answers to these questions. The opportunities, obstacles, and solutions varies depending on the use-case and the principle of data minimization have great impact of what's allowed to be shared. Therefore, the key questions need to be dealt with by running an exploratory, use-case, project.

Project proposal

- Overview of the project proposal
- Illustration of the project proposal
- Description of the project proposal
- Nordic network for knowledge sharing and coordination of mobile positioning data initiatives
- A use case is proposed to answer key aspects
- Clarify and challenge the legal framework
- Establish sustainable and efficient business models
- The long run vision: A Nordic Datahub

Overview of the project proposal

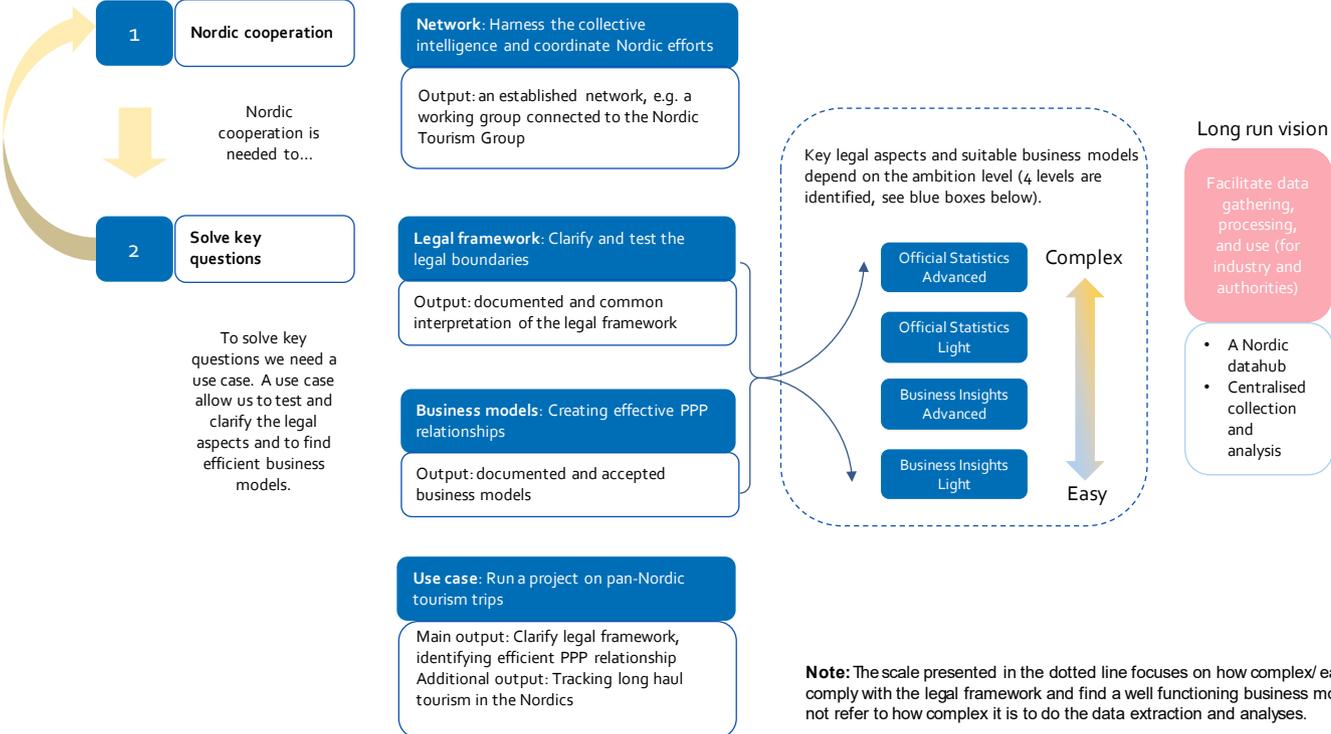
The proposed project is structured to improve knowledge sharing and to solve two key areas that, when solved, will have a great positive impact on future work within mobile positioning data for official statistics.

This feasibility study clearly shows the need of continued and developed Nordic cooperation. This is preferably managed through a structured network facilitating knowledge sharing and joint projects.

Further, the feasibility study indicates the need to solve key questions related to the use of mobile positioning data in relation to tourism statistics. This includes issues connected to the legal framework since the law imposes different possibilities and obstacles depending on what statistics is to be produced. The same goes for the business models, where the design varies depending on the type of statistics requested. Since no generic solutions with regards to these two issues exists, an exploratory use-case is crucial.

The ambition levels within the dotted frame in the figure are presented on page 60. They symbolize that solutions to the key questions differ depending on the kind of statistics to be produced. This highlights the fact that the solutions must be developed with the end-use in mind.

Illustration of the project proposal



Description of the project proposal

The project proposal is based on two levels where each level builds a foundation necessary for the next level. Information and learnings flow between the levels creating an iterative process and a learning eco-system.

Level 1: Nordic cooperation

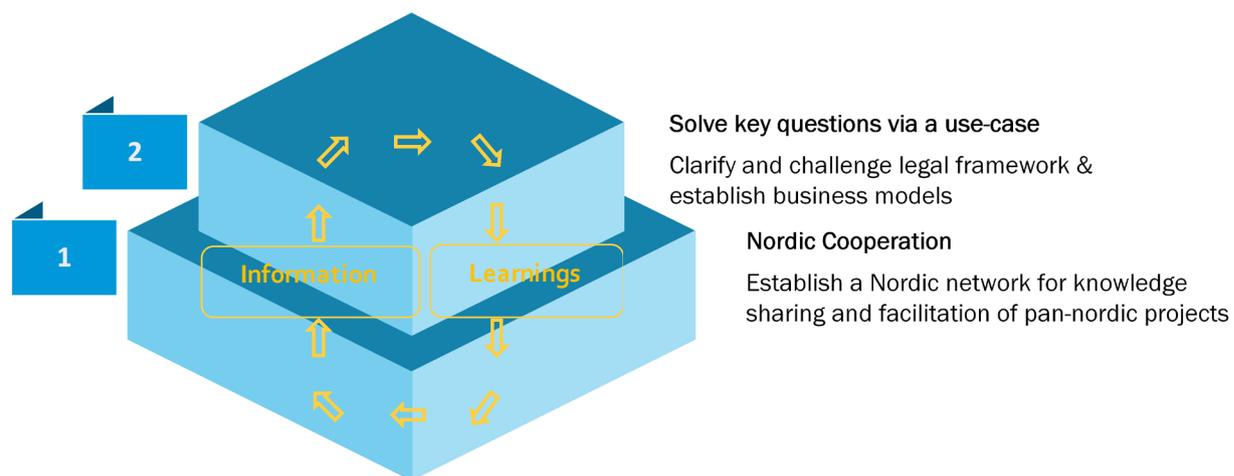
The feasibility study shows a clear need for a Nordic platform to foster cooperation and knowledge sharing. This need of structured cooperation has been unanimously mentioned by respondents in the study. The proposal therefore includes a detailed plan for establishing a Nordic working group, possibly associated to the current tourism working group* for the Nordic council of ministers. The aim of the cooperation is twofold: to facilitate a network for knowledge sharing, and to coordinate common Nordic initiatives on mobile positioning data.

Level 2: Solve key questions via a use-case

Examination of the legal framework and discussing potential PPP business models with key stakeholders clearly shows that there are no generic solutions to these issues. Opportunities, obstacles, and solutions vary depending on the use-case. Therefore, the key questions need to be dealt with by running an exploratory, use-case, project.

The main purpose of this use-case is not to produce statistics but to solve and document obstacles and solutions in terms of the legal framework and sustainable business models. The use-case is hence used to establish the infrastructure for future work on mobile positioning data. In line with respondents' requests, the use-case is suggested to focus on intra-Nordic travel. Next level of delimitations could entail Nordic tourists movement patterns, or pan-Nordic travels by long-haul tourism.

Illustration of how information and learnings flow between the two levels



Nordic network for knowledge sharing and coordination of mobile positioning data initiatives

Why this focus?

- Most of the initiatives within mobile positioning data for tourism statistics are run independently by actors in different countries. Even within the same country there are limited relationships between different organisations running mobile positioning data projects.
- Today there are no natural platforms where organisations and individuals get together and share their knowledge with regards to difficulties and solutions related to mobile positioning data.
- Involved stakeholders have appreciated the relationships facilitated through this feasibility study, and have asked for a network where they can continue the dialog.
- There are multiple projects ongoing, or about to start, on mobile positioning data. These are initiated and owned by different organisations. A well-structured network could both be a knowledge centre where these actors can become aware of pitfalls and solutions as well as a natural place to share learnings and initiate and manage joint projects.

What to achieve?

- Establish a network for knowledge sharing and coordination of joint Nordic initiatives on mobile positioning data
- Setting a structure and framework for the network
- Decide ownership and define key roles and responsibilities
- Secure initial and continued funding

How does it impact the overall development of mobile positioning data usage?

- Accelerates advancements within the field since the separate learnings are collected and added to a collective intelligence.
- Serves as a source of inspiration in terms of possibilities and advantages with mobile positioning data.
- Builds relationships that can reveal possibilities to run projects in cooperation between different organisations and countries.

A use case is proposed to answer key aspects

Why this focus?

This study finds that there are no generic solutions to the key questions raised. This is due to the complexity of multiple aspects, such as the legal framework, technical factors, and organizational and commercial elements. Therefore, the key questions need to be dealt with by running an exploratory, use-case, project.

By clearly defining the statistics to be produced it becomes possible to investigate legal opportunities and obstacles. The analysis can provide clearer answers when the questions is “Can we do (exactly) this?” rather than the more general question “What might we be allowed or not allowed to do?”

The same reasoning applies to business models. It will be easier to set up an efficient and constructive dialog between SOs and MNOs if discussing a concrete case rather than a hypothetical situation.

By choosing to focus on intra Nordic-travel there is also a clear advantage for Nordic countries to work together rather than producing statistics and solving obstacles individually.

What to achieve?

Main:

- Solve the key questions regarding legal framework and business models by a use-case.
- Establish infrastructure for Nordic cooperation on mobile positioning data.

Secondary:

- Statistics of the decided use-case, for example intra-Nordic travel patterns.
- Cooperation with, and analysis of data from, multiple MNOs.

How does it impact the overall development of mobile positioning data usage?

- When solutions are found and documented the learnings can be spread within the Nordic countries and act as a stepping stone for future projects. Even if the solutions might not be exactly the same, there will be a starting point from where advancements can be made in a higher speed than before.
- In essence, this is a light-version of the vision of creating a Nordic datahub. When completed there will be a solid foundation to expand within other areas of tourism statistics.

Clarify and challenge the legal framework

Why this focus?

- There is an extensive and complex legal framework related to the use of mobile positioning data for statistical purposes. The practical implications of the framework are ambiguous and interpreted differently by different stakeholders.
- The MNOs may be reluctant to share raw or pseudonymized mobile positioning data. If they can process the data and share it once it's anonymized through aggregation they may be more interested sharing data.
- At what aggregation level data can be seen as anonymized varies between MNOs.
- The methods and algorithms to achieve anonymization also varies greatly between MNOs.
- Some SOs are unclear about the details of the legal framework. By gaining clarity they will have a stronger position in the dialog and negotiation regarding data and/or insights sharing.

Comment: Several SOs points out that it may be sufficient to receive aggregated data for a majority of the statistics in focus in the short run. However, in the future when more advanced statistics is in focus, it could be problematic not to have access to non-aggregated data. advantage for Nordic countries to work together rather than producing statistics and solving obstacles individually.

What to achieve?

- Clarify the understanding of how mobile positioning data is allowed to be used for official statistics.
- Clarify the legal grounds for SOs to demand data from MNOs.
- Above should be done on a Nordic level to make it possible to combine data from all the Nordic countries.

How does it impact the overall development of mobile positioning data usage?

- Removing uncertainty regarding the legal aspects will support advancements within the field.
- Clarifying what's allowed and not may facilitate the relationship between SOs and MNOs.
- The results of this project would have a major impact since it affects all the other activities within the area.

Establish sustainable and efficient business models

Why this focus?

- There is a discrepancy between MNOs interest in selling data (one-to-many) and SOs interest in getting data and then publish to many.
- There are multiple ways to solve this, including:
- SOs could try to use their legal mandate to access the data
- SOs pay a (very) high fee to access the data
- Data access can be conditioned so that SOs only publish statistics that MNOs find less interesting from a commercial standpoint.
- The preferred business model and how willing MNOs are to share data or insights depend to a large degree on the statistics being produced, therefore this need to be investigated through a use-case.
- Different SOs have different experiences, both positive and more challenging, of working with MNOs.

What to achieve?

- Find a business model that's a win-win for both SOs and MNOs
- To reduce the risk that SOs compete with MNOs' statistics products, and thereby lessen MNOs' initiatives to participate in joint projects, this project should identify risk areas and efficient solutions.

How does it impact the overall development of mobile positioning data usage?

- Removing uncertainty on payment models and long-run profitability facilitate MNOs' operations and may thereby increase the advancement of the field.
- A joint Nordic project facilitate new and efficient learnings and create a space for sharing of knowledge and experience.
- Presenting a tested model for how MNOs get return on their involvement will facilitate efficient and sustainable MNO/SO relationships.

The long run vision: A Nordic Datahub

Why this vision?

- Interviewed SOs have all expressed an interest in a centralised unit where data from all the countries is analyzed and made available to all.
- It would be resource efficient to centralise parts of the production of statistics since it both could achieve economy of scale as well as avoiding that the same statistics are being produced by multiple countries.
- A common Nordic datahub is also in line with the Nordic Council of Ministers' plan for Nordic tourism co-operation 2019-2023 where more structured collaboration is proposed to improve the quality and comparability of data for national policymaking, simultaneously providing possibilities for common Nordic statistics and analysis projects.

Project proposal

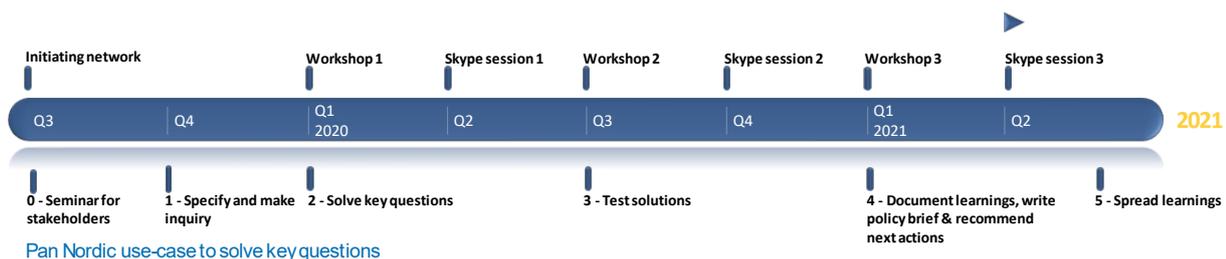
- Timeline and activities

- Timeline
- Network for Nordic cooperation on mobile positioning data for tourism statistics
- Time and activity plan for the Nordic Network
- Solve key questions by a use-case
- Time and activity plan for solving key questions

Timeline

The proposed way forward consists of two parts. The parts may be run independently but reinforces each other if executed simultaneously. The result of the feasibility study indicates the need of a Nordic network devoted to tourism statistics based on mobile positioning data (upper road in illustration) and a project to clarify and challenge the legal framework as well as test and establish sustainable business models for public-private relationships (lower row).

Further details, including a time and activity plan, for the two parts are presented on the following slides. Considering the high pace of development within the field of mobile positioning data and the momentum built through this feasibility study it would be beneficial to start the projects as soon as possible. Preferably, the initial activities take place in late Q3 2019 and the main project kicks off in Q4 2019 or Q1 2020.



Network for Nordic cooperation on mobile positioning data for tourism statistics

Participants. It is recommended that the network includes representatives from each country's agency for tourism statistics and, if it is not the same agency, the agency for producing statistics. A natural starting point would be the same organisations, and possibly the same individuals, that have been part of this study's Nordic expert group. The participants should preferably be given mandate to invite other representatives from their own organization or other national actors of relevance. In addition, a broader spectrum of stakeholders need to be involved, either permanently or more likely when certain topics are discussed. These are primarily MNOs and regulatory instances.

Structure. In order to balance the need of regular gatherings to keep the network alive and well informed about the high pace of development within the field of mobile positioning data, and at the same time respect the busy agendas of the participants four meetings a year are proposed.

The meetings are suggested to alternate between physical meetings and on line sessions due to the fact that:

- Physical meetings builds stronger relationships and creates a foundation for effective cooperation.
- Skype sessions are a more sustainable form of meeting with regards to the carbon footprint.
- Skype sessions are more effective in terms of time and costs.

The physical meetings are suggested to rotate between the participating countries. These meetings are preferably longer to allow for both the network meeting and presentations or workshop discussions on specific themes.

Ownership and management. The ownership and structure for long-run persistence should be a key concern at the network meetings. There are several ways of organising the ownership of this kind of network. Chairperson and overall responsibility for the network may rotate among the countries. Alternatively, a secretariat, presumably connected to one of the participating organisations, could take on the task of managing the network. During the initial, setting up, stage it may also be reasonable to out source the management and administration of the network to a third party. Regardless of which model that is chosen, it is important to find a suitable and sustainable solution for managing the network.

Platform for communication. The purpose of the network is to promote communication and knowledge sharing, and to enable joint Nordic projects. Hence, there is a need for a platform where participants can easily communicate, share news and documents, and search for knowledge (such as reports). Microsoft SharePoint is one solution that connects well with the office suite and a site within its framework should feel comfortable and recognisable for most users. Slack and Team are other alternatives. There are many technical solutions, the importance is to choose a low threshold solution.

Relation to existing groups/networks. Firstly, the network is recommended to function as an expert committee for the proposed use-case project. Secondly, it is important that the network align its activities with, and make efforts to cooperate/relate to, existing working groups, networks and events. This could for example be: Nordic council of ministers working group for tourism strategy, Nordic statistics group, Nordic analytics meeting, Nordics statistics summit, Nordic tourism conference.

Solve key questions by a use-case 1(2)

A use-case project is proposed to clarify and challenge the legal framework's practical implications, as well as test suitable business models between MNOs and SOs. The primary output of the use-case project is documented findings to be shared with other stakeholders and identified next actions of how to further advance. A secondary output is the statistics generated on intra-Nordic travel. At some level this project involves more or less every organisation listed on page 38, including but not limited to:

- SOs
- Agencies responsible for tourism and tourism statistics
- MNOs

Project management is preferably constituted by a team with strong process management skills, and complementing expertise including Nordic cooperation, mobile positioning data, statistics, and business development.

Steering committee preferably include people with decision power in terms of relevant issues such as initiating and funding mobile positioning data projects on a Nordic level.

Expert committee preferably includes some, or all, of the participants in the Nordic network on mobile positioning data for tourism statistics. This would in a natural way involve key stakeholders to make sure their interests are taken into account as well as keeping them up to date on advancements within the field.

Reference group including relevant perspectives such as the tourism business community and data protection agencies.

Solve key questions by a use-case

2(2)

The proposed use-case project may be sectioned into 5 phases:

- Specify and make inquiry to MNOs. This phase consists of in-depth dialog with SOs and MNOs to concretise the statistics that are requested as well as what can be delivered. The main objective is to find aspects where the legal framework, or the interpretation of it, hinders the production of requested statistics.
- Challenge the legal framework and test business models. Based on results from phase one, perform an in-depth review of the legal framework. The analysis should also include recommendations on how to solve obstacles and move forward. The in-depth review is complemented by a workshop where both regulatory instances and MNOs participate. Parallel to the legal review, dialogs with MNOs take place to identify suitable business models for the use-case. The phase ends with decision on which MNOs to move forward with.
- Test solutions. MNOs run their internal processes and deliver agreed information (datasets). SOs make their analysis and possibly share or publish the produced statistics.
- Document learnings and write policy brief. Through workshops and analysis, learnings are identified and documented. A policy brief is written, including recommending next actions, as well as a practical and hands-on guide to be used by stakeholders.
- Spread learnings. Presenting to all stakeholders what was learned and potential implications for different actors, knowledge sharing through conferences, workshops, meetings etc.

Overview of the five phases in the proposed use-case project.



Contact

Swedish Agency for Economic and Regional Growth

Sofi Sjöberg, sofi.sjoberg@tillvaxtverket.se

Appendix

- I – Mobile positioning data initiatives in the Nordic countries
- II – Data demands for tourism statistics

Appendix I: Mobile positioning data initiatives in the Nordic countries

There are many finalised and ongoing initiatives with regards to mobile positioning data in the Nordic countries. Below follows a sample of interesting project on the subject:

Statistics Finland: Usage of mobile positioning data to measure outbound tourism shows promising results, especially as a secondary source to verify survey results. Data is provided on a quarterly basis from one MNO.

Visit Denmark: Mobile positioning data from one MNO was used to identify different categories of visitors from Sweden, commuters, through-travelers, one day visits, and over night visits.

Femern A/S: Used mobile positioning data as a secondary source to identify the expected transfer of car traffic from the Great Belt and the newly generated traffic when building a fixed link over the Femern Belt.

Statistics Norway: Is currently conducting a pilot project where they get access to mobile positioning data measurements on inbound tourism on small areas (Grunnkrets", around 14 000 different areas in Norway).

Swedish agency for Transport Analysis: Conducted two pilot projects together with a university where the goal was to find patterns within 1) Long-distance travels, 2) Short-distance travels.

Statistics Sweden: Will probably get anonymised mobile positioning data from one MNO autumn 2020. Statistics Sweden has processes in place to explore how to incorporate new data into the ordinary statistics and will handle mobile positioning data in the same way.

Icelandic University: Conducted a pilot project where the dataset comprised snap-shots taken twice a day of the number of people in specific areas.

Uppsala University: Researchers at the university have, under strict confidentiality and safeguards in place, access to mobile positioning data from a Swedish operator. One study analysed cross-border movements at Svinesund.

Fredrikstad: Analysis of how mobile positioning data could be used to identify visitors at different tourism spots and track number of visitors during different times of the day.

Arctic-365: Used mobile positioning data to identify number of visitors, and got confirmation of the general feeling that number of visitors were increasing even if the accommodations statistics showed decreasing numbers. People were simply using alternative housing options not caught by the official statistics.

Eurostat: Has written multiple papers as well as financed pilot projects. For now their focus is on making long term studies possible by finding sustainable business models and technical solutions for cooperation with MNOs.

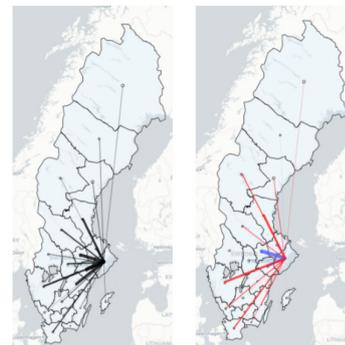
- The majority of the MNOs have initiatives ongoing regarding the use of their mobile positioning data. The MNOs have reached different stages in their development and have a wide range of projects ongoing, some with the aim to monetize and others to explore possibilities.

Appendix I: Mobile positioning data initiatives in the Nordic countries

Key highlights - Sweden

- The Swedish agency Transport Analysis has carried out a project in order to identify alternative collection methods and data sources. Within the project, two pilot studies were conducted within the areas of 1) short distance travels and 2) long distance travels (image below). There is no active project today. Key areas to solve are how we can make sure the SOs get insight to how the mobile positioning data becomes statistics, and how the confidence interval can be calculated. Questions of interest are the transportation flows, what long-distance travel patterns look like, and what means of transportation is used.
- The Swedish Agency for Economic and Regional Growth is interested in utilising the possibilities mobile positioning data offer. As for now, one area of interest is to use mobile positioning data as a complementary data source for current surveys, for example strengthening the data given by accommodation statistics. One-day visits is another area of interest where the agency has identified that mobile positioning data may have potential. The agency is also interested in looking into how mobile positioning data could be used to ease the administrative burden for organizations reporting accommodation statistics to Statistics Sweden.
- Statistics Sweden is about to start an exploratory project with one of the main MNOs in Sweden. Statistics Sweden's well-defined process of how to try-out new data sources will be applied to the case of mobile positioning data. The initial work will focus on finding suitable areas where mobile positioning data can be used, tourism statistics could be one of them. The data in question will be aggregated, but this is according to Statistics Sweden not an issue.

Images from the study of long-distance travel from Stockholm based on anonymized and aggregated mobile positioning data



Appendix I: Mobile positioning data initiatives in the Nordic countries

Key highlights - Denmark

- Visit Denmark has a responsibility for tourism statistics and has run a project together with an MNO, analysing Swedes visiting Denmark. On an aggregated level, it was possible to identify how many of each of the categories described in the figure on the right who visited Denmark. In addition, it was possible to identify where they entered and exited the country. Safeguards were put in place to ensure that no single individual could be identified. The precision of the statistics was satisfying but there were some challenges in finding a sustainable business model. The MNO also raised concerns about how to make sure the statistics in future, more advanced, projects is compliant with the regulatory framework.
- Moving forward, one-day visits is one of the main areas of interest for Visit Denmark. Finding a sustainable business model is of interest for Visit Denmark, as well as solving how to create a win-win situation and to clarify the legal situation. There is also a wish to map tourist movement on multiple levels.
- Statistics Denmark are also interested in day visits, in particular people flow before and after events, as well as potential differences in flow during times when a place is crowded or not crowded.

Definition of tourists used by Visit Denmark during MPD project (translated by Analysys Mason)

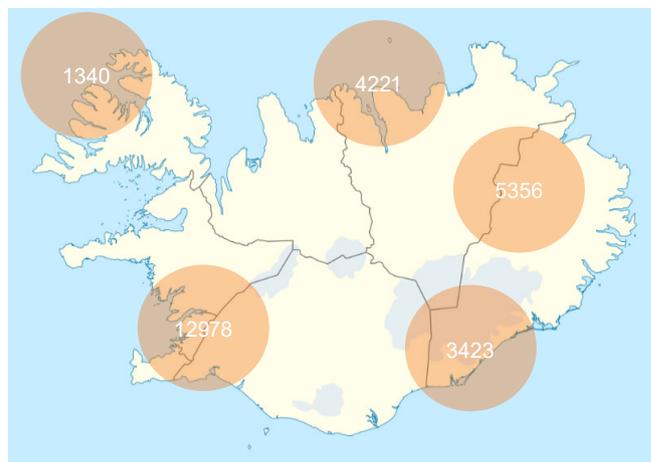
Commuters	Identified via at least 5 visit per month Visit duration is at least 90 minutes	Through travelers	Leaves the country through another place compared to where they enter. The maximum travel time is predicted travel time by Google Maps + 2 hours.
Over night tourists	<i>Is not a commuter</i> Identified during the whole interval between 0–7 times in Denmark The duration of the stay is maximum 21 days	One day tourists	<i>Is not at commuter or overnight tourist</i> Identified maximum 5 times per month Visit duration is at least 90 minutes

Appendix I: Mobile positioning data initiatives in the Nordic countries

Key highlights - Iceland

- The responders in this study knew of only one previously conducted study. This study was done in cooperation between a university and an Icelandic MNO. Twice a day, a snapshot was taken showing how many connected mobile phones there were in different areas. This made it possible to see volume changes over time.
- The Icelandic tourism board has great expectations on how mobile positioning data can help them get good statistics in a cost-effective manner. Today they have measurement equipment for counting cars at around 100 locations all over Iceland. The equipment doesn't have any communication link and has to be manually synced three times a year. In addition to the cost, this method is also problematic since there is no way to tell how many individuals are in each car, and if it's a few cars traveling often or many cars traveling more seldom. The Icelandic tourism board has shown great interest in participating in a joint Nordic project aiming at substituting/complementing existing statistics.
- Promote Iceland is responsible for the marketing of Iceland. They are interested in getting statistics which can measure the effect of marketing initiatives. Keflavik (main airport) has become a transit hub with lots of passenger staying a couple of hours or a night. To get a better understanding of their movement patterns, and be able to customize the marketing towards these individuals, it would be valuable to use mobile positioning data. Promote Iceland is also interested in mapping out the intra-Nordic travel, especially when foreign tourists make roundtrips throughout the Nordic region.

Mock-up made by Analysys Mason to illustrate snap-shot of how many visitors there is in a specific area at a given time



Appendix I: Mobile positioning data initiatives in the Nordic countries

Key highlights - Norway

- Statistics Norway is currently investigating the possibility to map movement on low level areas (known as “Grunnkrets”, approx.. 14 000 different areas in Norway) in cooperation with an MNO. The data are shared on an aggregated level, but so far it seems like the transparency is good enough to be able to make reliable statistics. If the pilot is successful there is a plan to incorporate the data into the official statistics.
- Statistics Norway mentioned that for calculations of the national accountants it’s important to get good insight of cross-boarder shopping. Mobile positioning data could be of assistance in identifying individuals who have a movement pattern representative for a person doing cross-border shopping.
- In relation to accommodation statistics, Statistics Norway is interested in looking into the potential of mobile positioning data in providing information on guests not captured by the traditional survey. This includes for example people renting private apartments and cabins.
- Statistics Norway also mentions that it would be valuable with a Nordic hub where statistics for all the countries are collected. This would make the data processing more effective and a wider range of data would be accessible for the Nordic countries.

Example of test data during measurements of the number of visitors from a certain country at a given time

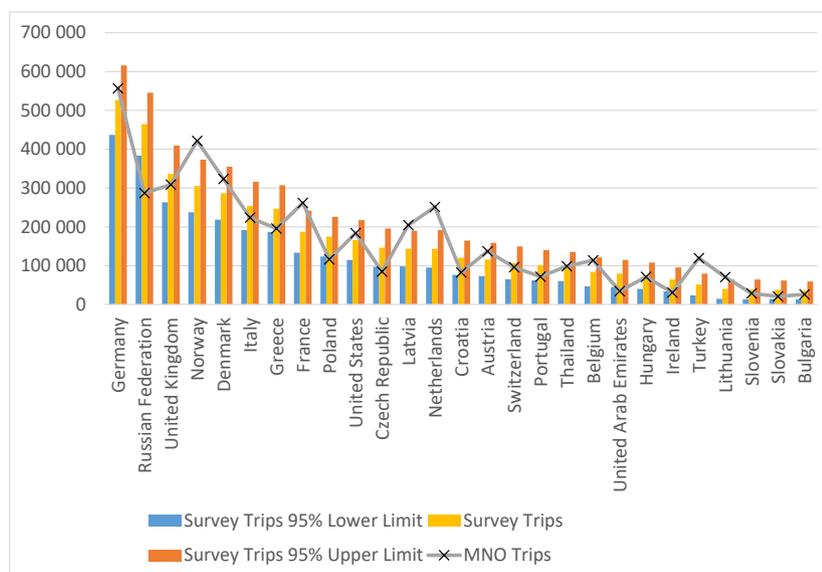
	A	B	C	D	E
1	Dato	Måleområde	Grunnkrets	Nasjonalitet	Antall personer
2	2017-07-12 00:05	15250205	Geiranger	United Arab Emirates	26
3	2017-07-12 00:05	15250205	Geiranger	Belgium	39
4	2017-07-12 00:05	15250205	Geiranger	China	21
5	2017-07-12 00:05	15250205	Geiranger	Czech Republic	108
6	2017-07-12 00:05	15250205	Geiranger	Denmark	117
7	2017-07-12 00:05	15250205	Geiranger	Finland	36
8	2017-07-12 00:05	15250205	Geiranger	France	33
9	2017-07-12 00:05	15250205	Geiranger	Germany	480
10	2017-07-12 00:05	15250205	Geiranger	Indonesia	21
11	2017-07-12 00:05	15250205	Geiranger	Italy	117
12	2017-07-12 00:05	15250205	Geiranger	Japan	21
13	2017-07-12 00:05	15250205	Geiranger	Lithuania	30
14	2017-07-12 00:05	15250205	Geiranger	Netherlands	99
15	2017-07-12 00:05	15250205	Geiranger	Norway	402
16	2017-07-12 00:05	15250205	Geiranger	Other	39
17	2017-07-12 00:05	15250205	Geiranger	Philippines	45
18	2017-07-12 00:05	15250205	Geiranger	Poland	48
19	2017-07-12 00:05	15250205	Geiranger	Russian Federation	33
20	2017-07-12 00:05	15250205	Geiranger	Spain	153
21	2017-07-12 00:05	15250205	Geiranger	Sweden	160
22	2017-07-12 00:05	15250205	Geiranger	Switzerland	93
23	2017-07-12 00:05	15250205	Geiranger	Taiwan, Province of Ch	24
24	2017-07-12 00:05	15250205	Geiranger	Ukraine	21
25	2017-07-12 00:05	15250205	Geiranger	United Kingdom	96
26	2017-07-12 00:05	15250205	Geiranger	Romania	29
27	2017-07-12 00:05	15250205	Geiranger	Saudi Arabia	29
28	2017-07-12 00:05	15250205	Geiranger	United States	25

Appendix I: Mobile positioning data initiatives in the Nordic countries

Key highlights - Finland

- Statistics Finland has conducted extensive tests on how mobile positioning data could be used for mapping outbound travel. The figures produced by mobile positioning data have been compared to values acquired by the standard questionnaire survey conducted and shows promising results. The use of mobile positioning data seems especially promising with regards to analysing seasonal fluctuations and trends. Statistics Finland will analyse mobile positioning data on a quarterly basis.
- As most of the other SOs, Statistics Finland needs better data on day-visit, especially since the boarder survey was cancelled a few years back. Also in line with other SOs, there is a wish to be able to complement the accommodation statistics with tourists who stay at friends' places or rent private apartments or other accommodations.
- Regarding outbound tourism it seems sufficient to retrieve data from one MNO but when analysing inbound tourism there is a need for a more complete data source, hence it's of importance to establish good relationships with all MNOs. Statistics Finland is also favourable of a Nordic datahub.

Comparison of measurements of outbound travel between traditional survey and mobile positioning data¹



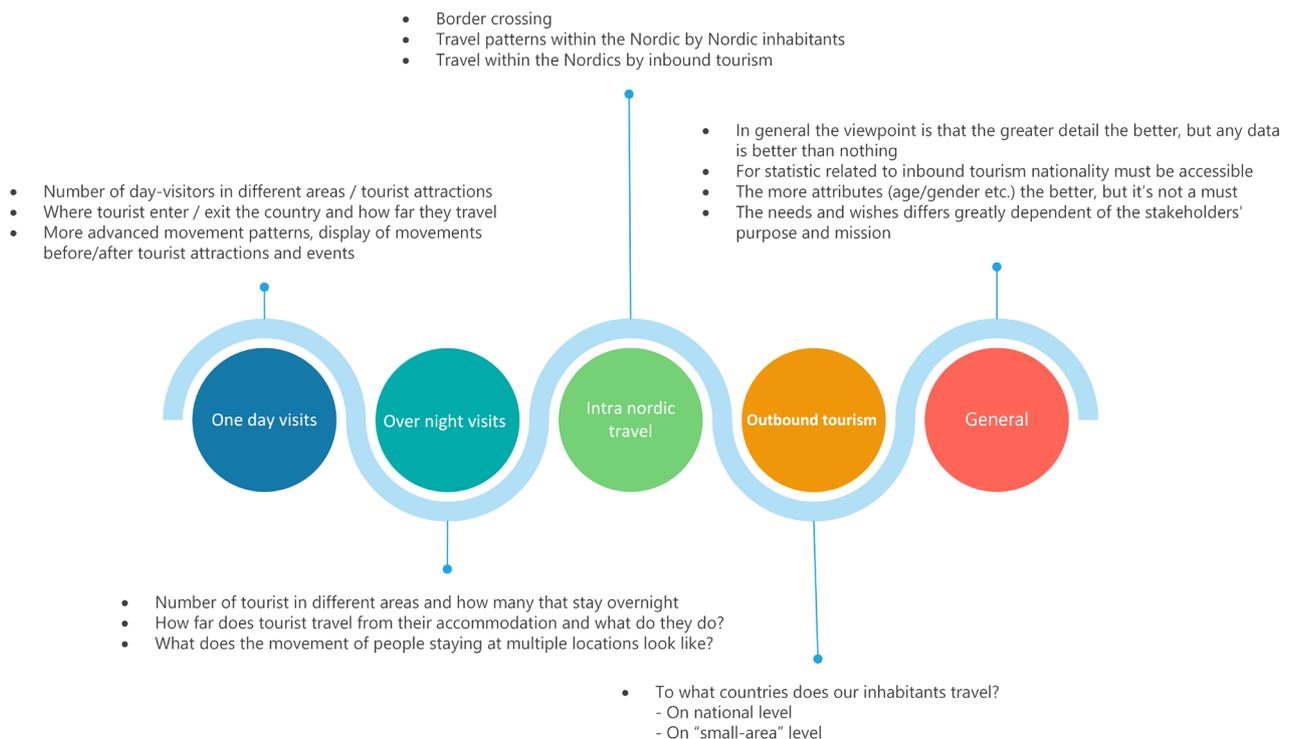
¹ Figure credited Ossi Nurmi, from the presentation Improving the Accuracy of Outbound Tourism Statistics with Mobile Positioning Data at 15th Global Forum on Tourism Statistics, Cusco, Peru, November 2018

Appendix II: Data demands for tourism statistics 1(2)

There are many finalised and ongoing initiatives with regards to mobile positioning data in the Nordic countries¹. The demands presented in the figure are based on interviews with stakeholders from public actors connected to the project. There are primarily representatives for organizations responsible for the tourism statistics in the Nordic countries.

In the short run, the following was found important:

- One day visits
- Over night visits
- Intra Nordic travel
- Outbound tourism



Appendix II: Data demands for tourism statistics 2(2)

In the long run, the following was found important:

- A common Nordic Datahub
- Harmonization of statistics
- To ease the administrative burden for organizations reporting information to SOs
- Same demands as in the short run but further developed.

