Understanding Ethical Issues of Emerging AmI Technologies in Europe (A Framework)

Bernd C.STAHL, Simon ROGERSON and Kutoma J. WAKUNUMA
Centre for Computing and Social Responsibility
De Montfort University
The Gateway, Leicester, LE1 9BH, UK

Abstract. Ambient Intelligence (AmI) is an information technology approach that is interactive, sensitive and responsive to a user's environment. Emerging AmI technologies are intended to be intelligent and intuitive to a user's needs and therefore embedded into a user's everyday life without so much as being obtrusive. However, with any emergent technology such as AmI, ethical concerns arise. It would be desirable to have a better understanding of future technological developments, and in this case, AmI technological developments in order to allow ethical considerations to influence design and implementations of the technologies. However, the unavoidable contingency of future developments provides a fundamental limit to what we can know about the future. With this, this paper attempts to explore how this problem can be addressed by providing a framework of technical developments which include AmI technology developments that one can reasonably expect to materialise in the medium term future of 10 to 15 years and ethical issues that are currently expected to arise within the European Union (EU). This is done by analysing current European research funding documents with a view to exploring the trends, purposes, applications, artefacts, ethical issues, and governance structures that the European Commission foresees. The overall aim of the paper is to provide the conceptual basis of this framework.

Keywords. AmI technologies, ethical issues, emerging technologies, applications, research framework, Europe, FP7

1. Introduction

A central problem of the ethics of technology is that it tends to arrive too late. In many cases ethical issues are only recognised when the technology is already on the market and problems arise during its wide-spread use. Ethics can then become a tool to clean up a mess that might have been avoidable. It is probably not contentious to say that it would be desirable to have ethical input at the earlier stages of technology design and development. Indeed, there are ethical theories and approaches that explicitly aim at an early integration of ethics into the technology life cycle (van den Hoven, 2008). One central problem of this type of approach is that the future is unknown. By definition we do not know with certainty what will happen in the future and an ethics that relies on future development needs to be able to answer the question how it decides which technological developments to pursue. Ethics has traditionally not been well equipped to deal with issues of uncertainty (Sollie, 2007) and in particular future uncertainty.

The present paper aims to contribute to this discussion. Its approach is to identify likely scenarios of future information and communication technology (ICT) developments and in particular AmI technologies that are grounded in empirical facts. The idea is thus to strike a balance between unavoidable speculation when talking about the future and factual grounding necessary for academic research. This paper should be understood as a first step in identifying future developments in AmI technologies. The chosen approach is to concentrate on an identifiable and relevant regional and policy area, namely the EU. It aims to give a high level overview of the European landscape of emerging ICTs. Its purpose is to come to an

understanding of the ICTs that are likely to develop in the next 10 to 15 years with a view to understanding which ethical issues we can expect and how we may best prepare to meet them. This will lead to policy recommendations for the EU as well as advice for individuals and organisations involved in technology development. This is an important element to consider especially as new technologies are continuously emerging and being used at a speed faster than policies can be enacted to deal with potential ethical concerns that come with the new technology developments. The paper is meant to provide the grounding necessary to develop empirical work. It will develop categories of ICTs and ethical issues which will be used to investigate specific ICT research projects in order to assess whether and how ethical issues are currently taken into consideration and how policies need to be developed. The paper will start by giving an introduction to the European research structure. It will then analyse how the EU views the development of ICTs by analysing trends, applications, artefacts, ethical issues, and governance approaches as they can be identified from current EU publications.

2. Conceptual Basis
2.1. The EU Framework Programme for Research and Technological Development
The EU has a long tradition of fostering research and development through so-called framework programmes. The previous framework programme, FP6 ran from 2002 to 2006. One of its themes was Information Society Technologies (IST). Among the IST key concepts and strategic objectives was research on Ambient Intelligence whose aim was

> for a broader inclusion of citizens in the Information Society, for more effective health, security, mobility and environment management and support systems. Preservation of cultural heritage and integration of multiple functionalities across these different domains will also be supported (http://cordis.europa.eu/search/index.cfm?fuseaction=prog.document&PG_LANG=EN &PG_RCN=5465040&pid=0&q=56B45243267F7F6D1A14929381D840DC&type=sim)

As a back drop to the above, in 2000 the IST's Advisory Group (ISTAG), a group set up to advice the European Commission on overall strategy and implementation of ICT research in Europe launched a scenario planning exercise to demonstrate what might be realised through AmI technology. Through the exercise ISTAG set out its vision for AmI by 2010 by depicting four varied future AmI possibilities. The scenarios were an illustration of what living with AmI might be like in 2010 where "People are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way" (ISTAG, 2001). Thus the ISTAG document set out to encourage a research agenda as

> Major opportunities to create an integrated Ambient Intelligence landscape can be built upon European technological strengths in areas such as mobile communications, portable devices, systems integration, embedded computing and intelligent systems design (p. 10)

These give pointers as to the type of emerging technologies that may arise. AmI technological developments have no doubt continued to be pursued under the current framework, FP7 which runs from 2007 to 2013 and has a total budget of over €50 billion. The majority of this money is and will be spent on research grants, predominantly in Europe. The European Commission names two main aims of the framework programme (European Commission, 2007, p.7): "to strengthen the scientific and technological base of European industry [and] to encourage its international competitiveness, while promoting research that supports EU policies." Ten thematic areas exist in the FP7 programme of which information and communication technologies is one. The ICT programme which is this paper's focus is the largest of all sub-programmes with a budget of over €9 billion over the lifetime of FP7 (http://cordis.europa.eu/fp7/budget_en.html). As a way of ensuring that Europe becomes a world leader in ICTs, the FP7 programme is tackling seven key challenges, which includes looking at the next generations of ICTs in the context of smarter machines being able to provide better

services. Under this and clearly embracing AmI, the programme's aim is to have research that that will focus on developing ICT systems that are more aware of what is going on around them, and will be able to learn, reason and interact with people more naturally. The idea is that the ICT systems and in this case the "smart artefacts" will be able to learn to work with the users for their needs rather than force the user to learn how to use the machines. (http://ec.europa.eu/information_society/tl/research/documents/fp7-ict-4poverview.pdf)

2.2. ICT Ethics

Ethics can then be defined as the philosophical study or reflection of morality (Adam, 2005; Weil, 1969). In everyday language and even in much academic writing this distinction is not always observed (Forester, 1994; Weckert, 1997). However, the distinction between social norms and their reflection is important to observe if one wants to come to a measured understanding of normative issues and their ethical evaluation. Ethics as the reflection of morality can have different tasks. There is a distinction between descriptive ethics, normative ethics and metaethics (Marturano, 2002).

Research in ICT ethics is often multidisciplinary and attempts to come to a broad understanding of the subject at hand. Much research is focused on specific issues and problems. Among the most prominent ones one can find issues such as privacy (Brown, 2000; Introna, 2003), intellectual property (Burk, 2001; Syme and Camp, 2002), access and digital divides (Rooksby and Weckert, 2006), data quality (George, 2002), but there are many others. It often overlaps with related discourses in neighbouring disciplines, e.g. computer law (Poullet, 2004). So despite AmI technologies user-friendliness, efficiency of service support as well as user-empowerment as highlighted by ISTAG (2001), scholars like Kort et al (2007) are concerned about the amount of personal data used and collected in the process of caring for older people, particularly as the elderly may not be fully aware of ethical implications of this. As such they argue that such technologies should be embraced with caution due to the ethical issues that come with them. In addition, Brey (2005) comments that although AmI technologies promise more responsiveness to human needs as well as an offer for users to be in direct control of their environment, the downside is that they can also impinge on the very freedoms and autonomy that humans cherish when technologies perform unwanted actions. Furthermore, Brey argues that humans may become too dependent on the technology such that they may leave judgements and decisions up to the AmI machines to act on. And as the future is difficult to predict there continues to be instances when new technologies are used in ways that push ethical boundaries due to what Moor (2005) has called policy vacuums because new technologies are constantly emerging faster than policy can be implemented to oversee ethical concerns. It is perhaps due to such concerns that ISTAG through the scenarios in a previous section of this paper rightly identified the following key socio-political factors which relate to ethical concerns: Trust and confidence, Privacy, Control, Social Cohesion / Inclusion, Digital divide, Human and not technologically determined and Environmental sustainability. These according to ISTAG have to be considered as AmI technologies are developed if society is to be accepting of AmI.

As such much work in ICT ethics engages with the normative question of how normative problems can be addressed in an ethically sound way. A typical approach that tends to be adopted is the adoption of some sort of behavioural guideline, policy or code (Siau, Nah, and Teng, 2002).

2.3. Policy Aims

Current public policies, in particular EU regulations, are pertinent to issues of ICT ethics and influence the outcomes of our paper. Normative perceptions and their ethical evaluation strongly influence what democratic governments perceive as issues to regulate. In current EU policy there are several areas where normative and ethical issues of ICT are addressed. ICT research has been identified as one of the three pillars of the "i2010 – A European Information Society for growth and employment" initiative of the European Commission. The i2010's renewed Lisbon agenda relies heavily on ICT to realise efficiency and economic gains. (http://ec.europa.eu/information_society/eeurope/i2010/introduction/index_en.htm). Furthermore, the EU's mid-term i2010 review report projects a legal and technical landscape in which the Commission shows that by 2010, AmI will be one of the high technical evolutions in Europe (European commission, 2008).

In other related documentation, the EU has viewed ICT as a main tool in addressing its demographic challenges. In its Green Paper "Confronting demographic change: a new solidarity between the generations" (European Commission, 2005), the Commission has outlined the challenges the Union is facing. The demographic development continues to be a main area of concern for the EU (cf. "The demographic future of Europe – from challenge to opportunity", European Commission, 2006). Three general trends combine to create the problem of decreasing population: continuing increases in longevity, continuing growth of the number of workers over 60, and continuing lower birth rates. The EU intends to address the resulting problems with a variety of strategies. Among them there is the aim to use ICT to allow older people to remain an active part of society but also to allow them to remain independent in their homes. One particular strategy is the Ambient Assisted Living (AAL) initiative which is covered in the EC's ICT work programme 2009-10 (ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/ict-wp-2009-10_en.pdf). The aim of the AAL initiative is to look at ICT based solutions that can enhance the quality of life of the EU's aging population. The aims of the European ICT policy are broad and as such an interesting question remains, however, whether general policy aims and the ICT research agenda that is investigated in the present paper are consistent.

3. European Landscapes

This section shows the major areas of technological development in ICT as well as ethical and governance aspects related to it. It is broken down according to the main items used for the data analysis: trends, applications, artefacts, ethical issues, and governance structures. The first attempts to provide an overall view of where ICT in general and AmI in particular is going. The two sections on applications and artefacts relies heavily on the most recent call for ICT projects at the time of writing this document, which is the FP7 ICT Call 4, published on 19 November 2008 with a submission deadline of 01 April 2009 (European Commission, 2008a). This is the document that explains in most detail the aims and objectives of the ICT work programme and thereby gives an exact view of what European policy makers believe to be desirable and realistic. Further documents are drawn upon where necessary.

3.1. ICT Trends

Those who have tried to forecast the next technological advances are usually incorrect. ICT has a track record of unpredictability in the specific nature and consequent impact of these future advances. The only certain thing is that there will always be significant advances and these will always impact upon society and its people. However, several general ICT trends can be seen even though the specifics are unpredictable. It is such trends which influence the overall strategic approach, for example, to national and European research funding and to societal acceptance or rejection of technology. Vaughn (2006 pp8-14) suggests that there are four key ICT trends.

- ICT trend 1: Ever-increasing computational power plus decreasing size and cost
- ICT trend 2: Technology advances enabling new types of interfaces
- ICT trend 3: Ability to be connected anywhere, anytime with services on demand
- ICT trend 4: Creation of virtual places, service providers and products.

And although there are elements of AmI characteristics in the ICT trends identified by Vaughn, another trend that can be added to the above list which is directly related to AmI technologies and which may conform to ISTAG's vision of AmI is:

- ICT trend 5: Intuitive, sensitive and responsive to a user's environment and need.

3.2. Applications and Challenges

The applications that the EU views as relevant for the next 10 to 15 years are reflected in the main challenges. These challenges are divided into two groups: "overcoming technology roadblocks and reinforcing Europe's industrial strengths" and "seizing new opportunities and applying ICT to address Europe's socio-economic challenges". The first group contains those challenges which can be seen as technological in nature, which seems to imply that their social

and economic context is less important or maybe unproblematic. These include: "pervasive and trustworthy network and services infrastructure"; "cognitive systems, robotics and interaction" and "electronic components and systems". These are seen to be crucial for the development of the next generation of technologies and therefore as a central basis for further innovation in products and services. It is interesting to note that for all of the three technical challenges the work programme is silent on their expected consequences and link to policy goals. This implies a pervasive belief that technological progress is desirable because of its knock-on effects, the hope that it will lead to successful products, higher competitiveness and thereby to well-being and employment.

The second group of challenges, the socio-economic ones, are more immediately and more visibly linked to the European policy goals. The four challenges meant to address "Europe's socio-economic challenges" are aimed at specific areas where technology is perceived to have a crucial role. They include: "libraries and digital content"; "Towards sustainable and personalized healthcare"; "ICT for mobility, environmental sustainability and energy efficiency"; and "ICT for independent living, inclusion and governance".

In relation to AmI technologies, three of these challenges stand out. They include:
- Challenge 2: Cognitive systems, Interaction, Robotics
- Challenge 5: Towards sustainable and personalised healthcare
- Challenge 7: Independent living, inclusion and governance

If we are to borrow from ISTAG vision of AmI, the above three applications and challenges embody the characteristics identified in the Advisory Group's vision which include that AmI technological applications should be intelligent, intuitive, interactive and seamlessly embedded in a users environment. In addition, they should be unobtrusive, recognise and respond to a user's needs but also invisible. More details in how the above applications and challenges embody the aforementioned characteristics are illustrated in the discussion under artefacts. Their potential ethical issues are also highlighted thereafter. Together these seven challenges represent the applications that the European Commission sees as central to advance its policy agenda. They set the boundaries for the type of research that will be funded under the seventh framework programme. They are therefore likely to have an influence on the technologies that will become viable and wide-spread in the next decade. It is clear that this is not an exclusive list and that there are other development agendas from private organisations, nation states, NGOs etc. that are similarly worth exploring. For our purposes, however, the EU policy is of central interest and we will therefore concentrate on these applications.

3.3. Artefacts

While the applications and challenges are relatively easy to identify and list, the same cannot be said for the artefacts envisaged to attain the policy goals. A detailed reading of the Call 4 document displays a range of artefacts that are considered possible solutions to a variety of problems. In addition to physical artefacts, there is a strong emphasis on processes and procedures that may lead to products or services. Having identified AmI applications and challenges, the most identifiable artefact's which are related to challenge 2 under the theme Cognitive systems, Interaction, Robotics are robots and robotic systems. It is hoped that these artefacts will not only be more cognitive and intelligent to users' needs but that they will be able to carry out tasks and work with people. AmI artefacts in Challenge 5 which is identified as "Towards sustainable and personalised healthcare" include personal health systems (PHS). PHS artefacts will include wearable, portable or implantable systems. The idea is to assist health carer's with monitoring of patients and improve on their knowledge of diagnostic data. In addition to AmI artefacts mentioned in challenges 2 and 5, others can be found in challenge 7 within the Independent living, Inclusion and Governance applications. The Commission hopes that research into this will include the development of robotics and new human computer interfaces based on brain neurocomputer interaction. To some degree one can see reflected the distinction between purely technical considerations, which at this stage are not yet application-oriented and those that are specific to particular issues. An interesting question that will guide our

further research is whether this more or less specific outcome focus of the artefacts raises particular ethical issues.

3.4. Ethical issues

It is interesting to note that in Commission's ICT work programme 2009-10 and under the ICT and Ageing objective which has a direct link to AmI technologies, the document seems ambiguous on what ethical issues are in the following quote when describing possible ICT target outcomes and potential challenges:

> Major challenges to be addressed include autonomous self-learning robotics solutions, sharing of contextual information with other artefacts in the surroundings of the user, navigation in unknown environments, precise manipulation of relevant objects and user robotic interaction taking into account the usability requirements of elderly people. The proposed R&D should cover all relevant aspects to allow for a full operational validation, including user acceptance, adequate safety, reliability and trust as well as ethical considerations (p.72). (ftp://ftp.cordis.europa.eu/pub/fp7/ict/docs/ict-wp-2009-10_en.pdf)

This begs the question of what the Commission sees as ethical considerations and whether issues like user acceptance, reliability and trust are not ethical issues in themselves. The interesting question for the present paper is how these general ethical concerns are operationalised, and whether there is any guidance on the type of ethical problems that should be considered. For instance it is not surprising and actually perhaps expected that the identified AmI applications and challenges including the artefacts highlighted above will bring their own potential ethical issues. The PHS, for example, may raise issues about: data collection, privacy, security, trust, wearable systems, ever present technologies due to their embedded nature, isolation of patients due to little or no human contact because technologies take over, over dependency on technologies like robots.

Several questions arise in relation to how the above ethical concerns might be dealt with as the technologies are being developed? For instance, what happens to all the patient data that is collected and how can we ensure that as patient data is exchanged within EU member states for instance that measures are put in place to ensure its security. How can patients be involved in the design process knowing that such technologies will exist to serve and service them? What form can wearable technologies take and how do we guard against misuse of information. How far can we go in terms of wearable technologies and to what extent can and should they be ethical. Questions also arise as to whether users will want technology to be ever present and if not how do we ensure that they are not left with no choice but to deal with the technologies they have been dealt with. Additionally, although the hope is that technology will bring positive developments as it emerges so much so that there will be less isolation of people, the opposite may be true. The fact that technologies are being developed to assist with health aspects such as the monitoring of patients may also lead to isolation. This is because patients can be monitored remotely without necessarily having to meet patients face to face. This is a downside because some patients yearn for human contact and if that ceases to exist, the downside is that it may also contribute to a patients continued underlying condition. Finally, the temptation to succumb to the ever present embedded technologies including robots may lead to over dependency on such systems even for the most mundane of things. How can we then guard against such possibilities thereby ensuring that we do not become victims of the very technologies that are intended only to improve and better our lives?

There are several documents that offer guidance on how to recognise and address ethical issues. A helpful distinction to categorise different ethical issues is the distinction between ethical issues as arising out of the research process and ethical questions arising from research content. In its "ethical guidelines for undertaking ICT research in FP7" (European Commission, 2008b) the Commission lists a number of substantive issues that may result from emerging ICT. The first problem identified concerns the autonomy and privacy of potential users. Researchers are reminded that a responsible approach is required and that compliance with European and national legislation is required. Further substantive issues discussed are those connected to specific

technologies, such as implants and wearable computing, which have been elaborated by the European Group on Ethics. E-health is seen as a further area worthy of specific warnings as it poses particular problems to privacy and security. The same is true for nano and bio-electronics.

The same concerns that are included in the ethical guidelines are reflected in the Annex 4 of the guidance for applicants, which also forms a part of the proposal form. This annex has the form of a check list that covers informed consent, privacy, and ICT implants. Additional issues that are not further explained are research on human embryos / foetuses, research on animals, research involving developing countries, and dual use of ICT for military or terrorist purposes. The points on this list are further elaborated on in the "Ethics for Researchers" document (ftp://ftp.cordis.europa.eu/pub/fp7/docs/ethics-for-reseachers.pdf). Questions of the social consequences of wide-spread use of particular technologies, which in areas such as e-health could have foreseeable consequences, are not elaborated in much depth. The documentation is quiet, for example, on how one can recognise terrorist applications and how to address such issues. One could argue that such substantive ethical issues of emerging technologies are beyond the scope of concrete current guidance and that this type of issues should therefore be covered by procedures that allow researchers to be alerted to ethical questions. A look at the procedural guidance shows, however, that it is not geared to capturing such issues either. The two main aspects of procedural guidelines are to ensure informed consent and to comply with legislation. Both are well-established ways of dealing with issues arising from the process of doing research. Informed consent in particular is the cornerstone of ethical conduct of medical research. It is open to question, however, whether it is sufficient to deal with ethical issues arising from emerging technologies. It is interesting to note that the guidelines do acknowledge that there are likely to be, hitherto unrecognised, emergent ethical issues resulting from advances in ICT research.

It is easy to imagine that there are further general categories of relevance to be explored for a better understanding of the ethical issues related to emerging ICTs in general and AmI technologies in particular. For our current purposes of charting a landscape of such ethical issues, the outlined categories offer enough of a differentiation to allow for a detailed picture of issues that can reasonably be expected to develop in the medium term future of 10 to 15 years.

4. Conclusion

This paper has explored a possible framework of future technologies which include AmI technological developments and ethical issues that may arise. This was undertaken by analysing EU funding documents. The idea has been to showcase the relevancy of such research in as far as emerging technologies like AmI are concerned so that as technologies are developed, so too are considerations of ethical issues put in the forefront. Ethical issues are usually only considered after a technology has been in place and understandably so because it is easier to see what ethical issues have materialised with a tangible technology in hand. It is however harder to project ethical issues as they arise from emerging technologies because the very nature of projecting something in the future is difficult. However, there is value in looking at ethical issues as they arise from technologies being developed rather than wait until they are fully developed because among other reasons, effective policies may be put in place to counter unwanted ethical fallouts. In addition, a knowledge of potential ethical concerns of AmI technologies for instance, can better prepare both developers and users so that they are better informed and make better choices and judgements in as far as the use of the technologies are concerned. With the EU's projection of AmI technologies high on the agenda by 2010, work as shown in this paper becomes ever more relevant because it helps with the awareness of what is to come in terms of technologies and also helps to avoid the pitfalls in as far as ethical issues are concerned. Thus, the paper has provided an overview of current social, political, and technical developments with a view to provide a framework for further research by starting with a European landscape of ethical issues. It has identified current EU policy with regards to ICT research, which will have manifest effects when current research and development projects come to the stage of market entrance, 10 to 15 years from now. To be useful, the framework itself needs to be applied as the basis of further research. Agreeably, there are limitations to the current approach; however, the paper provides a framework that can be used to identify a range of different issues whose understanding is crucial for any approach to ethics of ICT that wants to be able to contribute to

the solution of expectable problems. In addition, we believe that many of the aspects discussed are likely to be pertinent in emerging technologies such as AmI and that further research from a variety of backgrounds will be able to build on our findings. With this, the paper has provided a starting point for further discussion on the topic at hand.

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