TOWARDS UBIQUITOUS NETWORK SOCIETY

Helsinki Institute for Information Technology

September 15th, 2006

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Based on a original Finnish report "Uusi Arjen Tietoyhteiskunta" for the Ministry of Transport and Communications of Finland April 10th, 2006.

HIIT Publications 2006-3

ISBN-13 978-951-22-8436-8 (printed)

ISBN-10 951-22-8436-7 (printed)

ISBN-13 978-951-22-8437-5 (electronic)

ISBN-10 951-22-8437-5 (electronic)

ISSN 1458-9451 (printed)

ISSN 1458-946X (electronic)

Picaset Oy

Helsinki 2006

SUMMARY

The Ubiquitous Network Society is an umbrella term for the next generation of information and communications technology, in which formerly separate developments will meet and join forces. The effects will be wide-reaching. Information technology will intrude into every location and situation; all kinds of content will be created, distributed, and consumed digitally; and all kinds of objects, goods, and even places will be integrated into the network with the help of ubiquitous electronic sensors.

By virtue of its unique features, the ubiquitous network society and its technology, *ubitechnology*, will open up enormous opportunities in all areas of life. Ubitechnology is *local*: spaces, objects, and situations will be enriched by ubiquitous short-range wireless networking, by location information, and by context awareness. It is *social*: the actions and context of the user and his social network will shape the available services and the information they deliver. It is *open*: it leaves room for the innovations and insights of each user.

These opportunities won't come to fruition by themselves. This report describes the most significant challenges the ubiworld sets for users, for developers of products and services, and for the regulatory authorities and government. The response to these challenges must be driven by people and their needs, not technology: a future may be technically feasible but nevertheless incompatible with everyday life, its customs, or its social structures.

Ubitechnology reaches everywhere and concerns everyone. This is why it has to be studied and developed holistically, taking into account all the actors and points of view. We propose the following actions:

- Communication infrastructure: *a gigabit for everyone.*
- Information security infrastructure: *safety and reliability for everyone.*
- Information infrastructure: *mobilization of information as raw material for services.*
- Service infrastructure: *open service architectures and interfaces.*
- From idea to service: *promotion of innovation.*
- Legal regulation: *defining the basic rules of the ubiquitous network society.*
- From research to services: *study of the ubiquitous network society.*
- From ubi-Finland to ubi-Europe: *the European dimension of the network society.*

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1 INTRODUCTION

1.1 A brief history of IT time

The history of information technology is easiest to present in the form of five successive generations, each having built upon the previous:

1st generation, the great machines: The computers of the first generation were housed in machine rooms with walls of glass, where they were looked after by clean-cut, tie-wearing technicians. They were the instruments of power of vast hierarchical organizations whose bidding they did as the engines underlying huge and complex business and administrative information systems. They created an industry in which the dominance of IBM seemed unquestionably strong and permanent.

2nd generation, the minicomputer: The arrival of second-generation minicomputers in the early 1970s moved computers out of machine rooms and into design offices and laboratories, creating as a side product the first hacker culture, bitterly hated by those previously in power. The harbingers of this generation were DEC, HP, and many other small (at least in the beginning) and quick players. UNIX was also a creation of this generation, and in the end its most lasting achievement.

3rd generation, the PC: The third generation, that is the personal computer (PC), snatched information technology from the hands of engineers and made it available to a wider audience, who started to use it on tasks scoffed at by the engineers, such as word processing and spreadsheets. IBM created this industry but, for better or worse, handed its control to the market. The sceptre was passed to the pair of Intel and Microsoft, in whose hands the whole industry changed. Was the PC the cause or the effect of the crumbling of the hierarchic organizations? The answer is still unclear.

4th generation, local area networks: In contrast to the previous phases, the fourth generation didn't arrive in the shape of a new character in the computer family, accompanied by drum rolls and horn blasts, but quietly through the cable plugged into the office wall from the PC's network card, as local networks took over offices and joined the previously separated PCs into an intranet. The computers were no longer used just for word processing and spreadsheets, but also for e-mail and other trivial things, and companies started to draw up diagrams depicting matrix organizations instead of pyramids. Globalization started to build up speed and the middle managers collected their last paychecks.

5th generation, the Internet: The move into the fifth generation was made in the early years of the 1990s as the Internet escaped from the hands of its inventors and spread throughout the world. The computer was no longer a window onto the contents of a local hard drive or intranet, but onto the whole world. From machine rooms and offices it moved into homes and started the

corruption of the youth, who were keen on games and on-line chatting. Linux and open source are one of the products of this generation. This development is still ongoing and we have yet to know its eventual impact on business and organizational structures. The 1990s were a curious era in that we also witnessed the revolution of digital mobile communication through the explosive spread of GSM phones and cellular technology. The full force of this development has not yet merged with the Internet mainstream.

From each generation to the next, information technology has thus

- Infiltrated from machine rooms to offices and homes;
- Reached new users, whose needs have quickly begun to guide and dominate the development of the technology;
- Destroyed and given birth to whole professions and industries;
- Transformed and shaped organizations and communities, management and power, control and free speech;
- Shaped both work and leisure;
- Shaped the foundations of the economy;
- Split the world more deeply between winners and losers.

1.2 What is at issue?

This report has been written because, even though the upheaval caused by the fifth generation is still in progress, the next generation and its transformations are already at hand. Along with it, information technology will force its way into those places and situations it hasn't yet reached, as the new Internet, focusing on portable communication devices and optical data transfer, will reach between 1000 and 2000 million users throughout the world in the next 5 to 10 years; all kinds of media content will be created, distributed, and consumed in digital form; and various kinds of objects, goods, and services will be integrated into the network with the help of ubiquitous electronic sensors.

The upheaval caused by the change may prove to be more profound and violent than all the previous transformations. It may be that this new phase will once again give rise to new winners and new losers; disrupt the structures of the economy; shape both work and leisure for good and ill. Unlike the previous changes, it is not yet clear whether it will deepen the technological chasm between the developed and the underdeveloped world, or narrow it.

An adequate title has yet to be found for the new transformation. The term used as this report's title, *Ubiquitous Network Society*, is good for describing what's going on but can't quite transmit the explosive force we feel this upheaval will definitely have. On the other hand, the phrase

ubiquitous computing, or *ubitechnology*, is a cryptic and difficult term and makes the sceptics wonder how the letter "u" really differs from the vowels used on previous occasions (i-, e-, a-). For brevity's sake we will use this term and its derivatives, and talk about ubi-Finland and the ubi-world without shyness.

The core of mobile communication (and information technology), now part of our everyday life, is in the fact that wherever he is, the user can always be reached, and that he can use certain services (speech, text messaging, data transfer…) in the same way in every conceivable location. A consequence of this fact has been a kind of uniformity between time and location: work and leisure, office and home, private and public are blurring together and becoming virtual.

The ubiquitous network society and its technology stand apart from this in many profound ways. Ubitechnology is *local*: different spaces, locations, objects, and situations are enriched by short-range communication, the tracking of the user's devices, and the context information collected by the devices. It is *social*: the actions and situation of the user and other users belonging to his social network (co-workers, friends, family and relatives) will shape the ways in which the devices work as well as the information they transmit and how it is presented. It is *open*: it leaves room for innovations, combinations, and ingenious uses, both small and large, that ease the user's everyday life, as text messaging once did (to the great surprise of its developers).

To us it looks like the ubiquitous network society will also differ from the previous phases in that it won't result from the breakthrough of a single technology. It is more so a result of the synergistic convergence of previously separate trails of development. A few examples:

- Optical data communication in wired backbone networks;
- Wireless short-range and long-range networks and the basic technologies associated with them;
- Wireless sensor and location technologies;
- The movement of all wireless and wired communication into Internet-based technology (the so-called *all-IP infrastructure*);
- Open, component-based system architectures, which, drawing on Internet technology, cover actions like authentication, identities, session management, mobility, location, trust, integrity, privacy, and the indexing, management, and retrieval of information;
- Technologies of various application areas, especially XML-based languages and notations used to describe digital content and the semantic web built on them;
- The increasingly wide deployment and diversity of small terminal equipment, as well as the integration of networking capabilities into the software embedded in these devices;

The ubiquitous information technology won't have a single "killer application" that could swipe away every obstacle and bring users and developers along. It will proceed with shorter steps but on a wider front as information technology will reach and pierce everyday life, making all kinds of everyday innovations possible. Through this process more and more everyday actions will become information actions, which manifest themselves or maintain an influence in information technology – providing them with added value. We are talking about technology which is present in the everyday life of people, in different situations and environments, whether at home, at the office or in motion.

By looking around, one can see that part of this vision has already come true: information technology can no longer be found only in computers and cell phones but also in vacuum cleaners, stoves and children's toys, not to say anything about cars and consumer electronics. Nevertheless, we aren't talking about these already established devices and applications but about the whole greater than the sum of its parts, born as the parts are networked and made to communicate, thus providing a basis for multiple innovations and everyday services.

Thus, the ubiquitous network society is an umbrella term for contemporary visions about the future of information technology. It is not an extension of mobile technology, but a wider frame, under which previously separate trails of IT development can meet. It aims to make life significantly safer, more pleasant and easier to use. This has to be done with a human interest, not with the focus on technology: even though a certain future might be technically possible, it may not have a place as a part of everyday life, its established practices or the social relations it contains.

1.3 Outline

The writers of this report are researchers of the information technology of the future, representing different areas from technology to the humanities, social sciences and design. We are not futurologists aiming to predict the future: it is much more interesting to take part in creating it. We aren't trying to give easy answers to difficult questions either.

The aim of this report is to describe the most significant challenges the ubiquitous network society presents to the users, applicators and the developers of goods and services, to be solved before it can reach its destination. On these grounds we try to draw up possible ways of advancement and actions to be taken. Even though the focus of the ubiquitous network society is far away, possibly in the year 2015, we try to keep our feet on the ground and recognize things to be done already in the near future. We felt that the creation of a clear picture of the ubiquitous network society and the raising of conversation is more important than the single actions and lines of development that we propose – many of them being controversial and requiring further thought. The draft of the report gave rise to over forty different statements from various parties

and positions. Together with the report they present a many-sided collection of material suitable for the research on further actions.

The Finnish network society has succeeded in producing goods but not services. Since the ubiquitous network society is based significantly on innovative services, this weakness must be fixed. That is why we focus especially on trying to recognize actions that could further the development, testing and swift introduction of innovative services. We highlight the point of easing the everyday life of users, without forgetting the progress of the efficiency and productivity of different appliers and utilizers.

From the Finnish point of view, the next generation is the first in which we are – or could be – leading the development, not just adapting to it. The fact that we still haven't recovered from earlier transformations or made adequate use of the possibilities they offer, as well as having to work in a "post-hype" environment in which new technology and its influence is taken with suspicion, will make the new change more difficult. We hope that this report could play its part in removing these obstacles from the way of ubiquitous information technology.

1.4 Guide to reading

This report is naturally too long, but the subject is also far from simple. Luckily, the report can be read in many ways.

Those who are impatient or in a hurry can skip straight to chapter 4, which contains our recommendations concerning communication policy. A reader in need of more background can also read chapter 2, which describes the possibilities and challenges of the future in the form of six scenarios, as well as glance at chapter 3, which focuses more on subjects brought to light by certain scenarios and other material.

A reader interested in particular themes (e.g., protection of privacy, legal questions, ease of use) will find material of interest in chapter 3 as well as in the theme articles presented in appendix 1.

2 VIEWS ON THE DEVELOPMENT OF THE FUNCTIONAL ENVIRONMENT OF COMMUNICATION

2.1 Ubiscenarios

Ubitechnology reaches or shapes different areas of everyday life, traffic and work. Its impact is shaped as the sum of multiple concurrent and co-strengthening changes, through different singular influences and interactive relations.

This is why the description or understanding of the nature of the ubiworld is far from simple. In the process, one risks exaggerating the significance of a single technology or service in a way that is well suited to lowering the credibility of the whole outline. It is as easy to play down the concrete significance of a technology, application or service, which manages to pierce and immerse its whole user group and reach destinations not even dreamt of by its inventors. Who would've realized the full potential of the text messaging service while it was being developed?

A way of avoiding these difficulties is to use scenarios to describe a possible world of the future. In this context scenario is used as a word for a comprehensive, structurally consistent and logical description of a hypothetically possible future. Therefore a scenario is not a forecast, and doesn't need to fulfil itself in the way described.

Scenarios can be made in different ways and for different purposes. The scenarios contained here are aimed at making visible the effects of certain policy decisions (or the refusal of these decisions) that have much influence on the future and to provide material for these decisions as well as the conversation concerning them. We are focusing on drawing up alternate views of the functional environment of traffic and communication as well as different futures, challenges and possibilities having to do with the formation of policies on these questions.

We are trying to avoid the pitfall of techno-determinism: the ubiworld won't realize itself, by laws of nature, as the procession of events. Instead, the qualitative result depends on the selections, actions and power relations of different parties (government, multinational communities, corporations and businesses, citizens and consumers). For illustrative purposes, our scenarios are built on assuming a certain party, whose interests and solutions shape the procession of development. Because of this, the scenarios aren't necessarily exclusive, but can be realized in many ways in different countries and areas. In every case the historical, cultural and economical characteristics of each country will shape the result: the Finnish, French and American ubisocieties will be different even if they developed under the guidance of the same basic interests.

2.2 The Internet of goods and the Sorting Door

In 2004, Wal-Mart[1], the largest retail chain in the U.S. informed its one hundred most important suppliers that they would have to be able to equip every item delivered into stores in the Dallas-Fort Worth area (Texas) with an electronically readable detector (RFID, Radio Frequency Identification) by January 2005. By doing this, Wal-Mart aims at making its logistics and competition skills more efficient by making many phases of manual work automated with the use of the electronic tags. At the same time it tries to build up speed in the development and cheapening of RFID-technology (detectors, readers) and its affiliated IT-infrastructure (operations management, logistic systems), so that it could be brought to wider use. By the end of 2005 the chain had taken RFID-technology into use in 500 stores and five logistics centres. According to the information provided to the public it has achieved significant savings in, for example, the automatic creation of the picking lists needed in filling the shelves of the stores. In addition, the chain is waiting for even more savings once the technology is brought to use in the whole supply chain (pre-production, refinement, distribution), a move which is presumed to make it possible to follow the orders and deliveries throughout the chain automatically.

Why is this important? Wal-Mart's market force is heavy. Bar codes, now known by everyone, were originally brought to the field by Wal-Mart's initiative and sheer pressure. Now it seems like Wal-Mart's competitors are forced to establish the same technology for themselves and their suppliers in order to secure their future. The result is thought to be "The Internet of goods", a world in which goods that range from groceries and consumer goods to raw materials and equipment of the industry are equipped with electronic tags that enable tracking devices to follow their path from factories to their final destinations. The tags' reading devices will also become ubiquitous: for example, Nokia has for some time been researching the implementation of an RFID-reader into cell phones and the new innovations this process entails. The company is obviously capable of producing RFID-phones onto the mass market the moment it feels the demand is high enough and the readers are sufficiently cheap.

The victory of RFID-technology thus seems imminent. But what does this mean in terms of everyday life? Are we faced with effects we have more or less hoped for and which we can influence with certain actions and decisions?

It is easy to picture a large amount of innovative applications which would ease everyday life. Among these is a refrigerator that is able to notice the expiration date of foods and send a shopping list to the mobile device of a consumer, who is rushing off to the store; a washing machine that can select the right program for the clothes inserted inside and point out that a

[1] http://www.walmart.com/

certain item shouldn't be washed with the others; a cell phone one can use to pick information from certain products and search for additional specifics to help in comparing and purchasing the items. Naturally, consumers will also benefit from the lower prices, made possible by more efficient logistics.

It is also possible to imagine less-needed applications. As we step inside the store, the detector placed in the door can scan information from each article of clothing we wear as well as the contents of our shopping bag and wallet – this is the so-called *Sorting Door* nightmare scenario. This can be used to draw up a highly accurate profile of us, which can be used to make multiple deductions concerning our consuming habits and preferences of goods. On these grounds, the store shelves could plague us with tailor-made commercials or special offers. What if we step out of the store? Can any person walking on the street use his mobile phone to scan for the contents of our bags? One can also imagine the profession of burglary getting easier, when it is possible to check the offerings of a house from outside. These horrors might be somewhat exaggerated if the electronic detectors are coded in a way that has significance only in the information system of their manufacturer. On the other hand, experience shows that anything can be decoded if an incentive is provided.

Should consumers have a right to know if the goods they purchase are equipped with an RFID-tag? Should they have a right to read all the information in the tag with their own reader (that is, can the tag contain encrypted information)? Should they have a possibility of removing and deactivating the tags? Should they have a right to know when and for what purposes is this information read? Do they have a right to know what kind of information is formed by these readings? Should they have access to their own profiles? These are all public policy type questions having to do with RFID-technology and the rights of consumers, which are still waiting for an answer.

Similar questions can also be posed for other parties. Can a representative of a competitive retail chain gather an accurate inventory of the contents of a store's shelves? Can an RFID-hacker make a service-blocking attack by overloading the target's reading devices? Can the police read the RFID-information of a person suspected of a crime? Do companies have a right to read the RFID-information of their employees? How to handle passports containing biometric data and RFID capabilities?

RFID raises many questions. Since the technology also offers tremendously exciting and beneficial applications, these questions should be met with answers, which satisfy the users and create a sense of confidence. The same goes for other future probe-based technologies, which can be applied to quite fantastic targets, like the nanotechnology-using bioprobes now under development. These could be, for example, a band-aid that uses microcanules to suck a tiny amount of fluid through the skin, analyzes the molecules and sends the results through radio

waves into a collecting device, or even a toilet that uses its probes to monitor the state of the user's metabolism and helps him build up a healthy diet.

2.3 Discipline and punish: little and big brothers are keeping watch

In the end of 2005 there appeared breaking news, according to which the United States' National Security Agency (NSA) had been monitoring e-mail- and WWW-traffic much more closely than had been imagined. Part of this was based on the Patriot Act, set by President Bush in the aftermath of 9/11 in the hope of catching messages concerned with terrorist activities, but according to some sources the NSA had also applied certain procedures forbidden by the Congress, such as hidden cookies.

According to recent news U.S. officials have been pressuring Google to release collected information on searches, which would be used to investigate and limit the spreading of pornographic content. So far, Google has refused, referring to the protection of privacy and business secrets.

The European Union has prepared a directive on the recording of teleinformation, which orders teleoperators to record large amounts of information especially in order to investigate and prevent terrorism. The record- and film industries have also lobbied for closer scrutiny of communications, winning some member countries to their side in the process. Ireland and Italy have already established a mandate of recording information that stretches the countries' law regulation very far (Ireland for three years, Italy for four). Finland has recently decided to join this train's last cart.

Another big news event unfurled in the fall of 2005 in the form of Sony-BMG's so-called rootkit-case, in which it was found that the DRM[2]-technology applied by the company in its records installs a module, a harmful program, on the user's computer without his knowledge, thus making the computer vulnerable for multiple information security risks. In other ways as well it looks like the communication control of the officials and the media control of the content industries are very much alike on the level of technology. Is this the reason why the media industry has so easily had its demands accepted on the part of technical or juridical equipment that ease the control of media?

One need not be especially paranoid to think of the kind of future these and other similar traits refer to. Is the Internet and its affiliated applications of communication and media technology becoming a sort of police state, in which either a big brother or a large amount of little brothers monitors the users and restricts their movements? If this threat seems terrifying for the Internet we know, it is possible that in the ubiworld discipline and punishment might obtain an

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[2] Digital Rights Management

unprecedented scale. It probably is the case that it is too late to choose whether we want more privacy or regulation, and that we should talk about either a controlled or uncontrolled demolishing of privacy. Historically, privacy is probably a construction born as a side-effect of industrialization, which mankind has otherwise rarely enjoyed or missed.

It is characteristic for the ubiworld, that people are, in effect, always within the reach of one or more wireless communication technologies and can both send and receive messages and media through them. Still, this presumes that the users' equipment has an identifying electronic identity (MAC-cookie, Bluetooth-identity etc.), which comes to the knowledge of the wireless network. This way, the movement, communication and media consumption of the users can be monitored in all locations and situations of life. While the monitoring of Internet behaviour and media consumption offers only a tiny peeking-hole into people's lives, ubitechnology forms a real panopticon, in which nothing happens unnoticed. Even now, the people who have reasons to hide information concerning their movement and communication know this extremely well and use rapidly changing prepaid-connections in their mobile phones. In the future, maintaining privacy may mean a total rejection of the electronic society: refusing public services, obstructing marketing, refusing to submit information and rejecting every customer card and credit card. This is probably possible only for the very rich or the very criminal.

A certain line of development concerns the arms race, in which the disciplining and punishing party is countered by grassroots development, which avoids the monitoring eye by using the weaknesses and loopholes of the observation technology. The relatively new phenomenon of Skype can be used as an example of this tendency. On the other hand, Bittorrent2, released in March 2006, is an example of P2P-file transfer technology, which poses a hard task for the observing party in clearing who shares what content with whom. It is therefore highly possible that the users who the observation is trying to regulate and control, are left out of its reach and the monitoring only works by making life more difficult for the law-abiding and technically less proficient people.

2.4 Gadget heaven

Video game enthusiasts can hardly contain their excitement over the release of the third generation game consoles over spring 2006. Judging by the rumours (some of them sent by the companies themselves) there really is much reason for excitement: the market leader Sony's Playstation III will offer at least nominally the power of over 2 billion calculations in a second (2 teraflops) which puts it firmly into the supermachine-category. As the graphics processor is also of the same quality, one can understand that the wait seems unbearably long for the gamers. As crucial as this is the fact that the device is also equipped with all the standard data communication properties, thus challenging the role of the computer or a digital terminal as the core of the home entertainment system.

A few years back, the computer manufacturer Apple, known for its stylish design and ease of use, stunned the world when they brought out the iPod-series of digital music players. Throughout its existence Apple hasn't been shy about releasing devices that probe the new needs of users and shape the market's structure: the cornerstone of the company's success was the birth of the radically original Macintosh-computer in 1984. Many of the company's devices haven't had the success they were aiming at, but with iPod they hit the right notes. It has become a huge success and an integral part of the clothing of a trendy person. At the same time Apple has transformed the rules of sharing music in one move, through its popular iTunes-service. It seems obvious that a growing part of the distribution and consuming of music happens not by listening to CD-records but by the assistance of a device such as the iPod. Most iPod's can also play video and it doesn't seem far-fetched that part of the watching of DVD's would be moved to an iPod-type platform.

The years 2004 and 2005 formed a turning point, during which the sales of digital cameras finally passed the numbers of film cameras sold in most developed countries. Most of the photos taken around the world are now taken in digital form. A large part of them are also consumed digitally, whether by looking at them on the camera, the computer, television or on another device such as the iPod.

Game consoles, devices meant for the production and playing of digital music and video, digital cameras and mobile phones are all examples of *digital convergence*. The trailblazers of this development can be found in the manufacturers of consumer electronics as well as in companies like Nokia, which long for their own part in the market of media content. The consumer market and its needs is also a driving force in the development of the basic technology (processors, memory, monitors, interaction devices…). The needs of the consumer market are already much more important for the development of, for example, processors than the traditional market of IT-professionals.

The kingdom of traditional consumer electronics has always been the home, or, more accurately the living room. New electronics deviate from this by focusing on portable devices, often equipped with a wireless network connection, through which the reach of consumer electronics covers practically all the locations and situations in life – it is ubiquitous. This can't help but reflect on the distributed and consumed content: for example the contents and formats of mobile television will surely be based on different expectations than the TV one watches from the couch at home. In the research[3] on mobile video made by the National Consumer Research Centre of Finland, it was noticed that a picture taken from a large-size media (TV) can't be transferred onto the small screen of a cell phone just like that. On the TV screen, the facial

[3] Repo et al. 2003, http://www.ncrc.fi/files/4703/mobiilivideo.pdf, in finnish.

expressions of people can already be made out from half-body shots, whereas on the small screen the outline would have to be far tighter. Of course, the situations of viewing the programs (on the bus, at a café, at the bar) are also completely different from the company of one's family or the familiar couch.

The demands and possibilities of technology have already had an effect in Hollywood, where the production companies design their movie projects so that material is filmed at the same time for different versions of the product; a widescreen film is different from the first DVD-version, which differs from the Director's Cut DVD or the version distributed on TV. The same occasion can also be used to film material for official games and other products. Soon we will probably see cut versions of long Hollywood films formatted to fit a small terminal device.

The electronics of entertainment and other digital content working in cars seems to form a major part as a user context of the ubitechnology of the future. Even now, cars are naturally filled with sensors, actuators and immersed IT. Trafficways have also already been equipped with devices measuring information on traffic and the weather automatically. The combination and cross-using of this information can already be seen as a result of the active development programs of the car industry.

The future of digital convergence looks rosy. Nevertheless, its path is not completely without troubles: for example, it remains to be seen what consumers will do if, after ten years, they can't watch their photos due to the evolved media- and recording-formats.

The worst threat could be that devices like the iPod (and the interests of the manufacturers) are fundamentally at odds with the interests of the content providers (in this case the record industry). In the long run, it is difficult to think that the purchase of legal content for a 300-euro device would cost 10 000 euros. University of California Berkeley professor Michael O'Hare suggests the balancing of interests in quite a radical way. According to this, the distribution of recordings (and other digital content) should be done for a marginal cost, that is, for free. The compensation for the producers of music and other content would be based on a media tax collected from the consumers and distributed to the producers on the basis of consumption, for example the number of times the record has been listened to. The benefit of the suggestion is that it transforms the incentives of each party fit for ubimedia: the content providers should offer their content as widely and easily as possible in order to fill the devices of consumers. Since the consumers pay a tax for the content, they have no incentive to cheat or fake their consuming information.

A second possible bottleneck is that the workers of consumer electronics may not have a business incentive for the application of open interfaces and standards: a good example is the war going on over the standards of writable DVD-discs. Even the tiniest increase in costs caused by openness is meaningful when we're talking about a device meant for the mass market. On the

other hand, openness may speed up the development and introduction of new product-variants. Open innovation environments, in which a company can outsource a part of its product development for others to pay, are also sinfully tempting and frightening for companies.

It also remains to be seen, whether the solutions of the car industry end up in using open technologies; the temptation for the so-called walled garden type closed structures is real. Real ubiquity presumes universal openness and the space this creates for new innovations; the danger with closed industry standards is that they shape up as a kind of "minitel" that in the end proves to be a dead-end or obstacle to development. In the area of traffic, the government should use its own market force as a producer and owner of information to the benefit of open systems.

2.5 The Internet of the users

One of the basic principles of the Internet's architecture is the so-called *end-to-end principle*, according to which the network that relays packages is "dumb": it only transmits information from the sender to the receiver without checking the content. "Intelligence" is situated in the endpoints of communication, in the computers or other equipment interacting with each other.

The original creators of the concept, Jerome H. Saltzer, David P. Reed and David D. Clark[4] were working towards trustworthy communication, while proving that network-based traffic handling is unnecessary as the management can be more efficient when it is situated in the endpoints. The significance of the concept can also reach wider areas: as an example, Tim Berners-Lee couldn't have developed the Web on his own and without anyone's authorization if he hadn't have based his work on a neutral and "dumb" network. That is how the end-to-end principle has, in effect, furthered the fast development of the Internet by offering an open and neutral platform for innovations.

A related concept that has also played its part in the development of the Internet is the *end-to-end connectivity*, which means that any network endpoints can communicate without interference from the network. This principle has also been seen to speed up the diffusion of innovations by clearing obstacles from the path of new ideas and technologies and by making possible the so-called *network effects*, in which the added value of a new service grows exponentially in relation to the actors involved in it.

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[4] See Jerome H. Saltzer, David P. Reed, and David D. Clark. End-to-End Arguments in System Design. Second International Conference on Distributed Computing Systems (April 1981) pages 509-512. Published with minor changes in ACM Transactions in Computer Systems 2, 4, November 1984, pages 277-288. Reprinted in Craig Partridge, editor, Innovations in internetworking. Artech House, Norwood, MA, 1988, pages 195-206. ISBN 0-89006-337-0. Also scheduled to be reprinted in Amit Bhargava, editor. Integrated broadband networks. Artech House, Boston, 1991. ISBN 0-89006-483-0.

Both of these principals have become endangered through the growth of the significance of the Internet and the distribution of digital content. Consolidated content- and data communication businesses (AOL-Time Warner, *et al.*) have tried to bind the consumers to their services by creating networks with solutions that violate the end-to-end principles. End-to-end connectivity has been endangered by different data-interpreting and filtering network elements, such as network address translators, firewalls and proxy servers. In its original form, end-to-end connectivity can probably no longer be saved, at least not without a thorough remodelling of the Internet's architecture.

The basic ideas behind the open source code are mainly drawn from the same sources as the end-to-end arguments. When the program platform is transparent and same to all developers, successful ideas will spring up fast, providing a platform for new innovations. A few examples of open content (*e.g.*, Wikipedia) speak strongly for the fact that openness, transparency, and neutrality of the connectivity-providing technology are important points for digital content as well.

The antithesis of end-to-end principles is the traditional telenetwork, where all the "intelligence" is in the network instead of the terminal devices. It is no surprise that in the early years of Internet development AT&T was one of the fiercest opponents of end-to-end thinking. The striving of teleoperators to limit the services available to mobile phones to those they themselves produce (the so-called *walled garden principle*) is a product of the same kind of thinking. The failure of the WAP-based mobile Internet is commonly seen to have resulted largely from these actions. Due to the limits on the technology of the contemporary Internet (WWW and html/http), the services distributed to home entertainment systems (TV and information services) are largely based on walled garden thinking.

Who controls the development of the ubiquitous Internet of the future? Whose starting points and needs will be placed first? It looks like the interests of the different parties – media corporations, teleoperators, device manufacturers, different users and applicators – are at odds, and lead to different conclusions. Some of the other scenarios presented in this report focus on these alternate futures.

The term "the Internet of the users" describes a future in which end-to-end principles, open source code and its counterpart in the field of digital content, *Open Content*, have been victorious and gained the position of a development-speeding actor. In this world the Internet – containing the mobile, ubiquitous Internet – leans on an open, transparent and neutral architecture, which provides a platform for multiple innovations and services created by different parties. The data communication network works as a neutral "bit pipe", but also provides the qualities important for the trust of different users, such as mutual authentication of terminals and the protection of their privacy. Along with the innovation of services and applications the development of

terminals will also gain speed, because the open and shared program platform will help remove program development from the bottlenecks of product development.

Openness to new innovations is also a choice of values, which in integrally linked to principles of freedom of speech, the transparency of government and the principles of democracy. The Finland Information Society Council's[5] recent recommendation for the use of Creative Commons[6] licenses in the distribution of governmental media content is an example of a correct procedure in this light.

The Internet of the users is still wild and reckless, being also open to civil activism and EFFI[7]-type of a open discussion for influencing legislative proposals concerning personal privacy, freedom of speech and user rights in copyright law. It is also as open to unwanted or even criminal activities and content. The way in which an environment that is open to innovations and grassroots actions could be made secure and reliable to its users, as well as providing (barely) adequate tools for the prevention and investigation of suspicious activity is a current and important research question.

2.6 Ubimedia

The threshold to becoming a producer of media, not just the consumer, is constantly being lowered. Approximately 39% of Western-European homes have a digital camera. In 2005 nearly 300 million camera-cell phones were sold: Nokia is already the world's largest manufacturer of digital cameras. The cameras in the newest phones can by now produce pictures equal to standard cameras, at least when it comes to simple shots. As the memory capacity of phones has also risen to an adequate level (making possible the saving of tens or hundreds of digital photos), it is possible that, for some of the consumers, the intelligent phone will replace the digital or traditional camera. Therefore, households now have a large number of cameras equipped for taking photos or video instead of one or two film cameras. At the same time, through the combination of consumer electronics and information technology as well as digital technology, TV, movies and games are basically of the same substance as the home's PC, broadband or the equipment for the recording of video and photographs – as has been described in section 2.4.

As a result of this technological similarity (convergence), personal media is mixed with public media: the same computer, digital set-top-box or game console contains and displays the user's own photographs and the soap series most recently recorded. Convergence also means that

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[5] See http://www.tietoyhteiskuntaohjelma.fi/tietoyhteiskuntaneuvosto/en_GB/information_society_council/

[6] See http://creativecommons.org/

[7] See Electronic Frontier Finland, http://www.effi.org

public and commercial media production is no longer restricted to a band of professionals. The Internet has given birth to geographically independent micro-audiences. A fairly esoteric hobby or common interest might just as well create on-line communities or a public for amateur media – everyone can find their audience. In the world of network media, this material has easily been brought to the reach of people and content is available from one subject to the next.

The mixing of professional media can also be seen in the media of the immediate circle, that is, in media not meant for anyone except one's family and friends; for example, personal photos or home videos. To ease the use of personal media (photos, videos, e-mail and text messages), there are a number of professional tools, services and products, which can be used in the spirit of traditional family photography to create new kinds of media works, in which professional media blends in with private media. As an example, one could mention home videos that include commercial music or film, or photo books, which contain material collected from the network.

The most common forms of self-produced network media meant for public distribution are personal websites (*e.g.*, home pages and blogs), sites made for a school or some other organization, the distribution of self-made media (graphic art, photos, stories and video) on-line as well as the "remixing" of personal media by including net-based content.

Network media is usually produced by a single person, and is thus a matter of channelling self-expression and personal creativity. These can be attached to project-like media productions, where the authors are an accurately selected and well-versed group of enthusiasts (*e.g.*, the Star Wreck movie[8]). Another alternative is open content production, where the developing community gives birth to media products collectively (*e.g.*, the open dictionary Wikipedia). There are also different kinds of communal forums situated in the grey area of public and private media, such as fan-communities, hobbyists and interest groups.

The phenomenon of personal content production is in itself far from new. This sentence has been written in a room where there are one and a half shelf-metres of photo albums filled with personal photographs – media the writer values dearly. An important difference from earlier media production is that we are now talking about digital media, where one can add *metadata*, additional information about its use. For example, a photograph can be provided with information about where and when it was taken, what is in the picture and which situation or experience is it connected with. When a digital photo is taken with a cell phone, most of this information can be formed automatically or deduced by the information known to the phone. What is most significant is the *social metadata* joined to the media: Who took the picture? Who are the people in it? Who might be interested about the picture or its target?

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[8] See http://www.starwreck.com/

As this kind of metadata is attached to technological platforms on the Internet's scale, like search engines and metadata-fluent media browsers, the network media of the users changes into *ubimedia*. Through the platforms, the pictures and videos become a part of the network's content, which can be joined to other content by same or similar metadata, and in which the production and consumption of media are separated into independent channels.

An interesting and thought-provoking example of this kind of activities is provided by Yahoo!'s Flickr[9] photo sharing service, which is based on user-defined notes, "tags", attached to the pictures. Even though each user has his personal way of tagging photos, it is shown that users who know each other, users interested in similar things, users taking photos in the same kind of situations *etc.* mark their photos with statistically similar notes. This makes it possible to group the photos through the similarities in their descriptions. For example, while writing this text, Flickr has a cluster of approximately 300 photos, which is characterized by the following list of tags: *torino, turin, italy, olympics, olympic, winter, italia, games, olimpiadi, mole, night*. It isn't very difficult to guess what the photos are about. The information submitted to the system about the social relations of the users (who knows who) and other social metadata make this kind of clustering even more efficient.

The Google Maps service[10] provides another interesting example of the rise of ubimedia. It offers a map/satellite image service which covers (nearly) the whole globe, and is already staggeringly detailed. As for ubimedia, it also offers a technological platform for the publishing and finding of different kinds of location-centred information: when one writes, for example "Italian restaurants near UC Berkeley" one is provided with a map with 10 restaurants near the University of Berkeley, as was the point.

Yahoo!'s Maps service, still in trial use, offers a similar service, which also lets users add comments and social metadata, such as Flickr-type tags, on the information locations. The search "jazz in San Francisco" brings up a list of 580 hits and, using the user's profile information and social network, shows the top 25 on a map of the city. Users can easily add their own content in the service and, especially with San Francisco one can search for information on nearly any kinds of human activities or events. Through the open software interfaces provided by Yahoo! any Internet-program can search for this information, and the service has already brought up a wide array of independent ubimedia-services on its side.

It isn't hard to imagine the explosive force there would be for a service that manages to join the media production and the formation of varied content and social metadata based on cell phones

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[9] See www.flickr.com

[10] See maps.google.com

with this kind of media-organizing search service which supports different applications. A motorcycle person could order an RSS-feed into his cell phone, and get every motorcycle-photo his bike mates have taken transmitted straight away. Along with the upkeeping of social networks and entertainment applications, there could also be professional applications leaning on roughly the same technological platform and machinery of media production. Most of this report has been originally produced on a MediaWiki-platform, which offers a shared and structured working space for the co-operation of a research team and supports the upkeep of a shared consciousness on the writing process and the progress of background research. The teamwork-tools of the future will most likely also take advantage of other digital media, rich metadata and social networks for the support and variety of knowledge-intensive work.

It seems likely that ubimedia inlaid in suitable application platforms is going to shape the internal and external communication of companies as well as their other actions. For example, high-speed communication with equipment of both fixed and mobile networks (Instant Messaging) is already replacing many private message procedures in the corporate world, and a phenomenon similar to the Skype service is possible there as well. In corporate communications, the possibilities for metadata, especially ubimedia enriched by shared situation information, in product development, customer network management and logistics are many-sided but not practically tested.

Nevertheless, it must be asked which kind of a world are we working in, when we make the move from this world, already made intensive by mobile phones, text messages and e-mail, to the world of ”24/7 ubiquitous messaging” in the sphere of work. How can we manage the interruptions or the limited attention span and stamina of the users?

2.7 Ubitraffic

Those trying to reach Helsinki City area in the morning are fed up with the slowing and jamming of the traffic. In the eyes of drivers from Central Europe these lines would be child’s play. When the word “stau” is heard from the German car radio, there is every reason to perk up: a German traffic jam may not be a thoroughfare but a phase of hours spent immobile in the line. The tip of bringing lunch for a longer drive seems completely correct. It may not even be a question of a vacation-day traffic jam: according to the recent study by the German DEKRA[11] company nearly half of German motorists are weekly stuck in a line, with one fifth on the line every day. For this reason only, it is not surprising that the smoother flowing of traffic belongs to the targets of the traffic research in the EU’s seventh framework program under preparation, which also includes

[11] See www.dekra.de

the subtraction of the environmental hazards of traffic, the addition of co-operation among different forms of traffic and the furthering of traffic safety.

The ubiquitous network society and the technologies at its foundation offer many possibilities to the striving towards these goals. Probe systems, mobile devices as well as the growing popularity of wireless transfer and device tracking open doors to the collection of real-time traffic information. The "intelligent" electronics placed in the vehicle make it possible to distribute information produced by these means to the driver (or vehicle). Intelligent phones offer a platform suited for many kinds of traffic-related services, and one which reaches nearly every user.

Already in the near future we could imagine a world, where it is standard procedure to equip all motor vehicles with a remote individual electronic detector to collect up-to-date traffic information. This would make a great number of applications possible, such as traffic management and guidance for estates, terminals and other closed areas; the providing of individualized services at parking garages, gas stations, repair shops, car inspections, *etc.*; the identification of stolen and uninspected vehicles; different logistical applications. Since anyone could read the detectors on a reading device, the field would be open to the users' own applications – even those that may startle those worried about the protection of their privacy.

The benefit of the solutions based on intelligent phones is that they naturally support the chaining of a trip that takes advantage of different transports (*e.g.*, car-train-tram), where the observed unit has to be a person, not a vehicle. Since the phone is personal and makes it possible to identify the traveller, we could also sketch up adaptive applications, where the car adjusts to the preferences of its user, like automatically adjusting seats and rearview mirrors – or maybe the dialling of radio stations. This would be exceptionally beneficial if the car is used by different drivers (carpooling/sharing, car leasing). Traffic management applications can also be imagined, such as intelligent tolls that take into account the number of passengers or solutions favouring carpools (carpools may drive on the bus lane and be relieved of tolls).

Just a bit later in future the cars could be equipped with a traffic telematics device. It could be used to notify the driver of traffic information, like traffic signs and speed limits that change depending on the traffic and weather, as well as automatic emergency calls. When the device makes the locating of the car possible, a possibility opens for, *e.g.*, automatic speeding supervision. It would also make it possible to collect automatic tolls, by which the taxation of car-use could be moved from a tax paid on purchase of a car to paying for the use of it. Tolls could also be individual, making the pollution created by the vehicle a criterion for payment.

As this kind of a change would definitely make many motorists consider alternate ways of transportation, the attractiveness of public transport could be increased by offering a WLAN-based data communication service at stops and on the vehicles for the price of the ticket. This

way the time used for travelling (approx 70-80 minutes daily) would no longer be "lost" time, but could be used for one's own joy or the joy of the employer. Increasing the capacity for communication and creating higher-quality services will probably change people's experiences about daily travelling in the long run.

When a GPS-locating service is added to the mobile phones of consumers, the doors will also open for communal services based on user-collected traffic information; reporting a messy rest area; marking interesting sights on different routes and discussing about them; only the imagination (of the users) seems to set the boundaries for possible services.

The mentioned imagination may also reach less-favoured services: what if young people interested in speeding start to share information about adequate road strips and the record times they have made? Handy users have already made additional services for car navigators, which include the location of police traffic cameras, most likely to high demand. Ubitechnology works both ways; the sword of supervision may strike the very hand holding it.

3 THE CRITICAL DEVELOPMENT FACTORS AND PROBLEM SITES OF COMMUNICATION

This chapter describes and estimates the critical development factors and problem sites of communication in the light of scenarios and other material. By a critical development factor we mean an obstacle blocking a pursued path of development or a missing piece that would make the path possible. A problem site ("a pressure point"), on the other hand, is a real complex situation of choice, where the interests of different points of view, goals, and actors have to be made to fit together.

We will focus especially on the following development factors, which we feel to be the most essential:

- The agenda of the ubiquitous network society: what and to whom?
- Usability and the values of users
- The networks of the ubiworld
- Contents and content management
- Services and service production
- Business ecology
- Trust and the protection of privacy
- Legal regulation
- The critical development factors and problem sites of traffic.

Articles shedding more light on the themes of this chapter have been gathered in appendix 1.

3.1 The Agenda of the ubiquitous network society: what and to whom?

The recently published report of the Information Society Council has chosen as its point of view the furthering of productivity on different sectors and businesses. This is indeed an area where information technology has a lot to offer.

While pondering the ubiquitous network society we must first ask, on which kind of base values we want to develop it. Are we mainly looking for efficiency, the streamlining and promotion of the production of different services, and by this, increased productivity? If the answer is yes, whose productivity? And who does the added value belong to? We must also think in what manner should we take into account the different values, such as the principles of Nordic democracy with its transparent government, dialogue with the public, freedom of speech, democracy and the equality fulfilled over different borders (areas, social groups, ethnic groups).

Are we ready to pay more for an Ubi-Finland, where these values are also fulfilled? If yes, how much more?

Taking a side to these kinds of questions forms the foundation for the politics of the network society. A well-shaped and clearly argued standpoint sets the border terms, by which politics are made. This report sets out from the assumption that the target must be a balance between productivity and other values.

Estimating the productivity of different actions and services on the terms of the ubiquitous network society would in any case be difficult and leaning solely on it could produce slanted results. The main reason to this difficulty is the observation of different direct and indirect influences. How much would productivity be boosted by the distribution of teaching material, capable of being coded digitally and freely distributed, to every school, applying either digital television's broadcast-data transfer or P2P-networks? The costs of this kind of system could be calculated quite easily, as well as some of the savings the system would provide compared to the present situation. But how can the value be calculated if the children can (perhaps) learn better and the teacher (perhaps) make do with a little less work?

The complexity and difficult use of technology are challenges especially for two groups of people: the elderly and the immigrants. For both groups, the use of new technology and the adjustment to an environment filled with modern information technology can be difficult. The elderly and the foreigners moving to Finland suffer most from the lacking usability of technology due to insufficient education, physical limitations and language problems.

From the point of view of the elderly, most scenarios of the ubiquitous network society describe an intelligent home filled with new technology as an element that widens possibilities and raises the standard of life. At the same time the worries of friends and relatives could possibly be relieved. Still, the new technology should not be realized so that sensor-based automatic monitoring would cut down already narrowing social contacts. People use networked information technology especially to search for contacts to other people. The new communication and media technology provide many possibilities for the enrichment of one's own everyday life with ways familiar from traditional photography: memories, the feeling of togetherness, nearness, personal identity, as well as the identity of the family. At the same time it offers a chance to influence public debate. There's no reason to presume the case wouldn't be like this concerning the elderly as well. How should this be taken into account when making choices about the solutions to be fulfilled?

Both groups may also have a potential of being in a different role in the new society. The older people could be alert and long-living resources as kind of "emeritus"-consultants in the working life, but also as a family's spiritual resource in everyday life. This might also have a value reflected in productivity, but how large is it? Immigrants are also a necessary resource in working life, but

also in the society and culture. In addition to this, the relations to one's country of origin, community and personal identity are naturally significant to the immigrant. How much value do these factors have? The violent demonstration events of Paris in the fall of last year, maybe also those in Helsinki this fall, show clearly the price to pay for neglect.

3.2 Usability and the values of users

3.2.1 Changing values

The basic values of different users form a strong current in the ubiquitous network society and moderate the success and social acceptability of the services it provides. Following Manuel Castells, these basic values seems to shape up through the interaction of two large-scale phenomena: *networked life* and the *construction of identity*.

Networked life sums up every direct and indirect influence the wide introduction of modern communication and information technology as well as digital media in developed households and especially the business-elite ("networkers") has brought with it.

Multimedia-supporting e-mail, instant messaging, mobile calls and text messages have fundamentally shaped the content and rhythm of several knowledge-intensive tasks. At the same time, most large and small companies have introduced information systems (*e.g.*, Enterprise Resource Planning, ERP; Customer Relationship Management, CRM; Product Data Management, PDM), that cover the operative field of the whole company or network of companies and make it possible to react very quickly to changes and opportunities in market situations.

According to a phrase popular with company managers, a modern company should resemble a fighter plane, in that the aerodynamics of the planes are intentionally designed unstable, in order to enable otherwise impossible moves with the assistance of information technology. Without information technology, a Hornet would fall down like a stone; the same would happen to a large modern company. Professor Paul Lillrank from Helsinki University of Technology, Department of Industrial Engineering and Management uses the term *precision* to sum up the qualitative change brought on by networked life, reaching up to our private life as well. We no longer plan our comings and goings but synchronize our actions, almost in real-time, with the help of different communication devices: "let's meet in front of retail store Stockmann's in 10 minutes"; "I'll call when I'm near".

The construction of identity can be seen as a counterforce to the barrier- and status-breaking development of the network society. In Castells' exposition this definition covers a wide range of phenomena from feminism to Catalonian separatists and all the way to the Zapatista-rebels of Mexico (who are skilled in using modern media and information technology) and even al-Qaida (who are also suspected to use modern communication technology). All of these forces can be

viewed as a rebuilding of the foundations of a dignified life to replace the already crumbling foundations (communal culture; mass media; identity leaning on a nation-state). Another shared characteristic is *communality*: the construction of identity in relation to other people sharing the same values or interests.

This phenomenon also works on a smaller scale. The following list contains titles of music genres found in the iPod belonging to the children of this writer: *Acid House, Acid Jazz, Alternative&Punk, Anime, Big Beat, Chill Out, Club, Dance, Death Metal, Disco, Electro, Funk, Game, Gothic Pop, Hip Hop, House, Industrial, J Pop, Metal, R&B, Rap, Rock, Techno, Visual Kei*. (In the writer's youth, people made do with two genres: "pop" and "tango", and enthusiasts of both genres listened to the same radio show called "The List".) This kind of flourishing of genres, the fragmenting and mixing of different tastes and styles as well as the sense of creativity and play mark other areas of postmodern culture in addition to music, all the way to films, architecture and fashion. This process could also be seen as a search for new identities and the work of construction, joined with a search for a new kind of community.

At the scale of the individual, networked life and the construction of identity are obviously not contradictive: an IT-professional wearing a business attire by day can easily dress up like a character from a Japanese computer game (cosplay[12]) by night and fulfil his alternate identity on the town.

This kind of setting is naturally very challenging for the traditional mass media, which has seen the continuous decline of readers and viewers as the markets have fragmented. The same challenges must also be faced by the service producers of the ubiquitous network information technology. What do the users really want to do with the new devices and services? What is valuable to them? Unfortunately, answering these questions is not so simple. When information technology spreads around to all users, events and situations of life, the contemporary methods of product development and marketing will cease to function as the users and their needs are fragmented to even tinier segments.

User-centred product development aims to offer solutions to this problem. It leans on the collection of rich and many-sided information about the users and their actions, and tries to develop innovations through small steps in close co-operation with real users and situations. Since the information gathered in this way is by definition fragmented, the user-centred product development must be consistent and systematic, as well as joined with the research producing "deeper" knowledge and fragment-compiling design principles. This process requires an open, "living lab" type of environment, which makes possible the rewarding interaction with users and

[12] See www.cosplay.com

also unites different parties necessary to the production of services. The development and support of these kinds of innovation environments must belong to the central actions of the ubiquitous network society.

3.2.2 Usability

In the ubiworld the information technology is inlaid, in addition to the users' pockets, to the environment and to traditional products; the structures of houses, clothes and furniture. Therefore it is clear that the use requires new approaches. The positioning of keyboards and displays around the household isn't smart aesthetically, functionally or economically. Responses to the user-interface challenges can be roughly divided into four schools of thought, of which each stumbles in its own impossibility if realized to the end. Still, all of the alternatives also have some seeds for future development.

1. ***Invisibility****: an entertainment centre behind the wall*: The consumer electronics manufacturer Philips supports a vision according to which the computer is at its best when it is nowhere to be seen. We could imagine the physical devices of the home entertainment centre to be hidden inside the walls, while the operation happens by speech and gestures. Even though this would be possible in principle, people are still quite suspicious of "talking to the walls" and flaying hands in their own homes. A more central problem in this hiding is that the carrying out of basic operative functions may be difficult without finding a proper way of discourse: using an invisible interface requires the user to memorize the different commands. At its worse, this would mean a return to the times when users had to take courses to learn the command languages. It is also possible that small languages like Finnish are neglected and the idea of "natural" interaction is destroyed by having to give commands in English or in German.

2. ***Convergence****: one remote for everyday use*: Mr. Risto Linturi, the Finnish pioneer of ubitechnology, presented his idea of an intelligent house already in the early 1990s. For Linturi, the mobile phone is the ubiworld's nerve centre: it is used to guide information technology inlaid in the environment, open doors, adjust lights and turn on the sauna. One does not need a wallet and keys when leaving the home since the phone is also used for identification and monetary transactions. (Talouselämä magazine 2/2006). This process of combining different functions in one device is called convergence.

   The idea for a universal remote is very straightforward. For example, the user of consumer electronics might easily have to use even five different remotes. To replace these, there are programmable remotes which solve the problem but bring on a bunch of usability issues: if the use of the multiple applications of a contemporary mobile phone seems difficult, the remotes of the ubiworld may seem like something from outer space.

3. ***Decentralization**: specialized information terminals*: It is likely that in the future we'll have devices controlled through a specialized user interface. This is because the devices are probably designed for a certain meaning that presupposes the physical presence of the user. As long as a mobile phone can't be used to insert laundry into the machine, it is sensible that the controller of the washing machine is situated on its front.

   Then there are the multiple-function devices like cell phones, used for talking, messaging, photographing and listening to music. In and of itself, this isn't new at all: the idea of multiple functions is as old as humanity. What is more essential is that by ubitechnology the same goods are provided alternatively or concurrently through different channels. This way the user can choose the alternative that best suits the situation. One prosaic observation of a recent Helsinki-based mobile television research was that it is more convenient to bring a portable device along to the kitchen while making sandwiches and waiting for the end of the commercial break.

   Decentralized user interfaces also make it possible for the consumer to follow different things or information channels at the same time and modify them to form a convenient whole. Someone watching the Olympics can look at the events on the field, the scores on the scoreboard and a weather forecast, all from his cell phone. It can already be noticed how viewers of team events put their cell phone to their ears as soon as a difficult situation demanding the intervention of referees comes up: without the TV-commentary they have no idea what's going on so they call someone they know is sitting in front of a TV. One of the central ideas of the developers of ubitechnology is the assistance of the user in the combination of these kinds of things.

   As before, decentralized user interfaces also have both good and bad sides. To some this means freedom of choice, the widening of senses and the growth of consciousness and perception. To others it is only the newest form of information pollution and alienation from reality.

4. ***Situation intelligence**: the little brother watches – or provides service?*: According to the most Orwellian school of ubitechnology the sensors of future devices (*e.g.*, traffic, light, sound, and camera sensors in cell phones) will make it possible to adjust the interfaces and services to the user's situation. A simple example is the change of contrast in the phone's display according to the provided light. A more complex example is a program – a kind of "little brother" in the cell phone – that follows the user and deduces whether he is "able to be interrupted" and directs incoming calls to text message requests or blocks them entirely.

   A basic problem of adaptation has been the making of reliable deductions about the user. All interpretations that are more complex than those having to do with time and location

prove to be extremely difficult. The control of too difficult ubitechnology might demand constant tweaking and tuning, which may not interest the ordinary citizen. It is possible that the ubi-intelligence is turned off after the first unpleasant user experience.

An alternative way of thinking about adaptation has risen up among researchers. It tells that accurate interpretations about behaviour can't most likely be done. A more sensible way is to provide the users a possibility to use the interpretations to arrange their own actions. The Context Phone[13] developed by HIIT displays detailed situation information about other users, such as where they are and whether anyone else is present (Prosessori magazine 1/05). Naturally, this raises a group of questions concerning information security, protection of privacy and the management of these issues.

3.3 The networks of the ubiworld

Information technology is based on data communication networks, which rely on internet protocol suite (IP). Operators are also making the move to Internet technology and in the near future all significant data communication services will function on IP. Commonly this is referred to as *all-IP* development.

The interactive multimedia applications of the future need a much larger transfer capacity than current applications. A natural outcome is that fast, wired IP-networks are going to have a similar significance in the future as networks of roads or electricity have now. Unless we want to make humans passive consumers ("couch potatoes"), we need a lot of data communication capacity outward from homes and offices as well. The ADSL connections based on existing phone cables don't make it possible to transfer data at great speeds and especially their capacity away from the client ("upstream") is insufficient.

The current network society plans of Finland are lacking a solid foundation. Without an adequately fast, reliable and cheap data communication network it is impossible to fulfil large-scale public electronic services. At this time, approximately 50-60 percent of the budget of a typical Finnish municipality is spent on social- and healthcare. At the current rate of growth, these costs will surpass the budgets in 6 to 7 years. The seemingly only solution is the increased home care of the sick and elderly, which, when done properly, can also further the patients' quality of life. The arranging of home services of high quality requires a fast, reliable and cheap data communication network that reaches every home.

The fast networks of the future are based on an optic fibre infrastructure that, presently, reaches only a small part of Finnish households. The current commercial DWDM-devices can already

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[13] See http://www.hiit.fi/fuego/context/ and http://www.cs.helsinki.fi/group/context/#sw

get to the speed of 20 Tbit/s and the theoretical limit for a single fibre is 100 Tbit/s. In addition to this, a single optic cable usually has up to 96 fibres.

During the term of the next government, every home and company should be able to get a cheap data communication connection with the speed of at least 1 Gbit/s. This connection could provide every kind of service, including an Internet-connection, phone, distribution of TV programs and interactive multimedia-connections *e.g.* for the care for the sick and elderly.

Finland has approximately 2,4 million households. According to the estimate presented in the national broadband strategy the widening of the optic fibre network to reach all the households would cost approx. 2,5 to 8 billion euros. The costs of the village networks built in Finland and in Sweden have been approx. 2000 euros for every new household. It is perhaps surprising that the costs are same for both towns and countryside. The capacity of the optic fibre is practically sufficient to last to the foreseeable future. Experience from Finland and Sweden shows that an optic fibre connection raises the estate's market value far above its construction costs.

At least when considered fully market-driven, these kinds of networks won't be realized any time soon. The competition between operators has led to a situation where no single operator makes significant investments in new technology, since they are all focused on defending their current sources of income, based on an old local monopoly and existing copper wires. The fact that each actor tries to optimize its own situation, won't lead to a fully optimal solution.

In data communication the move is being made from a vertical architecture to a horizontal one. Whereas in traditional telenetworks the network and its services are solidly connected, in an Internet architecture all the services work in the same IP network and can be delivered by anyone with a fast-enough connection. Nevertheless, the service operators are still forced to use the network services produced and priced by the network operator. It is necessary for Finland's development that the networks be opened and the offering of services made possible in practice.

This requires that fibre networks and radio frequencies are seen as a single infrastructure, where every actor will be granted equal participating rights. Most of the costs of the fibre network come from digging work. The costs of a typical operator's fibre network are approx. 6000 euros/km, of which the cable's share is approx. 1000 euros. In cities the work's share of the costs is significantly greater. This is why an optic cable should be buried in the ground every time there is digging done, *e.g.* in the work done on electric-, water-, sewage-, or distant heating networks. For new building areas a fibre network should be designed and built as a part of normal municipal technology.

Owning an optic fibre network doesn't make the municipality a teleoperator. We are dealing with a passive network, with a life-span of at least 50 years and hardly any need for maintenance. When a fibre network is built as cheaply as possible (along with other works) and with enough

fibres, the fibres could be cheaply rented to inhabitants, companies, co-operative societies and teleoperators. In the area of network services we might also see competition and development when multiple operators can function in the same area. Village network-co-op societies and the like could build networks by relying on an existing fibre network and voluntary work.

Municipalities spend large sums on data communication services, the quality of which is not up to the real needs of the areas. The building of a municipal optic fibre infrastructure could mostly simply be financed with a 15-year loan, which would be paid by producing the data communication services the municipality needs in its own fibre network. After 15 years the network has been paid for and it still has a long life-span ahead. In addition to this, municipalities may pursue additional income by renting fibres to operators, companies and societies. Most likely the greatest benefit is to be had from the fact that more data communication capacity can now be acquired with speed and low costs for the developing needs of *e.g.* the social, health and education areas. The fast data communication network also provides the free placing, centralizing and competition of services.

The municipalities don't have to subsidize its citizens' broadband connections with tax money since they are able to be realized by everyone paying their own joining costs. At approximately the costs of a current ADSL-connection it would be possible to offer 100Mbit/s or even 1 Gbit/s two-way connections to every citizen and company in the municipality. The so-called open access concept means that the internal traffic of a municipal- or area network is fast and won't circulate through the backbone networks of the operators. The customers would purchase the municipal- or area network from a local company. Internet-connections and additional services could be offered on the network by all operators, between which there would naturally be competition.

The wireless side is also making a move from traditional closed networks into a horizontal Internet-architecture. The Flash-OFDM network, built on the frequencies freed from NMT-450, is a step in the right direction. Most of the lower (in the range of hundreds of MHz) radio frequencies are already reserved for TV-broadcasts, which could be sent on a much lower band than now if coded with MPEG-4. Digital TV is also a proponent of the old vertical thinking, where a network is only built for one application (in this case the distribution of TV-visuals). In horizontal IP-networks TV-broadcasts would be one application among others sharing the same network.

The term of the next government must see the relinquishing of a frequency bandwidth of at least 100 MHz from TV activities to use in realizing one or several open IP networks that cover the whole country. In low frequencies this kind of a network could be cheaply extended to the furthest of places. In cities the additional capacity could be had from cheap and fast short-range WLAN networks.

In an All-IP world it doesn't matter which kind of technology is used in joining an IP network. The same services can be reached any way, providing that the connection is fast enough to use them. There are already terminal devices on the market that are able to use such networks. For example Nokia's new E-60 mobile phone works in GSM-, UMTS-, and WLAN-networks. The goal of regulation must be in creating contest among network technologies. The horizontal wireless IP-networks could compete not only with wireless WLAN (Wi-Fi), WMAN (WiMAX), 2.5G and 3G networks but also with a wired broadband (ADSL), especially in rural areas.

3.4 Contents and content management

It is often thought that central services for the development of mobile services should be, *e.g.*, entertainment, news, bank services, some public services and so forth. However, this only covers a small amount of the mass of content distributed through mobile ways; after all, it is obvious that a large part of the content distributed by SMS is written by the users or the users groups. The same goes for Internet content, where user-generated content like e-mail, message forums and blogs dominate the time spent with content in general.

The fault can be found in the way of thinking about "content" as only the content that is commercially produced and distributed for a cost. This is unfortunate, since it distorts the thinking of the status of content and content management. The claim "content is king" is true only if the users' own content is though to be a part of it. Even then, the claim has been used to back solutions that leave the activities of the users completely unnoticed.

Which kind of things could the content of users consist of? All kind of information will soon be digital, and able to form content recognized and distributed by Internet search engines. It is good to recall that the capacity of mass memory scales most rapidly as a function of time: it doubles every 12 months, whereas, for example, processor capacity takes 18 months to double. A disk memory of one terabyte costs around 800 euros these days. In five years, the same money could be used to buy 30 terabytes.

What is it enough for? It has been estimated that the digital recording of all human communication – that is, all kinds of textual communication, every phone call and important conversation, every photograph taken by a person or portraying him, every TV-program and film he has time (or wants) to view, *etc.* – would require approx. one terabyte in a year. Therefore it looks like mass memory will soon be good for anything we wish to save and record.

Most of this "content" is interesting only to the user – maybe not even to him. Part of it may interest those close to him – *e.g.*, pictures and videos from his child's tenth birthday. A small part may be more widely interesting and some users can and want to produce content that interests large amounts of people, as has been seen in the case of blogs. In addition to this some contents may prove to be valuable in a way the producer hasn't taken into account – some of the

photographs now stored in museums were originally taken as simple shots. Even though all content – each byte in the yearly terabyte – might not be interesting, mass memory may be so cheap in the future that it is more beneficial to store everything than waste time pondering what is to be saved and what isn't.

This won't obviously be easy on a larger scale. If the digital storing of one person's life takes a terabyte in a year, the Finnish people would produce five million terabytes per annum, that is, five exabytes (we presume we should start getting used to exas). Since the wireless data communication scales much slower than mass memory, one must take to replicating the content so that a copy in a suitable format is always near. The management, indexing, searching, *etc.*, of this amount of information might give birth to new qualitative problems, the research of which has already begun, although it is still in its infancy. Still, it is obvious that the looks should be directed to decentralized architectures, which are based in one way or another on the ideas of peer-to-peer networks.

In the ubiworld, all of the user's content should be within his reach on terminals, whenever needed, and he should also be able to produce content while moving. The content is organized by locations and situations of everyday life (which can be described by metadata added to the content). Apart from locations and situations, the transitions are also interesting, since they often provoke needs to get one's hands on the content. When I get to work, I move myself as well as my mind to work. What meetings was I supposed to have this morning? Which documents should I read in preparation? Transitions and other breaks between actions provide situations for this kind of thoughts. They might also provide preconditions for the production of new services.

Search engine companies like Google and Yahoo! have clearly grasped this a long time ago. That is why they are looking for means to record, index, search and equip metadata with the users' digital photos, text documents and, before long, other kinds of digital contents. One can easily imagine a digital archive, which stores every phone call made by or to the user. Metadata and indexing that reaches deep enough into the semantics could easily fetch information – or maybe a text script – of the call made to Pekka, in which he mentioned an interesting German guy he met at CEBIT.

3.4.1 Media control

The forceful civil debate that rose up in connection with the renewal of the Finnish copyright law (and surprised the experts who were preparing the law) shows the painful state of the problematics of the government and rights of contents. It looks like the values, needs and rights of consumers are headed on a collision course with the exclusive rights of the content owners. Along with copyright, the issue consists of complicated questions concerning consumer protection and competition rights.

During the Winter Olympics, in progress at the time of this report's writing, YLE, the Finnish Broadcasting Company had, to its surprise, to stop the podcast distribution of broadcasts when the service became too popular. The problem turned out to be that the monitoring of the transmitted signal's copyrights required the implementation of content distribution with the assistance of a commercial service, which proved too expensive.

This case is an excellent example of the surprising results large-scale media control (supported by copyright and contracts) might lead to: a service that interests users and provides them additional value turned out to be impossible to carry out. Wide-reaching copyrights and the supporting DRM seem to build new obstacles for possibly interesting and important content services, obstacles that might ultimately prove harmful for the owners of the rights to the contents. How to provide the contents to the market past these obstacles?

The Olympics are an extreme example of a situation where the monopoly-type owner of rights has hardly any incentive to bargain its position: the content will sell for almost any clauses possible. But many other contents don't enjoy these benefits. Can media control be carried out in a way where the interests of the owner and the consumer would be in a better balance?

In some cases, media control could be relinquished (nearly) completely. For example, YLE has a large amount of media material that could be distributed on the network for a relatively cheap price, providing that the distribution could be realized in a cost-efficient way and be targeted to Finnish citizens or people living in Finland. The HIIT developed media distribution system DIMAS that leans on P2P-networks and cryptographically protected distribution packages could provide a perfect solution to these kinds of problems (being also able to solve the problem with the Olympics broadcasts). As a downside, this solution would require an efficient way of distributing the needed decryption keys and possibly adjustment to the contractual practices of the media business. Nevertheless, we think that the unquestionable benefits of P2P-networks, such as the flexibility of capacity and cost-efficiency, will make them an interesting distribution channel for many contents.

3.4.2 The value chains of content and IPR

The purposeful distribution of information products and services is troubled by the problematic rule of copyright and patent law: each person of the value chain who breaks these rights can be made responsible and security measures can be directed toward all of them.

This rule, rightful in some traditional cases, empties the nature of the information product's goods. By revisions to the law and development of contract structures we should get to the point where a digital information product is, on the retailer's and user's terms, legally the same as a newspaper. Even though the newspaper is a very sophisticated product, born from the arrangement of many contracts and arrangements, the retailer and customer make do with paying

the price for a single issue. In the same way the patent and trademark law focus only on entrepreneurs, that is, professionals in general.

In copyright, the case has gone in the opposite direction so that the buyer and seller of a single in itself trivial sound or video recording can be stopped by police and customs. Without understating serious piracy, the situation seems highly dubious when thinking about the proclaimed goals of the network society. A sensible person should be able to trust the legality of ordinary activities. Now the case is reversed: for example, a routine research paper in the university's library poses serious information security- and copyright issues. In this part the point is arranging the value chain for the purposes of practice, education and the network society.

The problem has been summarized a long time ago by Ronald Coase's theorem: badly defined rules are good for adding business costs. Due to legal regulation we have locations of information distribution (libraries) but no auction-houses of information. The old-fashioned style of the regulation makes sure that the price mechanism can't work in even those cases where the authors should get their legitimate compensation.

3.4.3 Location information

As estimated before, the ubiworld is based on a large amount of content distributed through different channels and mainly produced by the users themselves. But for a significant part, ubiservices still lean on information or content, which might be the target of certain intellectual property rights. A good example is location information and as its derivative, different kinds of information concerning locations, like traffic information.

Throughout everyday life information technology is present in different locations, not just at home or at work. A location, locating, location consciousness and location information are necessary and brand new ingredients opening up many opportunities for ubiservices. A traveller could be provided information on exactly the building he happens to watch – or directions to the next one. A mass transit traveller could receive the relevant traffic information concerning a certain stop automatically. A mother could find her son or a teenager his friend. Ubigames could be positioned in the right environment. Citizens could comment on propositions for city plan change in the urban environment also in the light of the history of the buildings. The value of the use of location information is therefore not only based on the increase in productivity or taxes, but also in the possibilities of people for acting out (*e.g.*, commenting on public spaces) and taking part in the civil society (consciousness on the state of the environment or planning).

Despite all this, there are still very few successful location-centred services, the GPS-based auto-navigation as the most glaring exception. The current actors haven't succeeded in creating services the consumers want. One reason for this is the expensiveness and difficulty of location information and locating: the location information can only be applied by a select few.

For example, the map base, necessary for the display of all locational information, demands an expensive user license from the Surveyor Department, the location of a mobile device is inaccurate and demands a separate permit from the user, and plan information can't be easily found in public distribution. To remove these bottlenecks, location information (maps, route information, building history, plans, pollution information, *etc.*), provided with public funds, should be in reach of developers without separate cost and under flexible licensing models, without taking into account the legal form of the developer. It only took three months for 200 new services to emerge on top of the Google Maps service, largely because of the free price and the ease of making contracts. This should be compared with the amount of Finnish map-using services.

In addition to the fact that operators haven't been able to produce services (*e.g.*, the Finnish telecommunication operator Elisa's locating service was recently closed as unprofitable), they have also stripped other parties of the possibilities to develop them. Even though every cell phone knows its location, the individual ID of the used network cell (that locates the phone to the nearest district and is enough for the annotating of media or picking up train schedules), the phones themselves can't access information about the physical location of the cells.

At this time, we should consider whether the spectrum licenses of the operators should be revised with a clause ordering them to make public the location of the cells as a database that can be uploaded into the phones. In this case, any one could develop location information services that work in a mobile phone (an application that works in the phone itself is especially important, because it doesn't require a contract between the application supplier and the user, which has been commonly viewed as a service killer). The location information of the cells is also significant on the terms of evaluating the state of the environment (radiation levels). The other phone-used radio networks, like open WLAN-networks and Bluetooth-lighthouses, should also be transformed into a platform for an open and free locating service.

The same kind of actions should be considered for map information, perhaps by applying double-licensing. The principle should be that content produced with public funds has to be put in good use from the society's point of view, without limitations and difficult actions adding the transaction costs.

3.5 Services and service architectures

In a TV commercial for a certain teleoperator the viewer is thrown in an exciting musical with dancing and singing. The lyrics go: "services-services, ser-vi-ces". The consumer would probably pay for better products instead of worse. In practice, there are hardly any differences between the services offered by different operators. The real competitive factor has become the price of basic services (calls and text messages). Ubitechnology won't bring an immediate relief to this matter. On the contrary, it creates competition to the core activities of companies, data transfer and

phone calls, as well. In addition to this, even a good idea might not fly far, since services based on applications and open platforms are quite easy to copy.

The central manifestation of ubitechnology is the mutual networking of applications and devices. This makes possible certain actions, without which the co-operation of the devices couldn't be carried out. For example an electronic calendar and a navigating program work, as well as in their original purposes, as windows to a family photo album. In the case of a crash, an automatic notice is sent to the emergency centre and to other drivers. The family photograph on the table shows the last digital photo taken on the daughter's or wife's cell phone. There is a great amount of possible combinations and a successful product may be built just by recycling and combining old ideas. This is why the researchers and other idealists – like us – speak for open interfaces, trying to build a technological and active environment that supports the birth of inventions.

Information and communication technology and the applications and services based on them can be developed according to different principles. There is often discussion about open and closed systems as well as immersed systems, when the point is not a general-use computer but a device designed for a specific purpose. Different principles have their own strengths and weaknesses.

General and open information technology strives to succeed in competition by the fact that it can be used for many purposes and thus creates larger demand, growing numbers of manufacture, lower prices through competition and the birth of a mass market. A device designed for a specific purpose may succeed due to a powerful characteristic like the GPS-navigator or a chess machine, or because building a device for a certain purpose is cheaper, *e.g.*, an mp3-player.

There exists simultaneously a horizontal and a vertical tradition of development for information and communication technology. Horizontal development builds standardized service layers and interfaces, on which new layers are built. For example on the Internet's common TCP/IP data transfer protocol there have been made different kinds of file transfer protocols for different needs, a typical example being HTTP for the transfer of hypertext documents. The vertical model strives to optimize the possibilities of carrying out a specified solution that entails a group of theoretical service layers and interfaces.

The horizontal and vertical models can be seen to be fulfilled in application and services built on general-use computers as well. Electronic service can be realized on the Internet with an easy-to-use browser or a tailor-made application. This can most clearly be seen in the services designed for intelligent phones, in which the usability and the resources of the device set more challenges to the development of applications.

Mobility freed the users (at least apparently) from the chains of time and space. A cell phone can be used to work up things from a distance as well as organizing and reorganizing everyday tasks. Ubitechnology brings back the significance of time and space. Systems and devices, along with the user, are even more conscious of the limits and possibilities of the using situation and environment. These possibilities should be looked for within stone's throw of the user. This means that the development work should be provided with fresh blood from outside the traditional inco-sector; from commercial, beneficiary, ideological, organized and unorganized actors, who are currently dominating the public space. In this area, business models might be completely different. For example, many cafes provide free Internet-access, because it draws in customers who will pay for coffee and bagels. There are also a great number of people who are in the game for motives that aren't directly commercial. Around the Internet message forums, pictures, media, maps and blogs there is a large group doing integration work on a hobby basis. Some of them already have one leg in the ubiworld.

3.5.1 The seams of services

People are already using parallel electric channels to take care of personal and mutual business. Typical ways of doing this are e-mail, text messaging and calls from wired lines or from a cell phone. Features that are slowly becoming publicly used also include blogs, network discussions, Internet-calls (like Skype) and instant messaging. When taking care of something one might begin with a text message, but quickly move to e-mail and calls, if it is more efficient to focus on things in another way. The use of different devices is interconnected: first you take mood photos on a camera phone and send them to friends, and later watch them on the Internet using your personal computer. The separation of media production and consumption described in the ubimedia-scenario makes this kind of multichannel actions possible.

People are skilful in integrating the offered technology as a part of their life by creatively combining it to fit their needs. This kind of flexibility and integration must exist in the offered ubiservices as well. Even if one would start using a service on a tabletop machine, it should be able to be continued on a mobile device, not just on the machine which was used to start the process. Still, because the operational situations are different when using different devices in different environments, flexibility also calls for providing the user ways of showing his own flexibility.

When these questions are debated in user-centred publications and conferences, the most common concepts are:

- *seamlessness* (the seamless continuance of the service over the borders of different network connections) and

- *seamfulness* (visualizing the seams to the user, thus making the inevitable changes in the service's quality understandable)

Making these principles concrete requires that the user is provided tools for individualizing and for flexible work, such as ways of transferring information between devices (with a wireless connection, a memory card or a cable). In this case, providing tools is a better solution than the creation of an all-encompassing data transfer system, since different users have different ways of using technologies.

Thus, the application developer's possibilities for the creation of tools should be eased by striving for the following goals:

- *The creation of active conditions for the notion that the use of the service remains uninterrupted while moving from one network to another.* This could be eased with a harmonized billing system, which would consist of an interface for, *e.g.*, WLAN-use as well as the mobile operator's network. The guidance of the government should aim at creating this kind of standard, while keeping in mind the challenges posed by the protection of the users' privacy. This matter includes the following points:
- *Making seamless service connections desirable for a large amount of the service suppliers.* The above-mentioned billing system should also be easy to join in without difficult clearance issues. This way, the home users could also offer their network for others to use (provided that a certain level of information security is reached) and make some profit.
- *Controlling the pricing principles of the use of the network so that users moving within networks can understand what the services cost.* In other words, the suppliers would be guided to price the supplied network in an intelligible and comparable way.
- *Making possible the many-sided channelling of data.* So that devices could be used supportingly, they need to be able to access the same information. This is why it would be beneficial if communication data could be forked and channelled. Example: instead of the current text messages only transferring from one phone to another, the operators could be encouraged to services, in which the messages would be guided, in addition to the phone network, to a user-defined database, which could be accessed by a private interface from other services and programs. This would further the generalizing of new hybrid services.

3.5.2 Finding the services

The ubitechnology, communicating with its surroundings, makes it possible to offer a great amount of services to the user all the time, wherever he goes. This possibility could be benefited by parallel solutions, that would further the notion that in every situation the user feels the networked environment supporting his actions, not causing information overload.

1. *Informing*: making it easier to perceive the supplied services
2. *Search tools*: Finding adequate services quickly, when the user has a certain goal in his mind
3. *The situational allocation of services*: Fitting the supply to meet the needs of the user
4. *Social navigation*: Sharing the good actions the users have found to the knowledge of others, in order to help them with the difficult situations they have faced

In different practical solutions these goals have been realized with varying emphasis. Point 1 is emphasized if the supplied services are pictured as an indexed directory that the user can scroll on the display of his device (*e.g.*, in Japan the DoCoMo iMode-services are reached in this way). Free text searches, similar to Internet search engines, stress point 2. They support the realization of a need emanating from the user himself.

The creation of new kinds of services becomes possible when the points 1 and 2 are combined with the allocation of services mentioned in point 3. This could be based on the user's location, date, current action or profile information of the user (set by himself). From this it follows that different services may be supplied in different situations. Of course, this isn't quite simple, because the estimation of adequate needs in each situation may be extremely difficult. Devices are capable of only limited automatic collection of information and comparing it to the supplied service categories is difficult because the categories themselves are also in a state of constant change, as new services become available and old ones move away from the field.

The point 4 offers possibilities for the solution of these problems. Since a large number of people use the same services, their solutions can be used to ease the selection problems faced by others. This is the operative way of, for example the recommendation service of the Amazon bookstore and the new, popular del.icio.us[14] –service, in which people notify each other if they've found an exciting web site. As a result of these actions, people, while working together, also regroup the material.

The same principle can also be used in the grouping and introduction of the ubisociety's services. At the same time we could look for a solution to the difficult problem of service configuration, which is already limiting the success of operator services.

One possibility would be to create a public register of the supplied ubiservices. The addition of new services should be carried out by a light process. A free search interface would be provided to the register, encouraging commercial parties to create their own portals from the content.

[14] See http://del.icio.us/

While creating the register, the needs of both inter-corporational and user-directed actions should be taken into account.

3.6 Business structures

The ubiquitous network society is thought to be seen by its users as a large group of different services easing everyday situations and providing additional value, easily introduced or modified to fit the needs and actions of each user or user group. In its full scale, this would only seem to be possible if the services can be produced on an open market that gives room for new parties and innovations.

From a current standpoint this looks to be demanding since the interests of the relevant market groups and the favoured paths of development, not to mention the speed of development, are not easily interconnected.

- *Content companies* look for additional value and new markets in selling content again and again to different channels and devices. The selection of actions is wide: careful stretching of the area covered by copyright and other IPR's; the media control spreading into even terminal devices, and its legal protection; closed service architectures. The nightmare of these companies would be the final unleashing of P2P-distribution, due to the influence of, *e.g.*, Bittorrent2.
- *Teleoperators* have searched for additional value and new markets from self-produced or self-distributed services, without success. The nightmare (the avoiding of which doesn't look to be easy) is having to serve as a "bit pipe", that is, a situation in which the operators are dealing only with the transfer of raw bulk data.
- *Terminal device manufacturers* have so far gotten to look for new markets in, on the one hand, developing economies, and on the other, in "must-have" features of new devices, that work to prevent price erosion. Their nightmares consist of the bulking of their product and in having to act as a servant to the operators.
- *IT companies* look for new markets on the areas of portable communication and home entertainment. They shy away from closed architectures and large royalty payments of key technologies.
- *Users and appliers* search for additional value from the market-provided innovative services and contents that are born quickly and modified to fit their needs. A nightmare would be having to lock down with one solution.

While in these circumstances it is understandable that the various parties try to protect their current business models, this will only delay the inevitable change, and possibly make it more dramatic than needed.

What is the interest of the government in this setting? It is based on three aspects:

- A *Regulator* looks for the founding of an open market that furthers competition and innovation as well as taking down the obstacles to the introduction of new services by maintaining security, trust and transparency. Through better services and falling prices it searches for additional value for the whole society (in addition to added tax income to the state through economic growth and new jobs).
- In a *User role* the government seeks for means to further not only its own activity but also its basic tasks and values, such as democracy, equality, transparency, and interaction with the citizens.
- In a *Business role* the government (in the form of a separate unit heading to the market) seeks for additional income by offering services based on the government's resources on commercial terms.

The roles of the regulator and the user look to be quite well connected by their basic interests. Apart from this, the business role is similar to the aforementioned role of a content company or an operator, and is thus apparently at odds with the other roles. Even though there might be a place for all the roles, the selection should be done with care, while being ready to force regulative action if the side-effects of the selection prove to be unwanted.

In such an open situation, where it is difficult to perceive the direct and indirect consequences of different choices, there must be emphasis on strategic flexibility in the sense that the phrase is used in literature on company strategies. This requires courage and readiness to experiment and learn fast. In practice it would mean the creation of a parallel market, which would in some ways work with different rules than the current ones.

Could, for example, literature published in Finland, Finnish movies, or Finnish music be completely or partly freed from the area of copyright, and be distributed to the consumer through libraries? If this seems radical, it is good to recognize that the library in itself is an intervention to the "normal" actions of the market. Library compensations most likely form a significant amount of the income of most present writers.

Should the content produced by public actors be offered to the use of different parties freely or with more flexibility than before? This might not overrule the commercial benefiting from the same content, if we could apply a double license, with the term for free use being, for example, maintaining the use of open system interfaces.

Should municipalities be offered investment support for the building of optic backbone networks or wireless broadband networks on the term that they offer, with certain clauses, data transfer capacity to third parties?

Could the government (including municipalities and different municipal areas) work towards building different area-based innovation environments ("living labs") and furthering the fast development of new services?

These examples cover only a small amount of possible future actions. What is important is that different ways of creating markets and making them active are tried and that learning is drawn from these experiences.

3.7 Protection of privacy

The additional value of many ubiservices is based on the information gathered on the users and their activities and transmitted to the use of the service-producing party to produce personalized and proactive services. Many users are ready to give up this kind of information (or to comply with its collection) if they feel they are actually provided with additional value in the form of better services. Ubimedia services aimed at the construction of a personal (digital) identity, like media blogs, are even presuming that the information describing the user's life and activities can be brought to the knowledge of others.

On the other hand, many users are already worried about the protection of their privacy and might refuse to use the service when they feel it is threatened. Protection that is inadequate (or seems that way) might therefore present an obstacle for the social acceptability of a service.

Current legal regulation offers quite good tools for these problems by presuming that the users have a right to know what kind of information is being collected about them and also the right to see the information concerning them. Unfortunately the service producers feel that these demands are difficult and are following the looks of the law more closely than its spirit.

To carry out the promises of the ubiworld we need a change both in the attitudes toward information security and the technological requirements it poses. Information security shouldn't be though of as a monster, that can only produce costs and harm, but as a resource that makes new kinds of services possible, when the user-specific information can be used in new services in a way transparent to the users themselves. This would require certain features from the service-producing information systems and their information architectures. The incentives must also be placed in a way making it possible for the information-collecting party to resend the information when the user wants it.

Services based on P2P, in which the information concerning the user isn't cluttered to any single party and is spread out on the network nodes, are a certain future possibility to the solution of some problems of the protection of privacy. This time the problem is more about how the communication-monitoring officials can perceive and prevent criminal actions.

But who monitors the monitors? In the ubiworld, the monitor's eye reaches far and it is difficult to see the final, even indirect consequences of certain technologies or protocols that make

monitoring possible. Do we really want a ubi-Finland, where a device placed in cars monitors the maintenance of speed limits and orders a speeding ticket home by the end of the trip, if the driver's foot spent too much time on the gas? When thinking about the mechanisms of monitoring one must clearly follow some principles of carefulness.

3.8 Trust

The readiness by which users take advantage of new services is ever more drastically dependant on their trustworthiness. This is difficult, because the natural human way of measuring trust can't be transferred to the electronic world. Unfortunately, there is no shortcut to developing trust, so we need qualitative and cross-disciplinarian research on trust that leans on the qualities of the human "trust motor" in good as in bad ways.

Trust in ubiservices is built through the interaction of many different points of view and doesn't have a single standard definition. Trust can mean, *e.g.,* the information-technological information security and reliability of communication, the visibility and reputation of the service supplier (*e.g.*, Visa and the electronic marketplaces), the look and usability of the service or the securing of the rights of users and service producers/suppliers with legal means. The many-sidedness of the active environment and the interaction of different viewpoints are important.

In this context, trust is focused on as an individual's subjective expectation and interpretation both of the ubiservices and of the action of other parties having to do with the communication of the service. Trust isn't thought to be transitive nor interactive, because communication isn't presumed to be continuous and the parties can remain unknown to each other. In this case, the treating of trust as a risk position estimate (*e.g.,* in business matters) would mean the subjective evaluation of the different factors and viewpoints of trust as well as their influences and binding force.

In the many-sided environment of the ubiworld the building of trust must be based on the starting points of the users and actions, supported by the solutions of technology and information security. Trust-building based on users and actions emphasizes as central points the real and possible events of the service and the sense of purpose. This angle of entrance can work to further the transparency of the service's action environment and framework, and, through this, increase the development and popularity of ubiservices. Development springing from the starting points of users and the action environment also makes it possible to take notice of the protection of privacy in the early phases of development, thus making it a natural part of the ubiquitous network society and its information- and communication services.

The ubiworld will bring changes to traditional electronic services, the most important being

i) the transformation of the traditional a priori hierarchic trust-relation setting

ii) the increased availability (for wanted and unwanted parties) of information connected to persons, and

iii) the complex application of regulations on constantly present services. Through these changes, the most central tools in building trust are in the investigation of the degrees of openness and decentralization in the mutual trust relations of the communicative parties and the service environment (*e.g.,* peer networks).

It should be noticed in the development that the trust decision is finally in the hands of the user. The building of restrictions in open and decentralized environments is challenging. The traditional notion of privacy as the right of governing personal information is no longer valid. Trust and privacy will become a dynamic process, which is used to negotiate and maintain the technological and social boundaries of one's own space as well as the space of publicity. The point is that the users decide when, how and in what way their personal information is communicated to others. This kind of process converges the different sectors that influence trust, such as the presumptions of users, the demands and regulations made by the society as well as technological solutions.

3.9 Electronic contracts and consumer protection

Contract law influences diverse phenomena in the ubiworld. Commercial transactions are usually contracts in the legal sense, so nearly every kind of ubibusiness is therefore subject to contract law. In addition to this, many other phenomena of human activity can be thought of as contracts.

At its most basic level, a contract can mean the buyer's and seller's mutual understanding of the object of trade and its price. On the other hand, contracts can also more widely define detailed things concerning the relation between the dealing parties. A contract can have an especially important role in defining the will of the parties in cases where the law is difficult to apply. If, for example, a provision of the copyright law doesn't lead to a satisfying conclusion, the parties can quite easily surpass it and make other arrangements. This is especially important when discussing a rapidly developing profession, the legal regulation of which can not keep up to date and answer every emerging question. If many things have to be dealt with case by case, it is obvious that the transaction costs of the business rise in significant amounts. One must also remember that contracts are chiefly binding only for the concerning parties: the rules focusing on outsiders can still be found in the law. That is why it would be beneficial for everyone that the legal regulation wouldn't be surpassed by contracts, and that the laws would be kept reasonably up to date in the ubiworld as well.

The basic starting point of contract law is the freedom of contract. This means that legally competent persons can make a contract on anything they have power over, an in any form that

suits them. Therefore, a contract is usually valid in written form, orally, or as silent understanding. In the ubiworld freedom of contract means that contracts can be completely legally made electronically by using many tools, and this starting points doesn't require any new legal actions.

Nevertheless, the freedom of contract has been limited, even severely, in some provisions. For the ubiworld's sake the most important are the provisions of the consumer protection law, which maintain that contracts can't limit the rights of the consumer in any significant way. This means that as an entrepreneur supplies goods and services to the consumer, everything can't be agreed on freely, because certain law-mandated minimum rules must be fulfilled in any case. On the other hand, the correct recognizing of a law in network-based consumer trade may be quite difficult. If the entrepreneur and the consumer are in different countries, the other possibly in a country outside the EU, it might be extremely hard to find out which country's law should be applied, even though it could have a large impact on, *e.g.,* the entrepreneur's duty to provide the consumer information, as well as on the interpretation of the terms of the trade.

By large, it is challenging in contract law's terms to apply such basic concepts as an offer and its acceptance for ubiservices. Ubiquitous information technology means that people don't have to actively guide all data processing, since a large part of even legally significant actions are made automatically and through many middlemen. On a largest scale, this could mean that agents, portrayed as computer programs, negotiate and make a deal through the network for humans, concerning, *e.g.,* the use of commercial services. A simpler case could be one in which people buy the services personally but do it on an almost invisible device inlaid somewhere in the environment. In this case as well, the foundations of contract law have to be re-evaluated. For example, it might be difficult to be completely sure about who are the parties concerning a certain legal act, when the contract has actually been made and whether the parties have understood its content in the same way. A contract may not be binding, if a party hasn't had a chance to view its every stipulation. If the contract has been made by using tiny, possibly hidden ubidevices, with quite modest user interfaces (as described in the chapter on usability), it is especially difficult to intelligibly describe all the terms of the contract to the user.

In the last few years, the European Union has actively made provisions to harmonize the norms concerning electronic trade. This legal regulation announces itself to be technologically neutral and to apply to every kind of electronic deal-making, no matter which devices are used in the process. Still, it may not be possible to create fully technologically-neutral legal regulation. It is especially challenging when a new generation of technology, like the ubiworld, demands a paradigm shift from the legal thinking. Even though the regulators have tried to avoid commitment to certain technological solutions, they must be unable to avoid thinking about

future solutions as well, using such familiar concepts as personal computers, displays and web-browsers.

For example, the directive concerning the network society's services (2000/31/EY) presupposes that there is a significant amount of detailed information concerning the service and its supplier available to the receiver of the service. When using a computer with a large display and a fast connection to networks, this isn't a problem. The situation looks quickly quite different if the service is supplied to ubidevices that might have only small and limited displays and network connections possibly not designed for the transfer of that kind of information. On a device like that, it may not be possible to transmit the information demanded by the provisions and the provision, first thought to be technologically neutral, turns out to be very discriminating towards some new technologies.

3.10 Questions concerning competition law

Efficient competition encourages different market parties to the constant strengthening of their modes of action and to the development of new products and services. This classical law won't change in the ubiworld either. But how to make the competition efficient?

Above we have pointed out situations where the possible positive effects of the ubiworld or the birth and growth of products and services built on them might slow down or not be realized at all thanks to the friction and increase in costs resulting from the fast and crooked multiplication of IPR's, the dominating status of some single companies or their oligopolistic behaviour or a combination of these two. Each of these cases is about the inaction of the market due to lack of competition.

First of all, we need to draw a line between the limited monopolies created by intellectual property rights and the misuse of dominating market force: when limited exclusive rights are created through IPR's to boost creativity and the birth of new products and services, which is a beneficial goal, the false shaping of these rights to the ubiworld or their straight misuse, especially when combined with a significant market status, will lead to harmful development for other companies as well as the society.

The traditional legal way of regulating the efficiency of markets is competition law, which in ubi-Finland means, *e.g.,* the Competition Restriction law's (KRL 480/1992) aim at, on the one hand, preventing harmful behaviour for the part of competition between companies and on the other securing the competitive structure of the market by the monitoring of corporate trade. Competition-harming behaviour includes the aforementioned misuse of market status and mutual contracts and agreements made in order to limit competition, that is, the creation of trusts.

In addition to the law on the restriction of competition the EU competition rules are still in effect in Finland, the most important ones being the articles 81 and 82 of the foundational contract of the EU as well as the communal competition regulation given along with them, which define Finland's competition-law status as a part of the European Union. Their most central task is, in addition to creating efficient competition through the whole union, to make sure that corporate actions are not used to prevent the free movement of goods, services and capital from one EU country to another.

In the area of electronic communication networks, there is some special Finnish regulation concerning the furthering of network- and communication services and their introduction to the reach of every telecommunication company and user to be found in the Communication market law 393/2003 that puts into effect the European regulatory system on transfer networks and services. This consists of the so-called framework directive 2002/21, the authorization directive 2002/20, the right-of-use directive 2002/19, the common service directive 2002/22 as well as the information security directive for electronic communication 2002/58.

The aforementioned systems aim at securing a healthy business environment by forbidding different abuses, whether IPR's are used or not. That is why competition law has a central role in the shaping of the rules, environment and operations of the ubiworld, especially as the possibilities and risks of the new business and the innovation work at its background are great.

We must also take care that the background or content technologies or possible basic services that make the ubiworld possible aren't laid in the hands of one company that might be from outside Finland or the EU and thus outside the bounds of national or communal legal regulation. Through this kind of stranglehold other companies and entrepreneurs from different sectors will also become dependant on these key technologies and services as well as their availability and pricing, so the blocking of the threat is an important factor in creating healthy development. This presupposes the careful monitoring of the forming market and the possible intervention through the means of competition law. For example, the rise of certain alternatives to ubitechnology, which have been dealt with in this report, might give rise to pressure for monitoring and investigation by the regulatory system of both Finnish and European electronic communication networks, if even a part of the supply of the ubinetworks is either dependant on radio frequencies or seen to consist of general telecommunication activities.

If we want to create the ubiworld as efficient as possible, the competitive politics will have to reach much further than traditional competition law. In addition to the restrictions mentioned in the law on restriction of competition, the work of the market may be disturbed by old or outdated laws, statutes and governmental orders. The methods of the officials can also pose threats to competition and a healthy market if, for example, they show passivity for the fact that the creation of open standards for the compatibility of devices making ubitechnology possible

can't be accomplished. The competition restriction law can't be applied on these kinds of public restrictions. The side of public law, including both provisions and the actions of officials, must be followed and updated to further the requirements for the ubiworld, using the help of professionals from, *e.g.,* the Finnish Competition Authority and different areas of business and technology. The possibilities for the enhancement of public activities brought on by new technology should also be brought to use without prejudice.

4 ALTERNATIVE WAYS OF IMPLEMENTATION AND THEIR EFFECTS

The ubiquitous network society, in the way we have described it in this report, leans especially on a wide and fast-developing group of digital services designed for everyday needs and situations and made available through different channels in a cost-beneficial and qualitative way by users and applicators. The birth and development of these services requires an efficient and open service market that makes it possible to innovate, develop, experiment and introduce new services very rapidly. At the foundation of the market we need a communication infrastructure fit to the needs of the ubiquitous network society and offering potential for the implementation of services with the help of different terminals and communication channels.

There are many bottlenecks on the path toward the realization of these goals, the opening of which needs to become the central content of the politics of the ubiquitous network society. Central bottlenecks are, for example:

- the lack of mutual will-space and commitment among different actors
- inadequate requirements for bringing new innovations on the market
- legal regulation that stiffens the trade and furthers outdated business structures and ways of action
- the availability, pricing and terms of use of the basic information of services
- the relative underdevelopment of a competitive information technology- and communication infrastructure, evident in the overpricing of central service components and a low investment rate.

In this chapter we try to sketch out some alternative ways of developing communication politics, including the costs and other influences, to meet these goals and to show some related concrete actions we feel must be taken immediately.

We deal with communication as a horizontal structure, that creates new possibilities to most everyday areas, businesses and public service sectors with the use of both the tools in control of the ministry of transport and communications in Finland (the governing and handing out of frequencies; rules of the protection of privacy and information security; compatibility issues; the force of legal regulation) and the more general ways of network society politics.

The thoughts we have expressed can't obviously cover but a fraction of the future challenges. That's why it is most important to reach adequate consensus on the goals and create a framework for flexible work in reaching them, without fear of taking governed risks or making mistakes. The work instructs the worker, but only if he stops standing helplessly around it.

4.1 Who leads the development of the ubiquitous network society?

Finland isn't the only country that thinks about the possibilities and challenges of the ubiquitous network society as well as the answers to those challenges. Japan and South Korea have for a few years fulfilled a publicly driven and ambitious ubistrategy. At this time, TEKES, the Finnish Funding Agency for Technology and Innovation, is drawing up a background report on "ubiquitous Asia", which looks for the possibilities and challenges inherent in the development of different Asian countries and their reflections on Finnish parties.

It is not traditional in Finland to work in the guidance of a "superministry" like the (especially former) Japanese METI, the Ministry of Economy, Trade and Industry[15], where public and private actors are given roles in implementing the strategy's projects. A clear market drive in which the society leaves the choices concerning the future up to the companies and to the developments of the market, is also quite a strange idea for European thinking.

Instead of the aforementioned approaches, Finns have good experiences of the "third way" which leans on reaching consensus between different actors and in which different actions can be flexibly planned and carried out with swift reactions to opportunities and events. The releasing of telecommunication markets for competition in the 1980s and the following birth and success of the NMT- and GSM-technologies are of course brilliantly successful examples of this kind of politics.

What is Finland's path to the realization of the ubiquitous network society? Is the "third way" still open? Can an adequate consensus between different parties be reached in a way that supports the quick move into concrete actions? The answer to these questions isn't completely favourable. The problem is that the ubiquitous network society treats a far larger sphere of action and requires the compatibility of more parties than the earlier examples. It isn't self-evident that the consensus-based way of action will work this time.

It was mentioned in the introduction to this chapter that the ubiquitous network society presupposes an adequate communication infrastructure that offers enough capacity for different wireless and wired communication needs in a safe, cost-efficient and reachable way. Whose responsibility should the building and operation of this infrastructure be? Unfortunately it looks like the teleoperators, working in difficult markets, can't necessarily make sufficient investments, that, *e.g.,* a widely accessible broadband optic fibre network would require.

It is evident that satisfying answers need to be found to these questions. That is why we propose the founding of a ubiquitous network society innovation program to carry out the body of actions described in the following list, provided with the required resources and clearances.

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[15] See http://www.meti.go.jp/english/

Different sector-programs can be founded with its authority, like the program for the traffic of the ubiquitous network society, described in detail in the next part of this report.

The alternatives to communication politics presented in detail in the next parts are the following:

- Communication infrastructure: a gigabyte for everyone
- Information security infrastructure: safety and reliability for everyone
- Information infrastructure: mobile information that provides raw material for services
- Service infrastructure: open service architectures and interfaces.
- From idea to service: promoting innovative actions
- Legal regulation: fixing the basic rules of the ubiquitous network society
- From research to services: the study of the ubiquitous network society
- From ubi-Finland to ubi-Europe: the European dimension of the network society

These actions form a body, from which it is difficult to remove anything without harming the whole.

4.2 Communication infrastructure: a gigabyte for everyone

The applications of the ubiworld need much more transfer capacity than the current applications. Without a fast, reliable and economical data communication network it is impossible to carry out large-scale public electronic services. Technology is not an obstacle: the fast data networks of the future are based on an optic fibre infrastructure, in which the commercial DWDM-equipment can already reach to speeds of 20 Tbit/s and the theoretic limit of one fibre is over 100 Tbit/s. One optic cable usually consists of up to 96 fibres.

During the term of the next government, every home and company should be able to get a cheap data communication connection with the speed of at least 1 Gbit/s. Through this connection, every kind of service can be provided, including an Internet-connection, the phone, the distribution of TV programs and interactive multimedia connections, *e.g.,* for the care of the sick and elderly.

It is necessary for Finland's development that the different networks be opened and the supplying of services becomes possible in practice as well. This requires viewing the fibre networks and radio frequencies as a common infrastructure, in which every actor is granted equal access and the building of which is the job of the municipalities just like a water-pipe network. Since a large part of the building costs of a fibre network come from digging work, an optic cable should be buried in the ground every time there is some digging done, in the connection of work on, *e.g.,* the electricity-, water-, sewage- or distant heating network. To new building areas an optic fibre network should be planned and built as part of normal municipal technology. The

municipality doesn't operate the network, but rents the fibres at a low cost to inhabitants, companies, co-op societies and teleoperators.

The wireless side is also making a move from traditional closed networks into a horizontal Internet-architecture. The Flash-OFDM network, built on the frequencies freed from NMT-450, is a step in the right direction. Most of the lower (in the range of hundreds of MHz) radio frequencies are already reserved for TV-broadcasts, which could be sent on a much lower band than now if coded with MPEG-4. Digital TV is also a proponent of the old vertical thinking, where a network is only built for one application (in this case the distribution of TV-visuals). In horizontal IP-networks TV-broadcasts would be one application among others sharing the same network.

The term of the next government must see the opening of a frequency bandwidth of at least 100 MHz from TV-activities to use in realizing one or several open IP-networks that cover the whole country. In low frequencies this kind of a network could be cheaply extended to the furthest of places. In cities the additional capacity could be had from cheap and fast short-range WLAN-networks.

4.3 Information security infrastructure: safety and reliability for everyone

Data communication and information security are an integral part of ubiquitous information technology. As a result of the development following the so-called Moore's law, a wireless network connection and the required data communication protocols and encryption mechanisms demand only a small silicon surface area and are cheap to produce. That is why there will be a larger amount of Internet-terminal devices in the world than humans. The networking, safe configuration and management of these devices pose weighty challenges.

There is a hierarchy of wireless networks developing in the area of joint networks: PAN (Personal Area Networks), LAN (Local Area Networks), MAN (Metropolitan Area Networks). These are some of the most quickly developing areas of information technology.

In practice, each device has to be equipped with a public key encryption system, where a public key identifies the device and the key pair's secret key is only to be found in the device in question.

The large-scale use of public encryption systems presupposes a functioning *public key infrastructure* (PKI). Authorization certificates are a good mechanism for diverse uses. In this case we must still consider which actions require a strong identification and which don't, and also be prepared to guarantee anonymity in cases where it's necessary.

Mobility and safety have to be solved together. HIP (*Host Identity Payload and Protocol*) is a technique that simultaneously solves many problems: mobility, safety, parallel networks (multi-homing), the depletion of address space and the combining of IPv4 and IPv6 worlds. In this

area, Finnish research is leading the development and could be transferred to better products and services.

For the part of information protection, it should be evaluated how the protection of electronic communication should be regulated after the effects of the ubiquitous network society. Even though we have an excellent regulatory environment for using personal information with respect to the rights of the person after the Personal Information Act and the directive 95/46/EY, the spirit of the law isn't always carried out in practice. Ubiquitous information technology means that the amount of registers, register maintainers and collected information will grow rapidly making the problem much more difficult.

The implementation of the law can be furthered with official actions by increasing personal and external monitoring, improving guidance or by influencing the functioning of information systems by setting concrete demands for the systems dealing with personal information. Examples of these demands could be: one should be able to create a register sheet from the system, which details the actually recorded personal information (these days, the author of a register sheet doesn't often know how to use the system with enough skill to produce a reality-based sheet). In addition to the register sheet there should also be adequate means to produce a report on the system's information, concerning a single person (*e.g.,* the personal information act's right to examine one's own information). To produce this kind of report the combination and utilization of information between different systems is necessary. The report should also be in a form in which it can be used in different systems as well. Demands for the system providers can be set with binding legal regulation, by the demands of public acquisition or by aiming to affect the self-regulation of reporters through, *e.g.,* the Finnish Information Processing Association FIPA, (Tietotekniikan Liitto ry).

For the protection of privacy, it is difficult to propose concrete actions in other ways than by supposing the use of the consideration principle. It is a difficult problem, which is not getting any less difficult; research on the area, and the conversion of results, is sorely needed to provide the guiding principles in planning and decision-making.

4.4 Information infrastructure: mobile information that provides raw material for services

The ubiquitous network society is based on the intensive and cumulative collection, refinement and utilizing of information. For its part it is integral that there are no obstacles to these processes and that they are furthered by creating an open and cost-efficient information infrastructure to suit their needs.

The development of this infrastructure is in the interests of the government not just as a way of network society politics but also as a way of boosting its own productivity. The dismantling of

silo-structures, the straightening of action processes and the monitoring and maintenance of processing times and decision-making can all be realized only with an efficient and flexible information infrastructure. It seems alarming that, according to our projections, the electronic patient-chart information infrastructure that is central to health care has only been developed from the viewpoint of archiving, as if it really was only a folder in which to store papers. Instead, it should be an information structure from which different kinds of printouts could be formed applying XML-technology for as much as it's worth. The MuseoSuomi project[16] and the Suomi.fi portal[17] are better examples of work that strives to utilize new technologies, especially those of the semantic Web.

There are obstacles on the way of the development of an information infrastructure, the removal of which is one of the integral points in developing the ubiquitous network society. One excellent example is the siloing of information: as long as information is power, it is not readily distributed to others. We must resist this phenomenon forcefully and simultaneously create incentives for the distribution of information in a form suited for refinement. The acquired cost benefit, which is often carried out only in the end of the refinement process, has to be distributed through the whole chain. Especially the information and content collected, produced and refined by public and generally beneficial actors must be made mobile and turned into a resource of the ubiquitous network society. This covers the culture sector (*e.g.,* YLE's media-archives, the Finnish National Library's collections), health care and education as well as the map, weather and traffic information necessary for transport.

An open infrastructure also needs to be able to manage information that is confident for reasons of information protection or other matters and the use of which thus needs to be limited and managed – an example is the aforementioned patient-chart. Still, this can't set an obstacle to the development of an information infrastructure, for it needs to be seen as a challenge that can be answered by applying information security technology. Information protection need not be seen as a monster that freezes all sensible action. Legal regulation will also need to be kept from creating an obstacle.

We warmly support the network society council's proposal for the furthering of co-operative use of information with the help of the Creative Commons license system and propose that this project be carried out immediately. The areas of culture and education could serve as especially good pilot targets. In the same instance the launching of ubimedia to the mainstream and the

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[16] See http://www.museosuomi.fi/

[17] See http://www.suomi.fi/

pursuit of additional value could also be considered: could, for example, the complete National Library be supplied as part of Google Books?

In addition to the public actors, the resourcing of information should also be aimed at the information in possession of personal actors whose status is the key to the ubiquitous network society. Especially the location information of mobile devices, locating it makes possible as well as location consciousness are both necessary and open doors to new services. We propose that, by legal regulation or other means, teleoperators be required to supply the location information of mobile devices (including the locations of the support stations) to third parties to make location-aware applications possible. Naturally the location information produced by public funds (maps, route information, building history, plans, pollution information etc.) should also be in the use of the service developers for free or on a light contract, not depending on the legal form of the developer.

As said in the recommendations on information protection above, we also propose that, by legal action or softer ways, different actors be made to offer reasonable access to personal information registers in a way that makes it possible to combine and reuse this information by the user or through the user in other systems.

4.5 Service infrastructure: open service architectures and interfaces

Open interfaces are exceptionally important for application development, just like generally useable program components. An abstract, standardized way of describing interfaces provides an opportunity to utilize the service of interfaces with general principles. Naturally, the rate of difficulty of application development grows as the abstraction layers increase. The construction of vertical applications may result beneficial but narrow results. Horizontal development is slower, but it simultaneously creates wide-reaching and many-sided services that also work as an innovation platform for new services and applications. When public funds are used for the development of applications and services, the development should always lean on the horizontal model and on open interfaces.

The ubiquitous network society is especially dependant on the favouring of the horizontal model and openness. Whenever it is possible, a service should be built modularly and by leaning on existing service components while simultaneously considering whether the components developed for the needs of the service could be opened for general use as a part of a common service platform. The fact that this process increases costs on a short-term basis, can not form an obstacle.

The qualitative features required from the service infrastructure include the seamless combination of actions from different channels (but in a "seamful" way recognized by the users, as described in chapter 3.5); interfaces meant for users to observe all needed information and for

selecting the privacy-protection level; the decentralized control of services and contents; the management of identities and trust. This won't be easy: otherwise an infrastructure like this would already exist.

We propose that the government use all possible ways (forcing by regulation, guidance and standardizing, their own market force along with public acquisitions) to further the birth of a general and shared service architecture in co-operation with journalists and other parties. For some parts, this work has already been begun as a part of the JUHTA-group[18] but its reach and resources should be checked nonetheless.

We also propose that a clause for the following of the general service architecture and the openness of service interfaces as well as their application whenever it is technically possible be included in the terms for the licensing of the government's own information archives.

The costs of the utilizing of openness and horizontal architecture can be governed by furthering the search for existing services and service components. We propose that a register of ubiservices be created in Finland, which, through its own standardized interface, supports the finding of existing ubiservices, licensing (when needed) and application. The maintenance of this kind of register could be handed out to, *e.g.,* VTT Technical Research Centre of Finland's Information Technology Program.

4.6 From idea to service: promoting innovative actions

The Finnish innovation system is widely held to be exemplary. It is true that, for example, the founding of TEKES has been a very beneficial act, and the co-operation between universities and industry born in its wake is highly exceptional in international comparison. Due in large part to this co-operation, Finland gained success also in the EU's research- and development programs.

Despite all this, there are some weaknesses in the innovative actions, which are becoming all the more apparent. Finnish people have traditionally been good at developing information- and communication technology goods. Even without Nokia the Finnish footprint in the development of the Internet would be clear due to Linux, IRC, SSH and MySQL. Compared to this, we are less skilled in the development, production and distribution of services based on goods. As the ubiquitous network society leans especially on quickly developing services that are tailor-made for different applications and the needs and values of users, this weakness is becoming more critical. Presenting the situation in a pointed way one could say that all of the

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[18] The Advisory Committee on Information Management in Public Administration, JUHTA, see http://www.intermin.fi/intermin/hankkeet/juhta/home.nsf/pages/indexeng

mentioned actions for the development of different infrastructures will be worthless if the innovative action can't produce services that build on them.

The so-called "hype-age" of 1999-2001 was better than its reputation. New ideas had space and funding, companies were created and an overall excitement characterized the atmosphere. The goals were high up and many people tried their wings abroad. As the speed and course of development proved to differ from the expectations, some people naturally fell from a distance but in the end the damages were quite limited. What remained was a group of surviving businesses and entrepreneurs rich in experience, who have grown the sales and employment of the Finnish software production business year after year. When Nokia has also simultaneously worked as a school for international managers, the "graduates" of which have moved to rising companies with skills in international business, the after-effects of the hype are on the positive side.

What should we learn from this? What should be done for new ideas to bloom and seed? The subject has already been researched in numerous reports, and at the time of this report's writing at least The Finnish National Fund for Research and Development (Sitra) is making a new research with the assistance of researchers from the United States. Let that be the last report and the start for concrete action! According to well-known researcher of the information age, Professor Pekka Himanen's metaphor, Finland in its present state is like a former athlete who, thinking of his past glories, draws up training programs with such glee that he never manages to do the actual exercises. The proposed innovation program of the ubiquitous networks society can function as a coach, whose aim it is to whip Finland in motion and make it the leading producers and test-society of innovations.

One of the problems of creating service innovations is that their cost-efficient production requires a well-functioning platform and swift action processes between different parties. If the aim is also the utilizing of the new technology, the route from research to product is long and winded. To straighten it up we need development environments that accelerate innovative actions with a plan of lowering the threshold for the development, testing and production of new ideas. This thought has been quite visible in Finland for the last couple of years and in 2005 the companies even founded to cooperation clusters, DIMES ry[19] and Forum Virium Helsinki[20], which were created to develop this kind of innovation platform. These are steps in the right direction, but their strength is insufficient. As of now they also haven't drawn together enough of the different parties of service production, and especially the paid grassroots-actors are

[19] See http://www.dimes.fi/

[20] See http://www.forumvirium.fi/

missing (schools, congregations, libraries…). We propose that to accelerate the innovative environments and to provide incentives for taking part in them, a Finnish innovation fund be founded, with an aim of funding the construction of platforms and the pre-commercial development projects made in conjunction. By these plans, the field of the fund would be placed at the seam of the current TEKES and SITRA; the actual development of technology wouldn't be in its area.

In conjunction with this, it should be checked whether the law on public acquisitions needs clearing to make these innovative joint operations possible. It currently seems that the competition required by law and the fear of the market court occasionally make it impossible to create sensible co-operation between the service customer and the supplier. The EU's legal regulation also presumes that foreign companies can take part in the development of test platforms and innovative projects as well. We feel this is a welcome addition that shouldn't be artificially blocked.

The status of Finnish universities has been a visible public question since the spring of 2005 and industry has made some especially strong criticism. This is an area that also needs concrete action. The idea recently put forward by the Ministry of Education about the combination of universities is a step in the right direction in the way that something would actually get done. But instead of furthering action and innovation it will lead to an opposite result if the freedom and legal status of universities isn't changed in the process.

Japan made a significant reform in the status of its universities in 2004 when they became sovereign and legally competent, even including the crown jewel, Tokyo University. At the same time their funding base was renewed and the status of competition-provided funding was strengthened. In Germany, the innovation minister of the state of Nordheim-Westfalen proposed on January 25th 2006 a similar reform in the state mentioned, beginning from 2007. We propose that Finland should also make a reform in which Finnish universities are made sovereign and legally competent, especially when it comes to economic guidance and activities. In conjunction with this, the rector of the University of Art and Design Helsinki, Yrjö Sotamaa's idea about an "innovation university" which would combine the innovative resources of HUT (Helsinki University of Technology), HSE (Helsinki School of Economics) and UIAH (University of Art and Design Helsinki) could be realized in a significant way that could also create a space for the founding of at least one top university of technology, economy and innovations in Finland.

So, maybe Finland could also use a minister of innovation?

4.7 Legal regulation: fixing the basic rules of the ubiquitous network society

The possibly surfacing legal problems of the ubiquitous network society demand constant monitoring for three reasons. First, even though the technology that makes the ubiworld possible largely exists already, the development of the ubiworld can't be properly thought of in advance due to the commercial and cultural factors. That is why all the positive or negative effects of the ubiworld won't necessarily come true and new ones might spring up unnoticed. Second, the fact that the influence of legal regulation can be a large obstacle or incentive, demands the constant monitoring of this sector. Third, the development of the area's European communal law regulation, its preparation and the similar processes in the United States, Canada, Japan and the countries in the proximity should be closely monitored to get up-to-date information on new legal phenomena for our own actions.

The Finnish law on electronic communication has changed almost completely in two years. The act on the supply of the network society's services, the act on the protection of privacy in the work environment, the act on the information protection of electronic communication, the personal information act and many other acts that deal with business in the sector of electronic communication and the use of public force on its area have brought up counter-intuitive changes for how and when information can be collected, what it can be used for, when does it have to be destroyed, how and to whom does one need to report about the collected information and which officials have a right to give out orders on these things. The demands are focused on both electronic and other collection of information, as well as data processing and communication. The discussed information also contains phone conversations by different devices (including the Internet), broadcasting-type solutions and the taking, collection and distribution of both still- and moving images. The Finnish Penal Code has also changed quite widely in the year 2000 and afterwards. It includes, along with the aforementioned, demands on reporting duty in certain situations.

The functioning of this structure in a rapidly changing world is still uncertain. We might be headed toward a situation where the legal investigation of solutions and actions is no longer sufficient, because the planning of the whole legal framework needs to be seen as part of technological planning an communal testing.

Further research and possibly even fast adjusting actions are also needed by the regulation development of IPR's, the protection of privacy, contract law and consumer protection.

In the area of IPR's the current Copyright law has, after its latest partial renewals, developed so complex that it is causing disturbances in the area's development in addition to the content problems mentioned earlier among both users and the owners of rights. This lack of thorough reforms harms the fast development of the network society and we warmly recommend the Information Society Council's proposal for the quick reform of the law (see appendix 2).

Other important areas of further research are the verification- and renewal pressures caused by the new technologies on the legal regulation concerning the telecommunication business. The question whether the growing, partly local ubicommunication creates verification pressures concerning the monitoring of radio frequencies, access and use of information networks, and the combination of different systems demands a thorough report.

The striving for a technologically neutral law regulation has failed badly, especially in the EU's directives. As has been pointed out, the technologically bound law can prevent the development of some useful ubiservices. In the ubiworld, one can't presume that all devices are capable of displaying large amounts of text or that some features can easily be turned on or off. The ubiworld might not even have a clear, central actor, for whom the limitations concerning the production of services could be set. When creating law regulation that affects the ubiworld, it should be taken care of that the preparatory group includes experts who are able to estimate the kinds of future technology the law might be applied on.

Finding the right balance between the protection of privacy and the useful distribution of information is one of the most critical tasks of the ubiworld. As mentioned above, weak protection of privacy may collapse the faith people have for ubiservices and block all sensible business. On the other hand, extremely strong protection makes it impossible to develop many important services. The European regulation emphasizes the significance of privacy, but it does it in an unreasonably difficult way. For the development of ubi-Finland it would be important to remove the unnecessary legal obstacles, also concerning the protection of privacy.

The question of what people really want from services should be legally stressed as well. The regulation shouldn't make it too difficult to produce services that actually match up to the needs of people. The law could be used to make firm demands for the protection of privacy and for usability, if they match up to peoples' needs.

The fact that the ubiworld makes it possible to use network powered time and cost-saving methods for negotiation and conflict solution both in public and private sectors requires a follow-up report of its own.

Monitoring by officials in its traditional form will not be adequate, despite its importance. As this report shows, successful legal regulation must be placed in relation to both ubitechnology and its development as well as the current society's economic situation. .One necessary way is the follow-up report of this paper, where the areas that were previously found problematic will be estimated and more thoroughly researched.

To create a complete estimate of the area, it would be useful to gather up a small and compact team of experts, a task force, which would consist of professionals from the important areas of technology, electronic trade and legal issues and work as a part of the program of the ubiquitous

network society. An important part of the group would be experts set by the Finnish Competition Authority and the Finnish Communications Regulatory Authority, who are able to estimate the underlying economical and competitive situation. The aim of the group is to monitor the development of the area and work up a firm consensus on the issue as well as to estimate the experiences drawn from program tests and demonstrations. While evaluating the course of the future the team could use a wider array of experts than has been done while working on this report.

4.8 From research to services: the study of the ubiquitous network society

The ubiquitous network society is new by definition: it leans on the combining and healthy interaction of paths of development that have previously been separate. That is why this report can only scratch the surface of the presented area of phenomena: the object is alive, it develops fast and changes its shape quickly.

For these reasons we think it is integral that the research of this area is carried out with adequate force and the right instruments. We feel that the research should be directed especially on the everyday innovations, their social acceptability and spreading mechanisms. This process should be seamlessly combined with strategic basic research aiming at the understanding and modulation of the subject, utilizing the methods of behavioural sciences, social sciences and design sciences in a cross-disciplinary and integrated way. The process should also provide developers useful information on the usability and the social acceptability of the devices and services, the different problems concerning the maintenance of privacy and the significance of social networks. In addition to this, the research should cover some themes covered in this report, such as content management and the conjoined legal questions.

All this has to be in an intimate connection with the development of services and service platforms, and most of all, with the use-tests conducted with real users in naturalistic environments (”living labs”) and the learning they provide. The funding instruments of the research have to be directed in a way that they also make possible wider and longer tests, which we feel to be absolutely necessary.

Therefore we propose that a research program of the ubiquitous network society be created as part of the wider development program, with adequate and correctly instrumented funding to back it up.

4.9 From ubi-Finland to ubi-Europe: the European dimension of the network society

The actions presented above to develop the requirements for the ubiquitous network society are based especially on the Finnish situation and its needs. Still, they are as critical for the goals of the EU as well: just like Finland, the EU is also facing a challenge of moving into a service-intensive network age, and needs the entailed boost in productivity and growth.

The realization of this is important for the Finnish people, first of all because it creates a possible market for service innovations developed in Finland. It is as important that the process can be used to further the spreading of values that are important to the Finns in the European ubiquitous network society, such as openness, equality, transparency and a dialogue with the citizens, thus strengthening the legitimate basis of the community.

The preparation of the EU's 7th research framework program is currently active and different Finnish parties are working in this project. It is important that the ideas presented in this report as well are taken into notice when the themes, research settings and contents of the future program are shaped. It is especially important to influence the meeting of the needs of the ubiquitous network society's innovation research in connection with the technological program-platforms. Is it possible to create a European network of living labs that would make it possible to proactively test Finnish service innovations in different European countries?

The legal regulation of the ubiquitous network society is by all important parts on the level of the union. When the EU is now preparing the renewal of the communication area's directives it is integral that Finns take an active and visionary part in this work and that the pondering of the Finnish standpoint leans on the best useable professional help and research. It could be represented by the aforementioned expert group on the ubiworld's legal regulation.

APPENDIX 1: THEME-ARTICLES

This appendix contains articles produced as part of the HIIT's research to provide background and in-depth coverage on the material presented in chapters 3 and 4:

- Antti Oulasvirta: Ubiquitous usability
- Esko Kurvinen: The application development of the ubiworld
- Mika Raento: Protection of privacy
- Katri Sarkio: Trust in the ubiquitous network society
- Perttu Virtanen: Content management, copyright and other IPR's
- Jukka Kemppinen: Open innovations
- Mika Raento and Antti Oulasvirta: A social presence service for a group of friends
- Risto Sarvas and Marko Turpeinen: An identity-construction service – the IRC-Galleria

Antti Oulasvirta: Ubiquitous usability

Ubiquitous computing is envisioned to support new kinds of activities depending on the co-operation of previously unconnected devices: an automatic notice to the emergency centre and to other cars in the case of an accident, one remote to control all home electronics, a digital family picture on the table showing the latest photo from the phone of the wife or daughter. This kind of ubiquity may have two important consequences for use of technology: 1) the diffusion of information to everyday objects implies increased difficulties in cognitively managing their whereabouts and 2) the new interconnections between devices implies increased experienced complexity of the experienced action logics. Corresponding usability challenges are the governing of the fragmentation of use and making technology understandable. .

Due to these reasons, usability is one of the main pressure points of ubiquitous computing. One can draw up five different ways of solving this problem. They are not mutually exclusive, and each has its own hopes and challenges. Some of the visions can be more realistically realized in the near future than others.

Vision 1. An invisible computer and "natural interaction"

According to this approach the working logic is hidden from the user and the user interface subordinated into a natural form. Usually "natural" means interaction that happens through discussed dialogue and gestures resembling human-human communication. This line of thinking is characteristic for consumer electronics companies like Philips. For example, the many remote controls of a household would be replaced by an agent commanded by natural language and gestures. This agent would be like the user's own "media butler" who would play the requested songs or record the favourite TV programs.

The problem of this approach is that as a user interface, natural language does not simply and directly improve usability, but changes the form of the user interface. For the user's this solution is acceptable only when it works more efficiently and flawlessly than the best "unnatural" alternative. What is alarming in this approach is the notoriously weak performance of present-day speech- and gesture-recognizing technology. When the rate of mistaken interpretations is in the range of 5 to 20 %, most of the user's energy is directed on correcting the mistakes. A significant solution to this problem will probably not be realized within the next five years. Another challenge is the creation of a uniform command language. The fact that the user has to learn a different command language for every device is not an acceptable point for the future. The only realistic line of development on this problem seems to be the co-operation of companies and officials for the technological standardizing and unification of command languages. In addition to this, the companies would probably not offer command languages for

small languages like Finnish and Estonian due to large expenses in language technology development. .

As a conclusion: it is clear that speech- and gesture user interfaces can not quite surpass other ways of interaction, even though they can bring about their own strengths together with existing ways in some application areas. This line of approach is called multimodality (coverage of multiple sensor modalities): the user is provided with a choice of selecting the way of interaction depending on the situation or preference. In this solution speech or gesture language is only one possibility among others that the user can select. The design of multimodality demands an elegant solution of this situation of choice, but this problem is also one for which a generally efficient solution have not be provided at the moment.

Vision 2. Convergence and the so called keyhole problem

Convergence means the increasing availability of information technology and digital contents on any terminal device (e.g., on PC, mobile device, or digital TV). It is a natural approach for companies producing a single terminal device and for media producers, the both of which see convergence as a possibility for increasing the lure of the product. An example of successful convergence is the use of the mobile phone for a wide range of purposes: as a media player, a browser, an e-mail program, for calls, as a camera etc. Generally speaking, convergence has been a stronger trend than differentiation on the market, but it is clear that the limits of convergence will be met some day. .

From the user's viewpoint the central problem of convergence is the so called keyhole problem: one should use a small user interface to perceive and control an increasing amount of information and features. A large part of the features remains unnoticed (the so called service discovery problem) and remain un-used. Another important factor is the additional cost brought on by miniaturization, which is visible in the prices of products. Partly due to these factors the intelligent phones and mobile-TV have not made the expected breakthrough on the consumer market, even though they are strong examples of convergence thinking. Implementing convergence in ubicomp scenario would require a constant, user-centred process of iterative design, where user-specific information is systematically utilized throughout the process. Most of the ideas based on convergence, like the interactive digital TV and WAP have failed especially in this respect.

Vision 3. Differentiation does not work in consumer applications

Differentiation is the antithesis of convergence: it means the active dedication of information artefacts. Taken to its extreme, every possible use or function is matched by a new device. Some new application ideas promised by ubiquitous computing are based on cooperation among such devices. For example an alarm clock can interpret a correct time to awake the user from his

calendar schedule. This approach has lately been, for understandable reasons, in the interests of component manufacturers like Intel.

The best thing in differentiation is that when there are few features, the usability of a single device has better possibilities to succeed. Still, there remains the challenge of supporting the seamless control of the multiple devices that are available in any given situation. Centralized design of cooperation is possible in limited application areas, like in certain sectors of trade and industry and in cars, but consumer applications have traditionally involved multiple factors that practically rule out this possibility. Carelessly realized differentiation might lead to a situation where the user is supposed to learn a large number of interactive models, one for every device from a separate manufacturer. It also leads to the user carrying around the needed devices or searching for them in the environment. A third problem is created by situations where the user has to control multiple differentiated devices. In this case, the interactive customs presupposed by the devices should fit into the user's cognitive and motor resources. For these reasons the only realistic path of development in consumer applications requires a standardization or other kind of compatibility ensuring process taken up together by the device manufacturers and the officials.

Vision 4. The limits of "ubi intelligence"

The recent fast development of machine learning (*e.g.*, Bayesian networks and support vector machines) has brought to the fore an idea about their utilization for the automatic adaptation of the new ubiquitous computing applications. This would happen on the basis of sensor data collected of the user in different use situations. For example, official information could be displayed in a way that takes into account the skills of the viewing user, or car seats could shape up to the driver's previous preferences. Adaptation to the use situation's special characteristics is called context-awareness. A typical example is turning one's cell phone to mute at a theatre or a meeting. An extreme form would be an application that anticipates the user's needs and works on its own. This application would be called proactive (working for the user).

Machine learning based on sensor data is generally speaking the most challenging approach to ubiquitous computing. If it worked reliably, it would solve many usability problems. Unfortunately, research shows that the identification of complex psychosocial events from relatively poor sensor data is nearly impossible. Human constructions like "can be interrupted", "at a meeting", "location" or "reliable" ca not be automatically recognized (reliably) with current methods. The largest obstacle is not so much the lack of processing capacity but the difficulty of adequately formalizing the psychological and social constructs. For example, defining some situation as "in a meeting" does not necessarily depend on one person's opinion, since the nature of the event is defined and negotiated in interaction with the participants.

The unreliability of automatic interpretations can be answered in two ways in user interface design: 1) Adaptation is only carried out for user actions where the cost that follows a false interpretation is not critical. A good example of this line of thinking are the ubiquitously functioning HVAC-systems, that can modify operating parameters (temperature etc.) .according to the time of day and year, but in which the cost of false interpretations is fairly small. All kinds of background actions that ease the work of the user (e.g., the "intelligent" anticipatory loading of web-pages) are also possible, since they do not demand costs from the user. 2) The second approach entails offering an efficient user interface mechanism to monitor the interpretation and to correct mistakes after they have happened, but this solution is not be trivial to design and is not often feasible in security-critical or social applications.

Vision 5. Sensor information as a resource of human action

According to this approach, ubiquitously collected sensor information could, instead of automatic adaptation, be used as a support and facilitator (more generally: as a resource) in human action. In practice this means different representations of the information collected from sensors. Instead of abstract concepts (*e.g.,* "meeting") fairly concrete and precise constructions like "chosen profile: meeting", "the person's location on the map: Fabianinkatu 33" or "the rating of other users: 3 stars" are possible and do not necessarily require complex machine learning algorithms so the effect of false interpretations is minimized. Abstract interpretations could be utilized to the degree where additional requirements can be offered to their interpretation with the means of user interface design – e.g., by using the so-called drilling method: an abstract interpretation from sensor data is represented on the precision level demanded by the user.

This approach is best suited to two kinds of applications:

1) Social applications like awareness applications, location-aware communication and photo sharing. In these cases, sensor data can work as cues helping the interpretation. A good example of an awareness-application has been presented in the theme-article by Mika Raento and Antti Oulasvirta. The general functional method in social uses is that the introduction and utilization of information is based on a mutual contract between the users. The contract can be called off, but in this case one loses the benefits it brings along. The special problem of this application category for user interface design's part is the thought on contract systems.

2) In applications aimed at modification or change of behaviour (e.g., in use of time, e-mail, washing one's teeth, social networks), sensor data can provide additional useful information. For example, a new kind of toothbrush made for kids collects information on the frequency and duration of the washing operation and changes its look accordingly (happy, satisfied, disappointed) in order to encourage the child to learn the skill of brushing. In both types of

applications ubiquitous computing presents additional information that supports and enriches normal activities. It is available whenever it is required (pull-thinking).

Taken to extremes, this vision also has down-sides: the active environment of humans can be ”over-populated”, that is, it is full of different displays and digital representations. Nonetheless, it must be noticed that since this vision includes the user as an agent collecting and utilizing information, “an information flood” is a less acute problem than it would be in a situation where the user is the object of the computer’s activity (push-thinking). The user’s activity with the use of .these new resources leads implicitly to the user-specific personalizing of services and, through this, guarantees their acceptability and supports their compatibility with everyday life. Another pertinent problem is that the user’s time may be unreasonably spent with maintaining trivial but socially significant actions. Third: the same problems as in the case with differentiated and invisible user interfaces may surface again; that is, learning and maintenance of numerous devices may prove difficult. The proper solution to this problem will follow same lines of thinking as for the differentiation. The fourth significant threat is the misuse of a ”resource” as for example .for controlling others. This problem is focused on in the other chapters of this report.

Conclusion

This chapter has dealt with five approaches to the design of user interfaces for ubiquitous computing. With every approach, we have pointed out central problems in usability and defined the fruitfulness of the approach on different areas of application. The analysis points out theoretical and pragmatic boundaries to some of the most deep-rooted belief systems in the business, such as intelligence, minimalism, invisibility and differentiation. Nonetheless, common denominators for the design can be found. In addition to the efficiency and enjoyability of use as well as the natural feeling of use (both typical goals of usability engineering), important goals for design include at least:

- *Transparency*: the user has to know the state of the device and the premises for interpretation it gathers from the sensor information.
- *Control*: the user has to have a clear possibility to influence the work of the application on a fitting level of precision, starting from the ability to turn off the service.
- *Error correction*: the user has to have a possibility to repair a mistake made by the machine or by his own actions. This can also happen on non-technological channels.
- *The appreciation of the cognitive demands*: the design should take into account the load posed by other activities in the situation of use as well as the strained senses.
- *Service discovery*: the difficulty of finding a service is emphasized especially in technologies striving for convergence. Solutions have many levels of freedom, depending for example on the inlaying (hiding) of services in the user’s area of action.

- *Social acceptability*
- *Unforced contracts*: the user should have an unforced possibility of making and understanding a data transfer contract with other users and agents. The application should not pass or refuse any contract between humans.

Esko Kurvinen: The application development of the ubiworld

Networked applications

The central manifestation of ubitechnology is the mutual networking of applications and devices. This, in turn, makes possible completely new applications. For example, an electronic calendar and a navigating program work both in their original purpose but also as views to the family photo album. In the case of a crash, a notice is sent out to the emergency centre and to other drivers. A family picture on the table shows the last photograph taken from the phone of the wife or daughter. There are an innumerable amount of possible combinations, part of which are naturally quite senseless. Still, it is clear that a successful product may be made just by recycling and combining old ideas.

Traditionally product development aims at a specific product or product family. These development projects, even networked ones, are usually in he control of one company/actor. This coordinator holds the threads by cropping and outsourcing parts of the project. Traditional product development also includes some kind of advance opinion on the business model. On the other hand, new technology makes possible a new kind of situation, where the final target of the development work (a product or service), the actors (companies, communities, individuals) and the business models (or other motives) meet only in the last few feet.

The effects of networking aren't only limited to applications, since they only reach the business models. Researchers of the area and other idealists usually speak for open interfaces. The aim is the creation of a technologically, socially and economically varied environment that supports the birth of innovations. That's why it is important that the development isn't channelled through a select few actors.

Part of this vision can already be seen in the services of the wired Internet. Open interfaces into different databases have created a rapidly growing group of so-called mash-up mixing services. For example, at the site http://www.mashupfeed.com there appear approximately three new combinations, "mash-ups", in a day (approx. 990 in a year).

The idea of mixing applications is to combine information so that the result is more than the sum of its parts. Google Maps and Google Earth, which combine map- and satellite images found for free on the Internet are perhaps the most famous examples and the most often recycled resources. A typical mixing application organizes the supplied information in relation to location information (*e.g.,* maps) and to time. For example, http://www.chicagocrime.org which is based on the Chicago Police Department's open database, offers a map-view of all the reported crimes organized by location, crime types etc. Personal relations, family history and other such things are also easily visualized by maps (*e.g.,* http://www.mapyourancestors.com).

The combinations aren't limited on maps, because contents can be related to each other in many ways. For example http://www.museosuomi.fi offers a view to the collections of three different museums and http://liveplasma.com offers a graphic view on movies, music and people.

Mixing applications aren't only non-commercial hobbies on the grass-roots level. Many commercial actors have already started opening up their databases. For example Amazon, eBay, Microsoft, BBC etc. have noticed that open interfaces offer consumers new ways to approach their products. In addition to this, the aim is not only in selling old products, but also collecting feedback and making product innovations with the users. Combining is also a way to get more out of the supplier's traditional products. For example, the representative of BBC motivates the BBC Backstage service in the following words:

> *"The BBC will support social innovation by encouraging users' efforts to build sites and projects that meet their needs and those of their communities ... The BBC will also be committed to using open standards that will enable users to find and repurpose BBC content in more flexible ways".* (see http://backstage.bbc.co.uk/archives/2005/05/faq.html)

On the side of the traditional Internet there appears to be a forceful interest on maps and the utilizing of location information in the production of services and products. The connection to ubiquitous information technology is obvious. Thanks to location- and situation-sensitive technology, it is possible to combine not just digital content somewhere over the Internet, but real, live products and services in the physical vicinity of the consumer.

A dialogue between digital technology and the physical environment

Mobility freed us (at least apparently) from the chains of time and space. A cell phone can be used to work up things from a distance as well as organizing and reorganizing everyday tasks. Ubitechnology brings back the significance of time and space. Systems and devices, along with the user, are even more conscious of the limits and possibilities of the using situation and environment. That is why technological- and business potential should be looked for (actually) within stone's throw of the user. This means that the development work should be provided with fresh blood from outside the traditional ict-sector; from commercial, beneficiary, ideological, organized and unorganized actors, who are currently dominating the public space.

Business models utilizing location- and situation-conscious technology might be very different from each other. For example, many cafes are already offering free Internet access since it draws in people who will pay for coffee and bagels. Present information technology shouldn't be thought of as a way to bring digital contents into a physical space. Using it, we could also make public (and private) space richer and more varied in its possibilities of taking part in it. At its best, the combination of information technology and physical or spatial resources makes spaces, locations and areas (street corners, districts, cities etc.) more drawing both from the viewpoint of

digital and traditional products and services. In addition to this, it must be noticed that the lure of spaces and locations is often connected with the social interaction, joint work or leisure they make possible. Location- and situation-sensitive technology brings its own addition to this fact. At its best, the new technology furthers not just economic activities but also the interaction, satisfaction and well-being of people.

The lifespan of location- and situation-conscious applications

Networked and context-conscious technology makes possible applications with a highly exceptional lifespan both when it comes to the user interface and the content of the service. Traditionally www- and mobile services have been designed for a long-time use in the hands of the masses. When starting services, the silent assumption is that their structure and idea remains the same for their whole lifespan, not counting small updates and incremental changes.

Situation-conscious applications with phased life-spans can be built around different events (festivals, sporting events, *etc.*). Before the event, the service can help users in planning their activities, in anticipatory conversations and in the selling of tickets. During the event the users (those present and others) can take part in the production of the content, its distribution and in discussions with others. After the event it can be recollected among the mutually produced material.

From the viewpoint of a single user, the lifespan of location-centred services can be very short. The things that the environment can offer to the mobile terminal devices moving in its vicinity include:

- description of the service that is put together with, *e.g.,* a web browser
- the program needed to use the service
- knowledge on which programs or resources the supplied service requires

For example, a tourist-information service, or a soft drink- or ticket machine could work on this principle. The service may only be used once and the technological infrastructure has to offer ways of verifying the service's origin, functionality and security.

Small-group specific and ad hoc applications

The outlook and content of networked and location-conscious applications can be designed for a very small group of users. Whereas traditional applications and services are designed for a certain customer base, small-group specific applications are more like platforms, where the users groups can organize, produce and modify content in the way they desire.

A comparative phenomenon could be found in the user groups and networks that have formed around the Internet message forums, images, media, maps and blogs. With the help of location- and situation-sensitive technology these activities (or part of them) can join or integrate the

phenomena, subjects and events of the real world better than before. This makes possible the creation of not just themes and interests but also groups attached to space and time. For example, the Helsinki railroad station is very different in different times of day. There is change in the supplied services as well as in the people and their interests. The idea of context-sensitive systems is to take into account these kinds of changes and offer contents and services related to the user's current situation. For example, those going off to work in the morning and those coming back home in the afternoon are likely interested in quite different things. The interests of the train-passengers, on the other hand, are different from the interests of the people using restaurant- or shopping services, not to mention the skaters hanging around the station's vicinity.

Application development/Recommendations

It should be a general principle that the officially produced (public) contents are supplied through open interfaces. These include different statistics or contents born as a side-product from official business. For example, in many major cities, the image material of security cameras monitoring traffic and public spaces are available through the Internet. The aforementioned material could be useful in avoiding traffic jams, coordinating activities or as part of personal communications. In addition to this, publishing the material makes the monitoring of citizens transparent.

Location- and map information are the main raw materials of ubi-Finland, which have to be brought to the free use of all actors. For example the Surveyor Department's map service has to be opened. At this time, different searches made by search engines are forbidden. The opening of the service would make it possible for both entrepreneurs and individuals to search and experiment with new utilizing manners without unreasonable investments.

We must strive to reach a situation where we work with teleoperators and device manufacturers in order to provide cheap and easy locating, that doesn't require difficult contracts.

We must work to make location-consciousness a part of content production throughout the production chain. YLE could make itself a positive example in this case. A long-term vision would be location- and situation-conscious digital television. The first step could be the user-centred developing of YLE's podcasting-experiments together with industry as well as the researcher- and developer communities (as in BBC Backstage).

We will need so-called Living Labs styled research-powered projects that map out and develop the interaction between important public actors (companies, communities and individuals) and information technology. These projects should be ethnographically powered, *i.e.*, researching the viewpoint of the potential content producers and users.

Mika Raento: Protection of privacy

Ubiquitous computing means the inclusion of information technology in all aspects of human life: in the home, in the workplace, in private spaces and in public spaces, as well as while moving from one to the other; for children, for adults and for the elderly; as a part of activities public and private. Thus ubiquitous systems will, by definition, be dealing in information considered private.

The concept of `privacy' has been framed in many ways. When it comes to computing, I find it helpful to distinguish between different spheres of activity – activities between different actors:

- an individual and the state
- an individual and a legal person (e.g., a company)
- an individual and strangers
- individuals known to each other

These different spheres differ in several ways: which legislation to consider (Personal Data Act vs. Police Act), where the legislation originates from (is it Community law or the member state's), what degrees of freedom the actors have (the state may compel citizens to act in certain ways, consumers may decide which products and services to buy, adult individuals have fairly free choice in how to carry out relationships), which technologies are involved (surveillance, advertising and commercial communication, data mining, personal communications) and what kinds of solutions are applicable (anonymity or pseudonymity, encryption, transparency and accountability, non-disclosure, lying).

In the following I lift up five themes that seem most urgent in creating ubiquitous computing systems that allow users to maintain control over privacy and disclosure.

The computationalization of the everyday vs. everyday thinking

When an individual writes a message on a web-based forum, their mental model of the action is most likely one of group communication – they think they are communicating with a limited number of others, and that their message will only live for a limited period of time. The forum is felt to be similar to a real-world conversation held with physically co-present others. In (technical) reality the individual is permanently publishing a text to a potentially unlimited audience. In doing this they may unwittingly breach the privacy of others, disclose information about themselves they would have considered private, or even break copyright if they use images found on the web as a part of their expression.

People use computational applications and services as a part of their everyday life, but these services do not follow everyday mental models. This problem can be approached from two directions: by creating computer systems that better follow our everyday mental models, or by

educating people as to how the systems actually work – with real solutions probably being a combination of the two. Such solutions will be a combination of social changes, education and learning, technological research and development as well as the regulatory environment. Member states and the Community have a possibility to support information technology education, privacy-related research in both technology and human-computer interaction and in maintaining a suitable regulatory environment.

The conciliation of mental and system models plays a key role both in data security, privacy and trust as well as in building successful ubiquitous services and maintaining a credible judicial state. Our current understanding of these issues is clearly not adequate, we need continued research into both human behaviour in these areas as well as into human-computer interaction.

Data protection in peer-to-peer networks

Although the 2002/58/EC Directive on privacy and electronic communications was written to be technology-neutral, it is not. The development it failed to take into account was not purely technical, but organizational: 2002/58/EC as well as the underlying 1995/46/EC assume that data processing is carried out by a well-defined, centralized entity – the controller (or the processor). An increasing number of modern computer systems are based on peer-to-peer networks (examples include Skype and Bittorrent). In such systems all users are both subjects and controllers. Although the directives are legally binding in such systems, almost nobody seems to have a clear idea of how the should be applied.

Guidance on applying the data protection to peer-to-peer environments, maybe even new legislation, is needed.

Are the Data Protection directives followed in the real-world?

The 1995/46/EC Directive on the protection of individuals with regard to the processing of personal data and on the free movement of such data, and its implementations, give clear and practical guidance in how to process personal data. The directive is the result of over 20 years of research and regulatory process including the OECD guidelines and ETS 108. Regardless, it seems that many controllers see these regulations as cumbersome, heavy and difficult to comprehend and follow. The regulations are followed at best in the letter, very rarely in the spirit. According to an experiment I carried out, nine out of forty controllers did not respond to an access request at all, and another fifteen only in part. There are problems in transparency, the right to be informed, the right of access, differentiation between information that is needed for transactions and that which is voluntary as well as in how long the information is kept. With ubiquitous computing, the amount of information to be processed as well as the number of controllers will be growing. It seems unlikely that these problems will go away without action.

There is no regulatory body, at least not in Finland, that would proactively check whether controllers follow the data protection regulation. Neither do subjects typically exercise the rights given by the legislation. There are no legal requirements on the providers of information systems to support data protection, nor do most customers of the providers demand such. The member states or the Community could provide pressure on information system providers or controllers in the form of proactive checks on processing and systems. States could also, as controllers themselves, demand better systems. Plainly: any information systems that handle personal data should explicitly support the controller in following the data protection directive. In addition to regulatory pressure, both controllers and information system providers would benefit from practical education and guidelines.

Creating utility from personal data

Rather than seeing data protection as an onerous extra demand placed on controllers, ubiquitous computing may provide an incentive for the controller and subject to act together to provide more value for both. The information collected by the controller can be seen as a resource for the subject: for example, the subject could follow their finances (how much money have I spent on what?), health (how much exercise have I been getting?), or relationships (who have I been calling and how often?). As more information is gathered through the inclusion of computing in everyday activities, utility is created, and the created utility can be shared between the controller and the subject.

Information systems should, then, not only support the legal minimum requirements set by legislation but support flexible, ongoing, real-time access to personal data *by the subject*. Fully transparent and real-time access to data should also facilitate trust and acceptance of new, ubiquitous computing systems.

Access to the user's personal data together with advances in terminal equipment may create a new class of applications: applications that run on the device owned and controlled by the user, but utilizing personal data drawn from multiple sources. Since the further processing of data is now happening under the user's control, there are no legal obstacles (contrast to the problems faced by current location-based services). Such applications can even explicitly help the user to manage privacy for themselves.

Privacy, anonymity and accountability

The balance of privacy, personal freedoms and legal accountability has been a central concern in legislation. Legislation concerning these issues includes the freedom of expression, the sanctity of the home, and regulations over police investigation. The balance is the result of several hundred years of development in what a state is.

In the computationalized everyday the current regulation may seem, or be, insufficient. Electronic communication can much more easily be used to harass or annoy than letters could, many actions may be carried out from the home, and private correspondence may travel through many intermediaries. These changes have triggered pressure to increase state surveillance of electronic communication.

State surveillance is not necessarily good or evil, but it *is*, without doubt, risky – or dangerous. New surveillance measures aimed at maintaining accountability in the electronic world (e.g., efforts to require retention of communication records by ISPs) have consequences that are very hard to judge beforehand, and carry large risks.

Any new surveillance mechanisms should be approached with the principle of caution. Information technology can be used not only for surveillance, but also to reduce the risks of surveillance through for example transparency and accountability of the surveillance itself. Ubiquitous and peer-to-peer computing easily mean that there are many more actors that potentially have to carry out surveillance (e.g., almost anybody can be an ISP). The right to carry out surveillance should be handed to non-state-actors with extreme reluctance – the safeguards on state actors have been hard-won. On the other, we do need enough accountability for electronic actions to enable products and services to be sold.

The problem with surveillance of the ubiquitous is predictability: when a new form of surveillance is to be created, all of its consequences should be known (e.g., the radically changed nature of closed-circuit television monitoring if-and-when face-recognition becomes viable). The same way a controller under 95/46/EC has to declare all *use* of private data prior to collection, surveillance should be limited by *use* rather than technology. Such limitations must also be monitored for compliance.

A technological research challenge is to find out ways to make those actions accountable that need to be (e.g., public expression, financial transactions) while retaining privacy for actions that do not need to be (e.g., private correspondence or purely personal data processing).

Katri Sarkio: Trust in the ubiquitous network society

Trust in the ubiquitous network society is constructed through the interaction of many different viewpoints, such as users, service producers and suppliers, solutions of technology and information security, usability, and legal questions. Trust can be focused on from different viewpoints with the means offered by the associated areas by observing the solutions with the service's user interface, contractual relations or the encryption mechanisms used in data communication. A significant challenge to the reliability and availability of the services is posed by different users and their different qualifications for being a part of a ubiquitous society.

Positioning trust

There doesn't exist a single definition of trust, since it depends on the observed whole and the viewpoint of observation. Trust can mean, for example, the information-technological information security of communication, the reputation and visibility of the service provider (*e.g.,* electronic bank services), the part an otherwise trusted third party plays in the service (*e.g.,* Visa and the electronic markets) or the look and usability of the service.

In the ubiworld, it is important to understand the variety of the active environment and the effect these different viewpoints have on trust. In this context, trust is focused on as an individual's subjective expectation and interpretation both of the ubiservices and of the action of other parties having to do with the communication of the service. Trust isn't thought to be transitive nor interactive, because communication isn't presumed to be continuous and the parties can remain unknown to each other. Trust is often treated as a risk position estimate from a business viewpoint, which in this case would mean the subjective evaluation of the different factors and viewpoints of trust as well as their influences and binding force.

In the many-sided environment of the ubiworld the building of trust must be based on the starting points of the users and actions, supported by the solutions of technology and information security. Trust-building based on users and actions emphasizes as central points the real and possible events of the service and the sense of purpose. This angle of entrance can work to further the transparency of the service's action environment and framework, and, through this, increase the development and popularity of ubiservices. Development springing from the starting points of users and the action environment also makes it possible to take notice of the protection of privacy in the early phases of development, thus making it a natural part of the ubiquitous network society and its information and communication services.

The information- and communication services that are constantly present will also bring changes to traditional electronic services. The most significant changes in the building of trust are:

- the transformation of the traditional a priori hierarchic trust-relation setting,

- the increased availability of information connected to persons, and
- complex application of regulations on constantly present services.

Through these changes, the central tools in the building of trust are especially:

- the investigation of the mutual trust relations, and
- observing the degree of the service environment's openness and decentralization.

The changing setting of trust

Through ubiservices, the pre-defined trust setting of traditional electronic services changes as well. Along the information- and communication services between different entrepreneurs, as well as consumers and entrepreneurs, there will be short-range networks and peer networks formed by the devices and objects of the users as well as the virtual peer communities governed by them (peer-to-peer, P2P).

Instead of tightly controlled action models and a trusted third party, P2P communities typically have principles and modes of action (silently) accepted and followed by the members. In these peer-environments the trust relations are influenced by the social networks of the users as well as trust estimates on other members, based on their previous actions. It is more and more frequent that users are identified by a pseudonym or other detector of the virtual world, on which the trust is aimed instead of the user's own identity. Unlike in the services provided by a third party, these networks and communities don't contain a single entity, who works in the role of a registry keeper, following the Personal information act. Instead, the information concerning multiple users is spread out in the network and within reach of other parties.

The cluttering and availability of information

In the ubiworld, information concerning the user gets cluttered and is available like never before. The setting of increasing security and trust by tightening centralized control and by binding individual rights will change. As the service- and communication technologies become varied, services and systems are more open and decentralized than before. Users can be recognized without traditional methods of registration by personal devices and objects containing detectors. With the help of the detectors, the users can be profiled and their earlier activities monitored. Even though there would be no extraneous information collected on a person's earlier activities in the network, or if he wouldn't register to the service, the traces left by the user could easily be linked to the detector in his terminal device.

The disregarding of the network's information and its uncontrolled availability are a threat to the service's reliability from the viewpoint of the user's privacy. Information is also becoming cluttered unintentionally and it will be available to unwanted parties, if the availability and cluttering of information isn't recognized and taken into account in the early stages of

development. For these parts the question return to the service's real and possible events and its intentionality in the building of trust based on users and actions. When developing ubiservices, we should at least recognize the examining processes concerning the user-information and the related parties and responsibilities, such as: at what point is the user's information cluttered, what devices is the information on, in whose control are they, where are they transferred to, within whose reach are they, whether outsiders can get hold of them and how long are they stored. Nevertheless, in a decentralized environment it is more difficult to shield from the following of one user's actions than it is from the collective gathering and misuse of information.

Afterword

As the information- and communication services develop, the significance of the interaction of different areas is emphasized, and they provide different means for furthering trust. These means include, both for traditional hierarchic service and virtual communities securing the legal rights of users and service producers/providers, the activity of services and the reliability of communication made possible by solutions in technology and information security, as well as the usability of services.

It should be noticed in the development that the trust decision is finally in the hands of the user. This notion is supported by research results [1] according to which Internet-users prefer applications i) in which personal information isn't transferred automatically, ii) that don't do ready decisions, but instead help the user in making it and provide swift data transfer when the contract is acceptable and iii) with a user interface that is fairly simple and the information processing is both seamless and undisturbed. In building the base of trust, the users' trust in the devices and technology is also important, along with the mutual trust of the parties of communication and the usability of the services. From these parts, trust could be furthered by applied solutions of technology and information security.

It is difficult to build boundaries in open and decentralized environments and the user's trust is often balancing and trade with privacy. The traditional concept of privacy as the right to control personal information is no longer valid. Trust and privacy becomes a dynamic process, which is used to negotiate and control the technical and social boundaries of one's own space and the space of publicity [2, 3, 4]. The question is about the users deciding when, where and in what way their information is communicated to others [5]. As a matter of fact, this process converges different areas effecting trust, such as user expectations, demands and provisions set by the society as well as technological solutions.

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Perttu Virtanen: Content management, copyright and other IPR's

IPR (Intellectual Property Rights) consists of a group of rights to the results of different kinds of spiritual and creative work, where the author has been granted a time- and area-bound monopoly to encourage in the creation of results and, more widely, distribution, including assignment .and licenses. In the ubiworld, the central rights will most likely be copyright, patent law and database law, even though also other forms of IPR-protection like the protection of the integrated circuit, utility model-, design-, trademark- and trade name law and, more recently, the protection of domain names can be taken into account.

To organize roughly, the IPR's will become current in two different areas of the ubiworld: for one, in technology, which makes it possible to transmit information in networks and to store it in terminal devices and also in the information contents that are being transmitted in the network. In this context, the focus is on the significance of IPR's in relation to the management of contents. When we talk about the management of contents in the ubiworld, they can be managed either by technical solutions that exist both in the technology and inlaid in the information itself or by legal remedies and business models. That is why the enabling technology is also important along with legal regulation when talking about content management, the most central forms of protection of which are presented below.

Forms of protection

Copyright provides, among others, on the basis of the Copyright Act (404/1961), the author of an individual and creative work the exclusive right to reproduce the work, including the transfer of the work into a device on which it can be reproduced, and the right to make it available to the public by disseminating it, for example, by networks, for 70 years after the author's death. Copyright and database law, dealt with further ahead, are born, unlike a patent and other rights mentioned later, without any application or registering.

Database law means the 15-year exclusive right that is born for the compiler of an information collection, like the information-content of an electronic database, according to the copyright Act's special provisions (especially Copyright Act49 §) on, *e.g.*, the reproduction of substantial parts and making them available, concerning either the whole database or a substantial part of it, if the collection, verification of the information or the presenting of the information has required a substantial investment. Database protection, of which the term *sui generis* protection is also used, is a part of EU law and a so-called right related to copyright. In Finland, there exists an additional form of protection, catalogue protection, which, based on the same special provisions of the copyright Act same 49 §), gives a protection of the same length and width for information collections born without a significant amount of work, if there has been a significant amount of information collected.

Of the so-called industrial rights, the traditionally (and perhaps in the ubicontext as well) most significant, patent right, gives, according to the Patents Act (550/1967) the inventor an exclusive right for the commercial exploitation of an invention registered by a patent by e.g. manufacturing, using or supplying it in one way or another or by importing the invention, the protection lasting 20 years at most. On the other hand, the utility models based on the Act on Utility Models (800/1991) works in a way as a petty patent, the requirements for protection being lesser concerning the standard of inventiveness, the application costs lighter and the duration of the protection shorter.

The Domain Names Act (228/2003) gives a company, other legal entity or recently also an individual the right to choose and register an Internet country code top level domain name ending in .fi for own activities and easier identification, unless a protected name, trademark, or a personal name already in similar use prevents it. The network domain name remains in force for 3 years at a time and it is possible to renew it as many times as the holder wants.

The application procedure for network domain names ending in .eu also shows that the importance of a network presence has been grasped on the European level, but it would be better if the matter were more clearly brought to the consciousness of the Finns as of now. Other ID's than those ending in .fi and generic domain names, which point to no country, like .org, .com, .pro or .name can be requested from the suppliers, or "registrars", licensed by the Internet Corporation of Assigned Names and Numbers (ICANN) organization, which decides on the so-called upper-level network identification. Domain names haven't always been held to belong to the area of IPR's but their significance in the context of networks and the ubiworld is emphasized along the traditional distinctive mark law, that is, professional names and trademarks exactly because of the ability to recognize them.

We won't go to the presentation of other forms of IPR protection in this context, but it is important to notice that in the midst of business practiced in the ubiworld, there can also turn up protection granted according to the law on unfair business practices (1061/1978) which forbids activities that are against reasonable business manners or otherwise improper on the terms of the other party, also in the cases where an IPR-protection can't, for some reason or another, be claimed.

Effects

The aforementioned IPR's, copyright and database law being the most important, are factors that on the one hand encourage the creation and distribution of contents, and on the other, limit them. This happens because the acquiring of an inventor's reputation and financial profit are often carried out by controlling the reproduction or distribution of content. The possibility to limit these actions and to demand of them either the authors' consent or a financial compensation directed toward them often works as an incentive for the authors, providing that

there is demand for the protected works, which in itself requires that either the author or the work are recognized. This often demands a wide distribution for the work in question, a part of it or a previous work, which can consist of reproduction, distribution or renown brought on by other channels.

The significance of IPR's in the ubiworld is emphasized because in this environment the reproduction and distribution of information through peer networks will most likely multiply compared to the traditional Internet in a way that is hard to anticipate, provided that this reproduction and distribution isn't blocked by the inefficiency of legal regulation, technology or market mechanisms. At the same time, there are a lot of contents, like short, simple messages or other bare information content that won't be granted protection under copyright, whereas the collection and organization of this information may enjoy a database or list protection.

This possibility of limiting the reproduction of content for the reason of getting familiar with it, can efficiently prevent even non-commercial and private information acquiring, education and non-commercial research in the ubiworld, which are all the lifeblood of the product development, production and trade of a resource-limited country like Finland. At the same time, wide limits on reproduction will prevent indirectly the re-use of information or other part of material, which makes the continuous refinement and development of new services more difficult. In addition to this, a legal limit that is too wide and that forbids all larger distribution of contents, works in the same way, blocking the birth of new innovations and new contents. The strength of the limiting influence depends on the one hand on the width of exclusive rights, belonging increasingly to professional distribution companies or other communities, which has lately grown at the expense of rights of use, and on the other on the actual market power of the distributor. If the strong exclusive rights are attached to the strong or dominating market-position of a distributor of scarce contents, we could be in a situation where the price for the use of the product and its possible use as "raw material" for the creation of a new product will rise so high, that it limits the efficient availability and re-use of material. At their worst, these forceful control mechanisms can block both the adoption of actual information contents and the related technology, as well as their large-scale utilizing in the ubisociety.

If, for example, the utilizing of location information individually or as part of the information products and services is legally forbidden or priced too high by using legal protection, it can either slow or prevent the birth of a related larger culture of services and products. A part, and only a part, of these negative consequences can be dealt with afterwards by using the traditional control machinery of competition law. It would be well-founded to use the analysis and research of legal regulation to take care that the beneficial incentive effects of IPR's and on the other hand, their limiting effects, be kept in balance by updating the limits concerning IPR's so that use of information collection for the reasons of personal use, education and non-commercial

research is widely possible while limiting the restrictions on the general distribution. In the same way, a thorough review of current regulation and national IPR strategy should be conducted, to avoid creation of monopolies on any of the key technologies that make the ubiworld possible.

Jukka Kemppinen: Open innovations

In addition to the well-defined and open system of agreement, an open innovation is a central question that has been noticed only in recent years. Even though significant innovations have been created since Edison and onto Bell and IBM by centralizing experiments and development to research facilities, there have also been claims that a real innovation is often born unexpectedly, like the current mobile phone and the Internet. There was no aim or vision behind either one of them, just incremental development work, which was realized by four actors: companies, the government's funding, the employees of the companies, and the customers.

The customers, that is, the end users are the most central and most forcefully neglected source of innovation. In the most recent occasion this happened in the form of the explosive distribution of P2P-architecture, which the organizations, stuck in their modes of thinking, almost managed to brand illegal. At this moment, the same seems to be happening in the media, where, for example, the number of blogs has risen in a year from 4 million to 30 million and "the customers" have snatched the initiative both in the political shaping of opinion and in news activities.

The problem of the employees is sharpened in so-called globalization. Production is quickly moved to so-called countries of cheap labour – but what is labour? When dealing with ubiquitous information technology we have to keep in mind that the central defining factor of this ubi-area is the producer's – the user's and the employee's – changeability. So: on the one hand a producer, on the other an employee. Linearly drawn value-chains should be drawn again in the shape of a horseshoe or a circle in a way that strangely reminds of the hundred-year-old business structures of scarce capital, that is, consumption and production- co-operative societies.

Peter Drucker pointed out seven sources of innovation in his classic text from 1965: the unexpected, incongruities, process needs, change of industry structure, demographics, change of mood or perception, and new knowledge.

Of these points, the first four are typically phenomena of factory-industry, leading down from upward. The three last are expertly sighted characteristics of the network society. The guiding of an innovation process is clearly more difficult in a decentralized network society than in an industrial society, which, for reasons of funding, tries to function monopolistically. The game industry might currently be the largest segment of the entertainment industry. It has been born and grown with an essential drive from customers, and in the side of official institutions – in many turning points as semi-illegal action by computer aficionados.

An integral part of the ubiquitous network society must come from an organization and funding, through which different unclear technological solutions and conjoined social structures could be

tested systematically. This experimentation could lead to the finding of ways of modelling and further to production.

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Monopolies lead to trusts, and trusts always lead to a world war.

In the society of information products and information services we have followed the World Trade Organization into an era of protectionism. The views of free trade can hardly be made out.

Mika Raento and Antti Oulasvirta: A social presence service for a group of friends

Matti, Anu, Heidi, Katri and Liisa are a group of friends going to upper secondary school. They are using a mobile communication device which, in addition to voice and text messages, includes an instant messaging and presence service. Through the service they can see each other's location in real time, whether the device has been used recently, the chosen alarm profile, calendar entries, the surrounding devices and whether any of their friends are present. These pieces of information have been integrated into the phone's application environment so that the service does not get in the way or require additional effort to use. The information cannot be seen by anyone outside the group, for example parents. The users can modify which information can be seen by each person. The following includes short scenarios on how the service can be used.

Heidi is waiting for a bus to school in the morning. She is tired and in a bad mood. She types "F*cking angry" to her status description. Katri notices Heidi's description while glancing at her own device and tries to cheer her by typing "Hug". Heidi reads the answer and feels a bit better. The bus seems to be a little late so she changes her description to 'The bus is late' so that her friends know that she'll be a bit late from school.

The group works on a group assignment. Liisa thinks the afternoon would be a suitable time to discuss the division of work and maybe get started on it at school. She has approximately half an hour before she has to go. She sees from the service that all of her other friends are near the school, except for Matti, who is at home. It is not worth bringing in Matti all the way from home only for a short meeting, but Liisa gets in touch with the other members of the group. Anu's device is placed on silent so she sends her an SMS. The group meets in five minutes in the school's lobby, and Anu also comes there as soon as she notices the message.

Anu and Heidi haven't known each other very well before the adoption of the service by the group. Through the service, they have started to become a part of each other's life: they know each other's routines and can at any time glance on the status of the other, or know something about what the other one has been doing. The instant messaging, less demanding than a phone call, gives them 'permission' to talk even though they do not know each other that well. Within a couple of months, they are good friends.

Heidi and Katri hold a First of May party at Heidi's place. Many of their other friends are coming and since there is not that much space, they are not inviting the other members of their group, not even mentioning the party to them. When the party is on, Matti and Liisa notice that Heidi and Katri are both somewhere near Heidi's home. On the day after, they ask Heidi and Katri about what they've been doing and why they were not invited. The situation is rather difficult, but Heidi and Katri explain the reasons, which the others accept.

Matti is in Kulosaari. The other members of the group are at home and talking through the device. They notice Matti's location and spend some time thinking about what he is doing in Kulosaari, They know that his ex-girlfriend happens to live there. At some point, Matti looks at his own device and ends the guessing game by telling that he is at the home of his friend Ville, who the others know, although none of them knew where he lived. The conversation moves on to other subjects.

It is the night of the Eurovision Song Contest. The four girls of the group are each at home watching the contest, but discussing it through their devices. There are comments given to each performance, but also discussion on other subjects. Matti is at a 'Eurovision party' at his friend's house. Around eleven p.m. the girls notice Matti has returned home. They tease him about the failure of the party, but soon he takes part in the general discussion. The conversation carries on through to the end of the contest.

Liisa is spending the Saturday by shopping. After a couple of hours she feels like going for a coffee, but thinks it is boring to go to a café by herself. She looks at the service and sees that Anu is also around, and not accompanied by any of their friends. She calls Anu, who accepts the meeting with pleasure. After having coffee, the friends walk around the stores for an hour.

Conclusion

Field studies have shown that a well-designed presence service supports the internal coordination of groups while providing a flexible media for self-expression, which might have positive effects on the development of group relations. In small groups that voluntarily try out the presence service, which does not collect information on a central server, privacy does not rise up major concern, although information security must guarantee the integrity of the group.

What might be surprising is that the scenarios above are not fictitious. All of the events have happened in field studies of the ContextContacts application (although we have combined the events of a number of tests) and the described service is possible with present-day technology. The results of the field studies have been described in a forthcoming article "On how users interpret and act upon mobile awareness cues", Human-Computer Interaction, by Antti Oulasvirta, Renaud Petit, Mika Raento and Sauli Tiitta.

Risto Sarvas and Marko Turpeinen: An identity-construction service – the IRC-Galleria

An estimated 50 % of those going to Finnish secondary and upper secondary school use a social media web service called *IRC-Galleria* (*i.e.*, IRC-Gallery). This site, which was founded in December 2000, is currently Finland's fifth most popular web site and has approximately 360,000 registered users. It is similar to services like MySpace or Facebook in USA, which have rapidly gained popularity in the recent years.

Originally the purpose of the service was to provide the users chatting on the IRC-channels (Internet Relay Chat) a place to post their pictures. In the service, each registered user has a page, which contains a collection of pictures that others may comment on. One of the pictures is the default picture that works as the user's identifying image. The other pictures can be arranged to user-titled folders.

The use and turnover of the images is very active. It is not unusual that the default picture is changed every week or more often, just like the pictures in the gallery. The presented pictures are mainly images about the user and his or her daily life. The pictures have been carefully selected to make a good impression. A stereotypical example of boys is a "tough guy" who doesn't shy away from cigarettes and alcohol. It is also typical to upload pictures of significant events like the confirmation camp or a rock festival.

The site's audience consists of friends, semi-familiar people, and complete strangers. It is presumed that the pages are viewed by the user's group of friends, but also a larger social network like classmates and other youths from the same school or activity group. This can be quite easily seen from the comments people leave on the site. With the comments, it is possible to "surf" the social network from one user to another. The site can be viewed without registering, but the comments are visible only to registered users. For example, it is not possible to see if a user's parents are accessing these pages, which discuss different everyday things and use different kind of language than what is typical at home.

What makes the service exceptional is the fact that the users are quite certainly real people. Every registered user has to type in his social security number (the number is not published, but used to only check that it is a valid one). As a consequence, each user-name can be connected to a physical person, if necessary. The service is also used in a way that makes it easy to identify the people in the images. In other words, the people don't try to cover up their identity.

The main motive to start using the service is social pressure: because all the friends are using it. The service is used along with different instant messaging programs, and it often happens that a user's picture site contains his instant messaging ID. Presumably, these two technologies work

together so that the instant messaging program is used to get to know a new person, after which one can visit this person's site at the IRC-Galleria. The process can work the other way around as well. In any case, instant messaging programs and the IRC-Galleria complete each other in creating new relations. It is good to keep in mind that a teenager might have tens, or even hundreds of IM contacts, whom they have never met outside the virtual world. In this sense, the IRC-Galleria matches up to its original goal quite well. The gallery is most likely also used to find dating partners, since the users are probably the persons portrayed in the pictures (e.g. the user's age is taken from the social security number) and because by using instant messages and the IRC-Galleria pictures it is easy to get to know the potential dating partners in advance.

However, branding the IRC-Galleria just as a dating service would be an oversimplification. With the help of the service's image galleries, the users construct their own identity and status in their social networks, also among friends and people they already know. Using the pictures, comments and communities (which, in the gallery, are in the form of lists that have a certain name, like the name of a band or a sporting group, although the name can also be a statement of purpose) the users build a portrait of themselves just like they construct their identity in the real world through clothes, music selections, friends, hobbies and behaviour.

One significant lesson that the IRC-Galleria provides for the ubisociety is the user's relationship with privacy. As pointed out above, nearly every user can be recognized from the pictures in the galleries (presuming that one is familiar with the person) and many users share their birthday and home town in public. Usernames are often the users' own nicknames or their derivatives. It is good to keep in mind that these under-aged youths pose in the pictures also with cigarettes and alcohol, and especially girls often pose provocatively. Taking into account the fact that the teenagers are technologically savvy and understand that the pictures of the gallery are available for public viewing, the question is raised whether those who upload fairly graphic images have any worries for their privacy? As we're dealing with teenagers, there also springs up the question whether they are worried that their parents might be looking at their images and comments as well. Since teenagers understand that the pictures on the service are public, they don't seem to be bothered by it. This is highly unusual among the conversation concerning the protection of privacy in both public and political decision-making.

The drawing force of the service seems to be based on the meeting of an individual's interests and a certain kind of content, as well as the interaction between humans, reciprocity and the social pressure that is born as a result of these facts. The publication of contents can also be seen as a tool for self-reflection and the upkeep and shaping of personal identity.

APPENDIX 2: RECOMMENDATION OF THE INFORMATION SOCIETY COUNCIL:

Furthering the common use of information – CreativeCommons

Due to the outdated nature of the copyright law and its regulation, the value chain of information refinement is not furthering the sharing of information and its shaping for different uses. A significant part of information producers want their own products to spread to the use of different parties, as long as the source is mentioned. To speed up the pursued development, the public sector should make a calculated move towards the wide-scale use of the CreativeCommons license (CC). This would especially ease the network-distribution and availability of contents produced with public funds.

Publishing a work on a CC-license doesn't mean giving up the copyright. It means offering a part of the rights to any user of the work, but only on specific terms defined by the author (see http://www.creativecommons.fi). CC-solutions are significant to both producers and consumers. The actors include, in addition to humans, associations, companies and consortiums without the status of legal competence. The use of a CC-license complements the copyright law regulation by clearing up the activities concerning information distribution and refinement. The private sector is also encouraged to use the CC-license in cases where its use is justified.

Works produced with public funds should be distributed and used as freely as possible, unless there's a justified reason for the opposite action. For example, publicly funded education materials or educational content produced in a public position should be distributed under a use-permitting CC-license. The compensation-system for actions that go over the standard qualifications of employment has to be built alongside, but separate from the distribution licenses. The state furthers the distribution of content produced on a CC-license by presuming the addition of standardized meta-information on the works it has funded and by pointing at a common network site, from which all the information concerning publicly funded CC-licensed works, or works meant for public use, can be found. The information society council proposes that to speed up the pursued development, CC-licensing be brought to use in publicly-governed and charitable organizations. The work needed for the starting of the system, which includes the description of actions, the preparing of decisions, the following of action and a method for solving arguments should be ordered from the Helsinki University of Technology's and the University of Helsinki's joint research facility HIIT, which coordinates the development of the CC-license.

Copyright law regulation to match the needs of the network society

The current copyright regulation is based on a time when the situation was mostly about the relations between private content producers and media. Back then, there were often questions about a journalist's right for his stories in the paper he worked for, or an artist's right to a compensation for a single radio performance.

Through the network society development the ways and channels of distribution have changed and grown in number. In a digital world, the same information is distributed in bit-form on many alternate routes swiftly and easily. Receivers can use up to one device at a time with concentration. Copyright questions have changed from cultural questions into industrial politics, as large multi-national companies own a large part of different copyrights.

As we are making the move to a multi-channel road of distribution and creating new services, we will often face situations where the stiffness and complexity of the copyright system will create obstacles for the intended distribution of information and the creation of commercially profitable services. To make sure that Finland is on the pursued level of network society development in the year 2010, a thorough reform of the copyright system should be begun immediately. The aim is to protect copyrights efficiently and to make possible the flexible use of works through different distribution channels with simple costs. As we're also dealing with a global matter, Finland should make an initiative for the discussion of the matter on the level of the EU and other international organizations. The information society council proposes that the ministry of trade and industry, as well as the ministry of education, begin to prepare a large-scale reform, where the copyrights are profoundly evaluated, taking into account the changes in the society. The starting point for this preparation should not be motivated by cultural politics, but by industry and network society politics.