

## Final Report Summary

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Individual Privacy Issues in Wireless Communication: the Internet of Things

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The Internet of Things (IOT) is a conceptual vision to connect people, things (everyday things from buildings to coffee cups), and devices (from mobile phones to ovens), in order to create a ubiquitous computing world. Things are expected to become active participants in business, information, and social processes, where they will interact and communicate among themselves, with people, and with the environment. However, one of the most important challenges in convincing users to adopt this kind of all-around network is the protection of individual privacy. For IOT applications to be successful, people must be able to rely on them. The focus of this research project was to study the personal perspectives of European and Chinese people who are working with different aspects of the development of the IOT and of European and Chinese people who are potential end users of the IOT and its applications, i.e., “ordinary people”. The used research methods included personal interviews, online surveys, and monitoring of online forums. The research project also included a research visit to Southeast University, Nanjing, China, during 23.9.2012–5.11.2012. The results of the research project are presented in the 8 published articles. The final report and the published articles were delivered to The Helsingin Sanomat Foundation in November 2014.

The published articles and their abstracts:

- J. Virkki, Finnish Perspectives for the IOT, American Journal of Networks and Communications, Volume 2, Issue 2, 2013, pp. 23-27.

The Internet of Things (IOT) means connecting people, things, and devices in order to create an omnipresent computing world. One of the most important challenges in convincing users to adopt this kind of all-around network is the protection of security and privacy in different applications. This paper presents the results of interviews conducted in a Finnish study during 8/2012-2/2013. In this research, 11 Finnish people working with different aspects of IOT development and 11 ordinary Finnish people were interviewed. The goal was to investigate their feelings on the IOT and its applications, as well as personal opinions on security and individual privacy in the IOT. Most of the answerers in this study believed that we are heading towards the IOT in the future and many IOT applications were seen tempting. However, security and privacy issues, the lack of control, and the actual need for versatile IOT applications were questioned. The people working with the IOT were found to be more critical towards the IOT than the ordinary people. An introduction of the IOT, examples of potential applications, the conducted interviews and collected answers, as well as highlights of the collected free comments are presented in this paper.

- J. Virkki and L. Chen, Personal Perspectives: Individual Privacy in the IOT, Advances in Internet of Things, Volume 3, Issue 2, 2013, pp. 21-26.

The Internet of Things (IOT) is the extension of the Internet to the next level, i.e., bringing the Internet to the real physical world of things. In this research, 22 people working with different aspects of IOT development were interviewed in Finland and in China, in order to investigate

their thoughts and personal opinions on the IOT and the individual privacy in the IOT. This paper presents the background of the IOT, interviews and collected answers, as well as highlights of collected free comments.

- J. Virkki and P. Raunonen, Perspectives for Wearable Electronics in Healthcare and Childcare, E-Health Telecommunication Systems and Networks, Volume 2, Issue 3, 2013, pp. 58-63.

This paper starts with a literature survey that introduces possibilities of wearable electronics (WE) in different healthcare and childcare applications. Next, 24 personal interviews and an Internet forum survey were conducted in Finland about the use of WE in applications mentioned above. According to the results, most of the people feel positively about clothes used for wireless identification purposes in healthcare and childcare, but when more information about the person is added that can be wirelessly read, the feelings become more negative. Several important points to consider before implementation of WE for healthcare and childcare environments were brought up.

- J. Virkki and R. Aggarwal, Privacy of Wearable Electronics in the Healthcare and Childcare Sectors: A Survey of Personal Perspectives from Finland and the United Kingdom, Journal of Information Security, Volume 5, Issue 2, 2014, pp. 46-55.

The innovative development of Wearable Electronics (WE) is creating exciting opportunities for application across many industries. Two sectors with high potential are healthcare and childcare. However, it is in these two sectors where the challenges of privacy are presumed to be of the highest. In order to ascertain the personal views of people about potential privacy problems in WE application in these two sectors, interviews with questionnaires were conducted in two different countries; Finland and the United Kingdom (UK). The results indicated that the majority of people in both countries are positive about the use of WE in healthcare and childcare environments. However, when more information is added to be read wirelessly, the attitudes become more negative. In general, the application of WE is more favorable in the UK and the reason as to the difference will make for interesting further research. Several interesting viewpoints and concerns were presented in the interviews. It can be concluded that the implementation of WE in these two sectors will require the collaboration of work on several areas and the development of versatile user studies.

- Y. Liu, Y. Zhai, M. Yang, F. Long, and J. Virkki, Personal Perspectives for Smart Vehicles and Driving, Journal of Emerging Trends in Computing and Information Sciences, Volume 5, Issue 9, 2014, pp. 682-689.

It is not yet clear which of future smart technologies will actually be accepted as part of our everyday lives. In this research, the thoughts of 248 people about smart parking and smart cars and driving systems were collected by interviews and with an Internet survey in Europe and Asia. Firstly, it was discovered that different people have very different thoughts about what the widely used terms “smart cars and smart driving systems” mean. However, according to our results, the majority of the answerers would be willing to use these smart applications. In general, the Asian answerers were found to be more worried about these new applications than the people from Europe, and the reliability of the technology together with cost were considered as the major worries. People were found to be quite willing to let their personal information and driving habits to be recorded by these smart applications. However, the information about the people travelling in the car was considered private. Some major differences were found in results gathered with different methods, which is also important to take into account in further research.

- Y. Zhai, Y. Liu, M. Yang, F. Long, and J. Virkki, A Survey Study of the Usefulness and Concerns About Smart Home Applications from the Human Perspective, Accepted to be published in Open Journal of Social Sciences, Volume 2, Issue 11, 2014.

It is not yet clear how smart home technologies and applications will actually be accepted as part of our everyday lives. In this research, the thoughts of 248 people about smart homes were collected by interviews and with an Internet survey in Europe and Asia. It was found that people have very versatile thoughts about what the term “smart home” means in practice and when smart houses will become part of our daily lives. The Asian answerers can be considered to be slightly more optimistic about the schedule. The majority of the answerers were found to be interested in versatile smart home applications and willing to live in a smart house. The cost can be considered to be their biggest worry and the Asian answerers were found to be more worried about the reliability, practicability, and cost than the respondents from Europe. Also some privacy concerns were found from both the European and the Asian answerers.

- C.K. Chan and J. Virkki, Perspectives for Sharing Personal Information on Online Social Networks, Social Networking, Volume 3, Issue 1, 2014, pp. 41-49.

The goal of this research was to study how people feel about sharing personal information on social networks. The research was done by interviews; 50 people were interviewed, mostly from mainland China, Hong Kong, and Finland. This paper presents the included 12 questions and discusses the collected answers. It was discovered, e.g., that 38 out of the 50 answerers use social media every day and share versatile personal information on the Internet. Half of the answerers also share information about other people on the Internet. It was also discovered that compared to male answerers, the female answerers were more active in sharing information about other people. There was a significant variety in opinions on what should be the age limit for sharing personal information online, while 22 out of the 50 answerers felt that there is no need for an age limit at all. According to the answers, only a few people use social media for making new friends. Instead, an important reason for using social media is that their existing friends are using. An interesting finding was that the answerers see the Internet as a part of the real world; the privacy that you have on the Internet is the privacy that you have in the real world.

- J. Virkki and C.K. Chan, Perspectives for Sharing Photos of Children Online, Journal of Social Sciences, Volume 3, Issue 2, 2014, pp. 357-366.

The goal of this study was to gather the thoughts people have about sharing photos of children online. The work was done by gathering a literature review, studying 29 Internet forum discussions (in English and Finnish), and by personal interviews of 50 people (from Asia and Europe). Eight main viewpoints for sharing photos of children online were discovered that also supported the findings of earlier studies. Also, it was found that compared to the male users, the female users are more active in sharing information about other people online and also feel freer to share the information without asking for permission.