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INTRODUCTION

TRACKING YOU — HOUSE NUMBERING AS A PROLOGUE TO GPS TRACKING

I once read a late 18th century account of a Swiss traveller in Austria, who expressed his shock about something we all take for granted in modern day Europe; the homes in the Austrian villages and towns he visited were all numbered! His journey must have taken place right after 1770. It was in that year that the Austrian Empress Maria Theresa decided to tag the houses in her realm by a number.

It had never had occurred to me that there had been a time when houses were not numbered. It even struck me as odd to learn that in some parts of Switzerland, house numbers still have to be implemented. How can you live without them? How can you find someone? Most of us have become fully adjusted to the idea that if you can always find someone's home by means of an address that is the combination of a street name and a house number. The use of such addresses has become the predominant way-finding strategy in Europe and other parts of the world.

Over the years, addresses and the corresponding names of those that live at them have been made available in public listings such as phonebooks. Only a few of us choose to be excluded from them. And even if you do, all the local, regional or national authorities know where to find you using their own, more complete, registers. You are notified when you need to renew your

driving licence and informed if the collection of your rubbish is rescheduled due to a public holiday. No one seriously seems to object to such use of personal data.

In recent years, the rapid development of information and communication technologies have produced a new array of identity tags such as IP numbers, mobile phone numbers and credit card numbers. Most of us are still somewhat cautious with regard to this 'new set of house numbers', and there is a valid explanation for this. The data attached to these new identity tags are a lot easier to process and share than the data that was collected in the time of Maria Theresa. It is no surprise that we frequently debate what personal data can be collected, the purposes it can and cannot be used for and the length of time it can be stored.

The use of such data is limited in Europe by EU guidelines for 'the protection of individuals with regard to the processing of personal data and on the free movement of such data for the proper use of personal data' (Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995). However, no matter what the directive attempts to regulate, it cannot reverse the greatest breach of the protection of personal data that took place two centuries ago by the simple act of numbering houses. That's where it all started.

Back in 1763, Austria badly needed to pay off its debts resulting from the seven year war it had just been through, the second global conflict in history. The war had involved a coalition of Britain, Hanover and Prussia on one side and a coalition of France, Austria and Russia on the other. Austria was forced to improve its collection of taxes (http://de.wikipedia.org/wiki/Siebenjähriger_Krieg, accessed 23 July 2008).

Keeping track on which citizens it had already taxed and which it had not was vital for its capacity to wage war. The empire therefore required a systematic register of all homes and their occupants. The need to create a new army-recruiting system provided a further reason to tag homes. The empire needed to know where the men lived that could fight in its army. As the Austrian army only accepted Christian men, it was also necessary to establish who was

Christian and who not. The civil servants responsible for numbering homes and carrying out a subsequent census were quite inventive in this regard. The homes of Christian inhabitants were numbered with Arabic numbers (e.g. 36). Homes occupied by Jews were tagged with roman numerals (e.g. - XXXVI). No wonder our Swiss traveller was shocked to witness first hand the absolute power imposed by the Austrian Empress on her subjects (Tantner, 2003).

At first glance, it may seem hard to imagine that the simple numbers placed above people's front doors made such a significant contribution to the many wars waged and human atrocities committed out throughout Europe in the following two centuries. However, the fact remains that house numbers provided an improved method of collecting taxes, recruiting solders and ethnically dividing people on an unprecedented scale. A breach of privacy of a similar magnitude would be almost inconceivable in our own times.

The result of house-tagging was certainly not all negative. Taxes also generated funds for roads, bridges, healthcare and social welfare. House numbers made delivering parcels and visiting people a lot easier. Addresses provided a wealth of information for the benefit of urban and spatial planners. How would we ever be able to accommodate the spatial needs of citizens if we didn't know the size and the composition of the population of a town, a city or a region? We need to count. We need to measure. We need relevant data. And much of the data nowadays processed by Geographic Information Systems is embedded in real world addresses that are based on simple house numbers and street names. Ten years ago, our society could not have done without these addresses. It was inconceivable that a postman could deliver letters or parcels without house numbers. With an actual description of a house we might find our friends in a village. But what if our friends lived in a social housing district where all houses were the same?

During the last decade, alternative way-finding techniques have emerged and their use is spreading rapidly. The introduction of satellite navigation is the major driver for change here. Today, everyone can afford to buy a GPS handheld and start positioning any given location that he or she has access to. Such a tag contains coordinates describing givens such as latitude,

longitude and altitude. These provide enough information to deliver letters or parcels to a specific building or home. Advanced software can even calculate each morning the most optimal route along which the items in a postman's bag should be delivered. It is no longer necessary for him (or her) to walk the same route day in day out. A modern GPS-assisted postman will skip streets, shorten distances, and reverse his/her tracks, all depending on the coordinates of his/her deliveries that given day.

The possibilities afforded by satellite navigation can even be taken one step further. If the tag used to deliver the parcel is dynamically linked to the actual position of the addressee, a parcel can potentially be delivered anywhere. There is no longer a need for the recipient to be at home, at work or at any other fixed location. I may be sitting on a bench in park when someone with a parcel shows up and announces a delivery for Mr. Frank van der Hoeven. At that point, it is not just my front door that is tagged. The tag will be on me.

The idea that anyone's position can be provided at any given time may sound rather far-fetched to some readers. But positioning techniques such as triangulation are already used to locate the whereabouts of subscribers to mobile phone services. As of 2007, the Dutch navigation firm TomTom tracks congestion on major roads in The Netherlands by positioning, in real time, all four million subscribers to Vodafone's mobile phone services (Farivar, 2006). Please note that four million subscribers is equal to one quarter of the entire Dutch population and that there is no technical hurdle to be crossed in increasing this number even further. All that TomTom needs to do is to include the other carriers such as KPN and T-Mobile in its scheme. With a mobile phone market penetration of over 100%, most of us will be tracked. The only reason that TomTom is not already tracking all of us is the simple fact that tracking a quarter of the population is quite sufficient to track all the congestion there is on Dutch roads. Four million users is also enough to update maps using this technique. The simple fact that a significant number of people follow a specific route each day at a specific speed indicates that the route can be travelled by foot, by bike or by car. Newly established roads will surface in the analysis the very same day that they are opened to traffic.

The experts among us will be aware that the accuracy of mobile phone positioning is not always optimal. Much depends on the density of mobile phone antennas. In rural areas, this density is relatively low. Positioning using mobile phones is therefore less accurate in remote areas than in central areas. But in this regard too, things are evolving rapidly. Mobile phones have already acquired the ability to take pictures, play music and receive and send email. Satellite navigation is set to become the next service added to our handhelds. As of April 2007, Japanese law makes it mandatory for mobile phones to identify the caller's precise location when making an emergency call (Yomogita, 2007). Such a requirement provides a much needed boost to the further integration of mobile phones and GPS services.

In fact this Japanese law comes close to the resolution that was signed by Maria Theresa two centuries earlier. The Austrians made tagging 'your front door' mandatory. The Japanese are making tagging 'you' mandatory. While in Austria the empress's objective was to expand her power over her subjects, all the Japanese authorities want at this time is to provide emergency services where they needed. Hopefully this is a much encouraging difference.

URBANISM ON TRACK

While the application of tracking technologies has developed substantially in social sciences and transportation sciences in the last decade, it has failed to make a significant impression in the scientific field of urbanism and spatial planning. The chair of Urban Design and the chair of Spatial Planning at the Delft University of Technology noted this shortcoming while working within the framework of the EU-sponsored Spatial Metro project and the Network Cities research programme. In a joint effort, on 18 January 2007, they held an international expert meeting on the application of tracking technologies in urbanism. The Delft School of Design sponsored and facilitated the expert meeting. The starting point of *Urbanism on Track* was the exploration of the current and future possibilities and the limitations in the application

of tracking technologies in urban design and spatial planning processes. The expert meeting *Urbanism on Track* aimed to address the subject from the viewpoint of multiple disciplines. The book *Urbanism on Track* shows a preliminary crystallisation of the ideas presented at that meeting. As such, *Urbanism on Track* documents the early stages of the application of tracking technologies. Practices or applications are as yet far from mature, but the documentation of this relatively early stage of technological development is what makes the book particularly relevant.

Urbanism on Track demonstrates a state of the art in a highly dynamic field of research and as such only represents a snapshot of our times. It provides insight in the challenges and bottlenecks we are currently facing, while it reflects the enthusiasm for new developments. The initiative *Urbanism on Track* is intended to live on in future meetings and, who knows, new books.

This book contains three parts. The first part deals with the basics; what is GPS tracking, what is different about using GPS in an urban environment, how can we process and visualise GPS-obtained data, and what do we know about the relationship between human spatio-temporal behaviour and navigation?

The second part takes a closer look at some of the first experiments urban researchers carried out with GPS as an emerging tool: the Danish field tests, the EU-sponsored Spatial Metro project, MIT's Real Time Rome and the Sense of the City project that was implemented in Eindhoven.

First, the third part discusses true applications such as replacing paper travel diaries, travel demand management and collaborative map generation. This part concludes with an agenda for structurally embedding research using tracking technologies in urbanism. This part concludes with an agenda for the structural embedment of research using tracking technologies in urbanism.

A BRIEF SYNOPSIS OF ALL CHAPTERS

Tracking and navigation, the basics

Shoval introduces us to the world of GPS tracking and presents two cases in which he used GPS-obtained data for his research on the outdoor mobility of elderly people with cognitive disorders and research on the user-density of an Israeli heritage site.

Van der Spek provides an overview of the demand and availability of a range of tracking technologies.

Nijhuis explains how to use GPS tracking data in Geographic Information Systems (GIS) for the visual representation, analysis and modelling of complex spatial environments within the context of urban planning and design.

Millonig and Schechtner provide a survey on current research on human spatio-temporal behaviour aimed at the development of pedestrian navigation systems, including route choice behaviour, localisation technologies and the adoption of location-based information systems. Linked to these topics, they outline three related projects performed at arsenal research and the Vienna University of Technology.

First pilots with tracking

Hovgesen, Nielsen, Bro and Tradisauskas report on their experiences in tracking visitors in public parks in Denmark as part of their Diverse Urban Space (DUS) research project. The work involved the testing of equipment within small-scale and large-scale surveys.

Van der Spek describes the results of a pedestrian observation study that was conducted among others in Norwich, Rouen and Koblenz within the framework of an EU-sponsored network.

Sevtsuk and Ratti present the results of a survey conducted in Rome, Italy in January 2007 and analyse how accurately and reliably mobile phone positioning data describes the actual presence of vehicles and people on city streets. They moreover question whether mobile phone data predict additional over-time variations in mobility patterns which is lacking in traditional fixed predictors.

Leestemaker and Van Berlo discuss the development of tools, based on multiple media, to observe, map and analyse changing patterns in human time use. Within this framework, they present the dynamic 3D maps of Sense of the City and argue that geo-referenced databases, geographical information systems and the application of chrono-geographic models are within reach.

Integrating tracking into urbanism and spatial planning research

Bohte, Maat and Quak argue that paper travel diaries can be replaced by methods based on the Global Positioning System (GPS). Such methods are potentially more accurate and less of a burden on respondents than paper diary methods. Especially when GPS data are placed in a GIS application subject to further interpretation, the possibilities in using GPS are promising.

Janssens, Hannes and Wets discuss how knowledge developed through the use of new tracking technologies can impact the spatial planning process and the kind of spatial interventions that can be expected as a result of new tracking technologies. Their focus is on travel demand management.

Edelkamp, Pereira , Sulewski and Costa look at the possibilities of fundamentally changing 'map-making' (cartography) in light of tracking technologies. They propose a general architecture for a collaborative map generation system and discuss in some detail the technical challenges for each module, as well as its current solutions. They address filtering, map-matching, updating and aggregation, steps for the construction of the maps, and some efficient algorithms and data structures that are used to compress, process and query maps once they have been generated.

Van Schaick analyses the assumptions underlying the application of tracking technologies. On the basis of his findings and the results of the expert meeting *Urbanism On Track*, he synthesises an agenda for the application of tracking research in the context of urban design and planning.

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