Locating, Tracking and Tracing

From Geographic Space to Cyberspace and Back

Lorenz M. Hilty, Britta Oertel, Michaela Evers-Wölk and Kurt Pärli

Abstract

Technologies for tracking and tracing objects and people are becoming ubiquitous. The possibility to determine the location of a person (either in real-time or ex-post) often emerges as a side-effect of other activities the person is performing, such as making a phone call, using the Internet or taking a picture. It is the combination of two factors which creates considerable societal risks in addition to the obvious advantages and opportunities afforded by the positioning technologies: a drop in the voluntary nature of our use of these technologies and the increasing amount of personal data in circulation. By using a qualitative risk-assessment approach developed in an earlier TA-SWISS study, the project team identified the need for political action in several areas (from surveillance and child protection to critical infrastructures) and formulated recommendations for legislative bodies and stakeholders for minimizing the societal risks of these technologies.

Introduction: Technologies for Tracking and Tracing

An increasing amount of technologies are being used that involve information about the location of objects or persons. In addition to the widely known geolocation by satellites via GPS, at least 12 other technologies are in use today that make it possible to determine the location of devices and indirectly that of their users, such as GSM/UMTS,/LTE, WLAN, RFID, optical and even acoustical technologies (for details, see Hilty et al. 2012). This may be happening in real time (tracking) or following a delay, depending on the technology (tracing); it may happen with a degree of precision ranging from a few kilometers to a few centimeters and either with or without the knowledge of the persons affected. The mix of technologies in use today bears much greater privacy risks than passive RFID technology used to tag objects with smart labels, which stirred a public debate almost a decade ago (Oertel et al. 2005).

Because tracking and tracing can be technically implemented with increasing convenience and decreasing cost, more and more location data are being generated and stored. When the results of many positioning processes are combined, movement profiles or even

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relationship profiles can be prepared for individual persons. In addition to navigation, there are numerous other application areas of localization technologies: location-based services, micromarketing, calculation of fees and insurance premiums, surveillance of individuals (for health reasons or in law enforcement), emergency missions, documentation and forensic evidence.

From the standpoint of the person being located, this happens often as a side-effect of another function the person wants to use:

- All mobile devices with integrated GPS receivers (such as smartphones) can determine their position with a high degree of precision; many apps build upon this; the user is not always aware whether their localization data are visible to third parties when they use an app or a service.
- Mobile phones that do not even feature GPS receivers can also be localized by mobile providers. Just knowing in which cell the device is operating provides for a rough localization. A more precise localization of mobile phones without GPS is also possible by triangulation.
- When a user is accessing information on the Internet, servers can roughly estimate the location of the user. Whenever Internet access is via a WiFi hotspot, an even more precise localization is possible.
- When buildings or fee-based zones are accessed using electronic identification or when electronic payments are made, data are also generated that document the location and movement of persons.
- Images showing persons or vehicles may document locations. More and more digital cameras are equipped with GPS receivers and mark digital image data with geotags that specify time and location; video surveillance cameras are becoming more powerful and less conspicuous. Parallel to this development, image processing algorithms are being improved so as to enable authorities to mine collections of images automatically for faces or license-plate numbers.

Identifying Potential Areas of Societal Conflict

Localization technologies are in the process of assuming a dominant position in our lives and just as well-accepted as the telephone or the Internet. These devices are becoming an "external location memory" that stores an ever-increasing amount of records about our acts and when and where we performed them.

In the future, it will become difficult to imagine everyday mobility – both individual and in public transport – without localization systems. Likewise, acting in social networks on Internet platforms will be increasingly associated with the physical location of the user. New location-based business models will result from that. Advertising focussed on location, time and the individual will become normal.

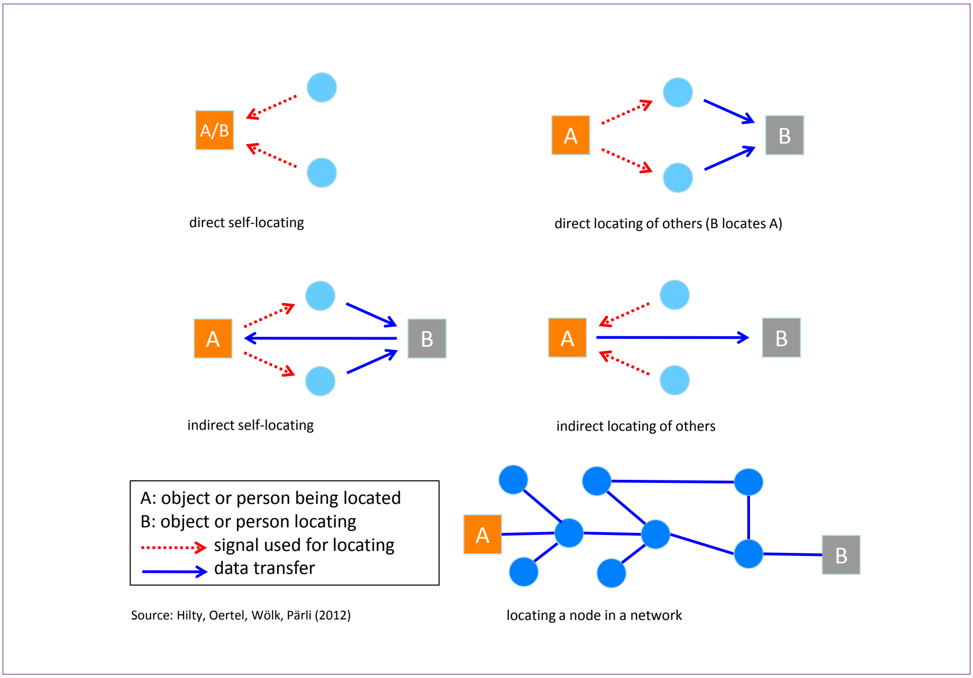

Figure 23: Basic types of determining the location of objects or people (Hilty et al. 2012)

Localization technologies offer many societal opportunities, e.g. for promoting public transportation (easier to find connections and to pay for them), for emergency and rescue operations, for personal security and orientation at unfamiliar locations, for meeting friends and perhaps even for making friends among strangers. They may even provide a technological basis for the vision of a sustainable information society that has been around for a decade (Dompke et al. 2004; Hilty et al. 2005; Som et al. 2009; Berleur et al. 2010; Hilty et al. 2013).

However, as localization technologies become more readily accepted, society will become more dependent on them. The technologies are becoming new critical infrastructures whose malfunction or collapse can have far-reaching consequences comparable to a breakdown of the telephone network. Manipulated localization information may have even more serious consequences than a lack of information because it can misguide vehicles, persons and freight.

It is mainly the combination of the following two factors, which creates considerable societal risks in addition to the obvious advantages and opportunities afforded by localization technologies. The factors are:

1. ***A drop in the voluntary nature of our use of localization technologies:*** If a person does not wish to be located even today, he or she has to do without a mobile phone and many Internet functions, in extreme cases, even without electronic access and payment systems – thus becoming excluded from many aspects of personal and professional life.
2. ***The increasing amount of personal data in circulation*** due to the increasing generation, transmission, storage and processing of localization data: the public or private-sector organizations that process such data can combine them into tracking and relationship profiles. Far-reaching profiles of persons and groups can be assembled by combining that with other data, in particular geographic data.

The combination of these two aspects – the drop in the voluntary nature and the increasing amount of data – holds a potential for societal conflict because the difficulties of the individual that exist today in getting his or her right to informational self-determination respected might later intensify to a critical mass. The lack of transparency in the processing steps used, which are frequently not associated with a person until after the fact, is increasing the risk of personal and data protection violations.

Conclusions: Need for Political Action in Switzerland

The TA-SWISS study "Localized and Identified – How Localization Technologies Are Changing Our Lives" (Hilty et al. 2012) examined the technologies, applications and Swiss legal-framework conditions of localization technologies, including the situation in the European Union whenever relevant. In keeping with the themes of Mobility and Social networks, the possible impacts (both the opportunities and the risks) are discussed and evaluated as regards their societal relevance. By using a qualitative risk-assessment approach developed in an earlier TA-SWISS study (Hilty et al. 2004, 2005; Som et al. 2004), the project team identified the need for political action in the following areas:

- For the technical surveillance of people in dependency relationships, especially employees, persons needing protection and children
- In Child Protection Measures pertaining to the participation of adolescents in social networks with localization functions
- In defending the informational self-determination of the individual vis-à-vis the state and private-sector enterprises; this is a matter of maintaining control over one's own data and avoiding the thoughtless surrendering of basic rights
- In limiting the retention of localization data, because in many cases it can be associated with persons after the fact, possibly jeopardizing their rights to privacy ("right to be forgotten")
- As regards the permissibility of the Terms of Service used by the providers of software packages and services with localization functions, some of which violate current law

- Taking seriously the model function of government offices in implementing data-protection principles, whenever they use localization technologies to perform their own duties more efficiently
- To recognize the security of localization systems as a new critical infrastructure and to protect the populace against those forms of cyber-criminality that are facilitated by localization technologies

From this list, a set of recommendations was derived. The general recommendations aim to further develop the legal framework:

- There is an urgent need for introducing more efficient ways to sanction violations in the data-protection rules intended to effectively prevent the misuse of personally identifiable data (the localization data of persons in particular).
- Measures are needed to improve the enforcement of data-protection principles in the international context.
- Because localization systems are developing into critical infrastructures for the Swiss population, they must be protected from malfunctions, breakdown or destruction.
- Many people have difficulty understanding the operation of software products and services processing localization data; this makes a certification necessary, so that software products become more reliable and transparent.
- The widely discussed “right to be forgotten” for personal data is of special importance in the case of localization data; therefore, a legal anchoring of this right should be investigated thoroughly.
- Empirical social-science research is needed, so that the real handling of localization technologies in everyday life and the social-development dynamics of sharing relations and dependencies can be better understood. Such an understanding is the basis for effective regulation.

In addition to the general recommendations that aim to establish legal guideposts for the on-going development and use of localization technologies in compliance with basic law, the study articulates special recommendations for specific areas:

- Improving the public’s understanding of the Terms of Service of social networks
- Directions and a clearer regulation of the permissibility of localization in the workplace
- Integration of the topic of localization in measures for the promotion of media literacy of adolescents
- Introduction of effective ways of establishing the legal age of users of Internet services with localization functions

- The accession of Switzerland to the Council of Europe Convention on the Protection of Children from Sexual Exploitation and Abuse
- Exercising the model function that governments have in the application of localization technologies
- Bringing the use of crowd sourcing (cooperation of many volunteers) in road traffic into a compliance with data protection principles
- A uniform regulation of video surveillance
- An extension of the principle of the so-called Robinson List ("don't send me any advertising") to digital media, especially location-based marketing

The recommendations of this TA study are not intended to hinder the use of localization technologies or to underplay their many advantages; instead, they are intended to help recognize and minimize the risks of these technologies at an early stage – only then will society succeed in in exploiting the opportunities of localization technologies and in deriving sustainable benefit from them.

References: Page 416

References

PART I – Challenges for Technology Assessment

Technology Assessment: The State of Play. Towards a Hybrid and Pluriform Process of Governance of Science and Technology, p. 23.

Bijker, W. E. (1995). Democratisering van de Technologische Cultuur (Inaugurele Rede). Maastricht: Universiteit Maastricht.

Bijker, W. E. (2007). American and Dutch Coastal Engineering: Differences in Risk Conception and Differences in Technological Culture. Social Studies of Science, 37(1), 143-152.

Bijker, W. E., Bal, R., & Hendriks, R. (2009). The paradox of scientific authority : the role of scientific advice in democracies. Cambridge, Mass.: MIT Press.

Bijker, W. E., & Law, J. (Eds.). (1992). Shaping Technology / Building Society. Studies in Sociotechnical Change. Cambridge, MA: MIT Press.

Clausen, C., & Yoshinaka, Y. (2004). Social shaping of technology in TA and HTA. Poiesis Prax, 2, 221–246. doi: 10.1007/s10202-003-0046-1

Collingridge, D. (1980). The Social Control of Technology. London: Frances Pinter.

Collins, F. S., Patrinos, A., Jordan, E., Chakravarti, A., Gesteland, R., & Walters, L. (1998). New Goals for the U.S. Human Genome Project: 1998-2003. Science, 282(5389), 682-689. doi: 10.1126/science.282.5389.682

Enzing, C., Deuten, J., Rijnders-Nagle, M., & Til, J. v. (2011). Technology across borders: Exploring perspectives for pan-European parliamentary technology assessment. Brussels: European Parliament, STOA.

Est, R. v. (2011). The Broad Challenge of Public Engagement in Science. Commentary on: "Constitutional Moments in Governing Science and Technology". Journal of Science and Engineering Ethics. doi: 10.1007/s11948-011-9296-9

Est, R. v., & Brom, F. (2012). Technology Assessment, Analytic and Democratic Practice. In R. Chadwick (Ed.), Encyclopedia of Applied Ethics, Second Edition, Volume 4 (Vol. 4, pp. 306–320). San Diego Academic Press.

Est, R. v., Malsch, I., & Rip, A. (2004). Om het kleine te waarderen... Een schets van nanotechnologie: publiek debat, toepassingsgebieden en maatschappelijke aandachtspunten. The Hague: Rathenau Instituut.

Est, R. V., Walhout, B., Rerimassie, V., Stemerding, D., & Hanssen, L. (2012). Governance of Nanotechnology in the Netherlands: Informing and Engaging in Different Social Spheres. International Journal of Emerging Technologies and Society, 10, 6-26.

Ganzevles, J., & Est, R. v. (2012). Positioning and conceptualising Parliamentary TA. In J. Ganzevles & R. v. Est (Eds.), Parliamentary Technology Assessment Practices in Europe (Vol. Deliverable 2.2, pp. 18-28). Den Haag: Rathenau Instituut.

Gezondheidsraad (2006). Health significance of nanotechnologies. Den Haag: Health Council of the Netherlands.

Hellström, T. (2003). Systemic innovation and risk: technology assessment and the challenge of responsible innovation. Technology in Society, 25, 369–384.

Hommels, A., Mesman, J., & Bijker, W. E. (Eds.). (forthcoming in 2014). Vulnerability in Technological Cultures. New directions in research and governance. Cambridge, MA: MIT Press.

Jasanoff, S. (Ed.). (2004). States of knowledge : the co-production of science and social order. New York: Routledge.

Nanotechnologie, C. M. D. (2011a). Verantwoord verder met nanotechnologie. Bevindingen maart 2009 - januari 2011. Amsterdam: Nanopodium.

Nanotechnologie, C. M. D. (2011b). Werkverslag (over de periode maart 2009 - januari 2011). Amsterdam: Nanopodium.

Why Autonomous Unmanned Aerial Vehicles Will Lose the War, p. 337.

Arkin, R.: Governing Lethal Behavior: Embedding Ethics in a Hybrid Deliberative/Reactive Robot Architecture, Chapman & Hall/CRC, 2009.

Deportes, V.: Décider dans l'incertitude, Economica, stratégies & Doctrines,2007.

Gaulle, C. de: Le fil de l'épée, 1932, Perrin, Mémorables, 2010.

Royal, B.: La conviction d'humanité. L'éthique du soldat français, Economica, 2008.

Rhode, D.: "The drone war", Reuters Magazine, http://www.reuters.com/article/2012/01/26/us-davos-reutersmagazine-dronewar-idUSTRE80P19R20120126 (19/05/12)

Suarez, D.: Kill décision, Dutton Books, 2012.

Towards Machine Ethics, p. 343.

Anderson, M.; Anderson, S. L. (eds.), 2011: Machine Ethics. Cambridge

Asimov, I., 1950: I, Robot. New York

Bendel, O., 2012a: Die Moral der Maschinen: Überlegungen zur Maschinenethik. In: inside-it.ch, 24 October 2012. Via http://www.inside-it.ch/articles/30517

Bendel, O., 2012b: Maschinenethik. In: Gabler Wirtschaftslexikon. Via http://wirtschaftslexikon.gabler.de/Definition/maschinenethik.html. Wiesbaden

Clarke, J., 2011: Asimov's Laws of Robotics: Implications for Information Technology. In: Anderson, M.; Anderson, S. L. (eds.): Machine Ethics. Cambridge, pp. 254–284

Egger, L., 2013: The morality of avatars. Term paper for the course "ToBIT" at the School of Business of the University of Applied Sciences and Arts Northwestern Switzerland FHNW. Grey literature. Olten

Guarini, M., 2011: Computational Neural Modeling and the Philosophy of Ethics: Reflections on the Particularism-Generalism Debate. In: Anderson, M.; Anderson, S. L. (eds.): Machine Ethics. Cambridge, pp. 244–253

Gips, J., 2011: Towards the Ethical Robot. In: Anderson, M.; Anderson, S. L. (eds.): Machine Ethics. Cambridge, pp. 316–334

Lin, P.; Abney, K.; Bekey, G. A. (eds.), 2012: Robot Ethics: The Ethical and Social Implications of Robotics. Cambridge, MA

McLaren, B. M., 2011: Computational Models of Ethical Reasoning: Challenges, Initial Steps, and Future Directions. In: Anderson, M.; Anderson, S. L. (eds.): Machine Ethics. Cambridge 2011, pp. 297–315

Papaioannou, Y., 2013: Fuzzylogik in Wissenschaft, Recht und Ethik. In: faz.net, 26 January 2013. http://www.faz.net/aktuell/wissen/atomium-culture/logik-mit-unschaerfen-fuzzylogik-in-wissenschaft-recht-und-ethik-12029866.html

Schnyder, M., 2013: Towards a Machine Ethics. Term paper for the course "ToBIT" at the School of Business of the University of Applied Sciences and Arts Northwestern Switzerland FHNW. Grey literature. Olten

Footnotes:

1) Asimov wrote in his short story "Runaround" (1942): "A robot may not injure a human being or, through inaction, allow a human being to come to harm. 2. A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law. 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws." (Asimov 1950)

Locating, Tracking and Tracing: From Geographic Space to Cyberspace and Back, p. 349.

Berleur, J.; Hercheui, M.; Hilty, L. M., 2010 (eds.): What Kind of Information Society? Governance, Virtuality, Surveillance, Sustainability, Resilience. IFIP Advances in Information and Communication Technology 328. Berlin Heidelberg New York

Dompke, M.; von Geibler, J.; Göhring, W.; Herget, M.; Hilty, L. M.; Isenmann, R.; Kuhndt, M.; Naumann, S.; Quack, D.; Seifert, E., 2004: Memorandum Nachhaltige Informationsgesellschaft. Stuttgart

Hilty, L. M.; Aebischer, B.; Andersson, G.; Lohmann, W., 2013: ICT for Sustainability: Proceedings of the First International Conference on Information and Communication Technologies for Sustainability. E-Collection ETH Institutional Repository. Zürich

Hilty, L. M.; Behrendt, S.; Binswanger, M.; Bruinink, A.; Erdmann, L.; Froehlich, J.; Koehler, A.; Kuster, N.; Som, C.; Wuertenberger, F., 2005: The precautionary principle in the information society – effects of pervasive computing on health and environment. Edited by the Swiss Center for Technology Assessment (TA-SWISS), Bern, Switzerland

Hilty, L. M.; Oertel, B.; Wölk, M.; Pärli, K., 2012: Lokalisiert und identifiziert. Wie Ortungstechnologien unser Leben verändern. ETH Zürich

Hilty, L. M.; Som C.; Köhler A. R., 2004: Assessing the Human, Social and Environmental Risks of Pervasive Computing. In: Human and Ecological Risk Assessment, 10/5 (2004), pp. 853–874

Oertel, B.; Wölk, M.; Hilty, L. M.; Köhler, A., 2005: Security Aspects and Prospective Applications of RFID systems. Bundesamt für Sicherheit in der Informationstechnik. Bonn

Som, C.; Hilty, L. M.; Ruddy, T., 2004: The Precautionary Principle in the Information Society. In: Human and Ecological Risk Assessment, 10/5 (2004), pp. 787–799

Som, C.; Hilty, L. M., Köhler, A. R., 2009: The Precautionary Principle as a Framework for a Sustainable Information Society. In: Journal of Business Ethics 85/3 (2009), pp. 493–505

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Privacy Aspects of Social Networks – An Overview, p. 355.

Bonneau, J.; Anderson, J.; Anderson, R.; Stajano, F., 2009: Eight Friends are Enough: Social Graphs Approximation via Public Listings. In: SNS 2009 (2009), pp. 13-18, http://www.cl.cam.ac.uk/~rja14/Papers/8_friends_paper.pdf

Boyd, D.M.; Ellison, N.B., 2007: Social Network Sites: Definition, History, and Scholarship. In: Journal of computer-Mediated Communication 13/1 (2007), pp. 11

Čas, J., 2011: Ubiquitous Computing, Privacy and Data Protection: Options and Limitations to Reconcile the Unprecedented Contradictions. Computers, Privacy and Data Protection: an Element of Choice. Springer. pp. 139-169

Clarke, R.C., 2006: What's 'Privacy'? http://www.rogerclarke.com/DV/Privacy.html

Finn, R.L.; Wright, D.; Friedewald, M., 2013: Seven Types of Privacy. In: European Data Protection: Coming of Age (2013), pp. 3-32

Montjoye, Y.-A.d.; Hidalgo, C.A.; Verleysen, M.; Blondel, V.D., 2013: Unique in the Crowd: The Privacy Bounds of Human Mobility. In: Nature Scientific Reports 3/1376 (2013)

Strauß, S., 2011: The Limits of Control – (Governmental) Identity Management from a Privacy Perspective. In: S. Fischer-Hübner, P. Duquenoy, M. Hansen, R. Leenes, G. Zhang (eds.): Privacy and Identity – IFIP Advances in Information and Communication Technology - AICT vol. 352. Boston, pp. 206-218

Strauß, S.; Nentwich, M., 2013: Social Network Sites, Privacy and the Blurring Boundary Between Public and Private Spaces. In: Science and Public Policy/6 (2013), pp. 724-732

Footnotes:

1) Cloud Computing. European Perspectives on impacts and potentials of Cloud Computing and Social Network Sites, 2012–2013, solicited from STOA to ETAG (European Technology Assessment Group), http://www.europarl.europa.eu/stoa/cms/home/publications/studies

2) This contribution is an abridged and focused version of an article the authors wrote for Science and Public Policy, appeared in issue 6/2013. For further references see that article.

3) Judgment of the First Senate from 15 December 1983, 1 BvR 209/83 et al. – Population Census, BVerfGE 65, 1.

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