2

Information, Society and Technology

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"Ambient Intelligence is more than an enhanced Internet, a smart phone, an interactive television, or a combination of them."

2.1 Introduction

Ambient Intelligence is fundamentally a European concept for a future information society where intelligent interfaces enable people and devices to interact with each other and with the environment in real time and pro-actively. Technology operates in the background while computing capabilities are everywhere, connected and always available. This intelligent environment is aware of the specific characteristics of human presence and preferences, takes care of explicit and implicit needs and is capable of responding intelligently to spoken or gestured indications of desire. It even engages in intelligent dialogue. Central to the AmI concept is "human-centred computing", "user-friendliness", user empowerment and the support of human interaction (ISTAG 2001; Aarts et al. 2002). Ambient devices and services for work, health, comfort and sanity will need to function in a seamless, unobtrusive and often invisible way. Ambient Intelligence flags the idea of machines that become really active, that think for us but only – and this is crucial – when people want it and only on their conditions.

That is why the abbreviation of Ambient Intelligence as AmI is used – it should signal a move beyond concepts such as user-friendliness into a servitude to people in a way users can never realise on their own. Ambient Intelligence is therefore a human-centric approach to next generation Information and Communication Technology (ICT), and by being so responds to some fundamental European values. The humanistic dimension of technology is becoming an increasingly important driver in the information society. This clarifies to a certain extent why a concept that only emerged in mainstream technology discourses at the end of last century (ISTAG 1999) – and that was built upon the notion of ubiquitous computing as coined by Weiser (1991), a computer scientist at the Palo Alto Research Center (Xerox Parc) – is already significantly widespread. It might explain why the number of hits that are generated by Google on the term "Ambient Intelligence" is significant: 440,000 hits in

April 2006 (against 38,500 in November 2004). The words Ambient Intelligence without quotes almost returned 500,000 links (against $> 200,000$ in November 2004).

Ambient Intelligence is an emergent property (ISTAG 2003a) at the core of the Information, Society and Technology (IST) priority of the sixth RTD Framework Programme (FP6) of the European Union (EU), following the work of ISTAG and of other consultative procedures organised by the European Commission. The IST thematic priority was set up to contribute to realise the so-called Lisbon goals, i.e., "to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion" (EC 2002). But also outside the main EU instrument for RTD funding, there are considerable efforts in Europe dedicated towards realising the building blocks for Ambient Intelligence. There is for example the ITEA consortium at the pan-European level and also national programmes exist, such as the UK Equator one (Equator, online; ITEA, online). As a result, the AmI vision has gained momentum within the IST community, where it helps to focus resources on a common project in Europe possibly leading to greater economies of scale while avoiding fragmentation and duplication of efforts (Punie 2005).

The development of AmI may signal new encounters between technology and society; encounters that are different compared to the past. AmI encounters are supposed to be friendly, pleasant, useful and seamless, but probably – like all Schumpeterian innovation ("creative destruction") – the encounters will also be surprising because the new always entails uncertainty. That is why this article alludes to Steven Spielberg's classical science-fiction movie "Close Encounters of a Third Kind" (Dirks 1996) where people have close encounters with UFOs and aliens, but in a benevolent and enlightening way. Although obviously Ambient Intelligence is nothing extra-terrestrial, the parallel with one of the film's poster slogans "We are not alone" can be drawn, since Ambient Intelligence is planned to support and help people and to enhance their everyday life experiences. This is the "creative" part of "creative destruction", i.e., the changes in our way of living and working Ambient Intelligence will bring about.

Ambient Intelligence indeed may represent a new paradigm for citizens, administrations, governance and business. Radical social transformations are expected from its implementation. Although the AmI vision is not a panacea for social and societal problems, it could offer innovative ways to address the fundamental socio-economic challenges that Europe will be facing during the coming years, such as the increase of its customers and citizens, the population and increased mobility (ISTAG 2003a).

We argue that as the AmI vision is currently being constructed in ways that enable new directions for Europe, it has the unique potential to bring something new in terms of the information society we are building. Firstly, because the AmI concept is different compared to earlier technology visions and, secondly, because Ambient Intelligence offers opportunities to deal with Europe's specific challenges in ways that are "Euro-friendly".

2.2 The AmI Vision: A Different Encounter Between Technology and Society

As we know from Schumpeter, all major technological innovations or paradigms are ambiguous: old and well-established forms of doing things are challenged or destructed whilst at the same time new but uncertain ways of doing things emerge. The challenge for developers and policy makers is then to make this destruction creative, leading to better ways of doing things. Ambient Intelligence has the potential to become a major force of creative destruction because three interrelated shifts occur: (1) shifts in the "logic" of ICT and ICT usage, (2) shifts in EU RTD and (3) shifts in designing Ambient Intelligence.

2.2.1 Shifts from Technology to Usage

The AmI vision implies several related shifts in IT and ICT. A first technology shift concerns the way computing is organised. Computing systems have changed from mainframe computing (1960–1980) to personal computing (1980–1990), and are evolving from embedded and multiple computing (2000 onwards) towards invisible computing (2010 onwards). A second shift is related to the move towards distributed and peer-to-peer computing whereby resources (e.g., computation power or content) are networked, decentralised and shared amongst peers in a location independent way. A third shift concerns communication processes: from people talking to people, to people interacting with machines, to machines/devices/software agents talking to each other and to people. A fourth important change is the one which presumes that interfacing with computing capabilities will become natural and intuitive, in contrast with current Graphical User Interfaces (GUI) and past keyboard-based input systems. What Ambient Intelligence offers is a combination and integration of these different shifts, and by doing so, it adds a new and significant layer to the current evolution in ICTs (ITEA 2005).

These changes in the way ICTs are functioning go hand in hand with progress in the diffusion and acceptance of past and current ICTs. It should not be forgotten that businesses, homes and individual lives have embraced many technological devices and services during the last decades, although there were also notable failures such as Videotext in the 1980s. In the last 10 years mobile telephony in Europe has grown into a market of over 300 million users. In many European countries, mobile telephony penetration rates are above 70% of households. Short Message Service (SMS) has also given a considerable boost to the mobile services market in recent years. Residential Internet access rose to 43% in the EU15 in June 2003 versus 28% in October 2000 (Eurobarometer 2002; SEC 2005). The Internet has become huge and it is in the meantime already changing due to the roll out of broadband networks and always-on connections. In the EU15 in July 2004, roughly 80% of the people could be reached by broadband, although only 8% were subscribers (EITO online). A reason for the latter observation is that Internet chat and

e-mail rather require always-on connection while peer-to-peer computing also requires high bandwidth. The convergence between broadband and wireless networks might stimulate however the demand for new converging multimedia services and for broadband access. Another driver is related to the fact that digital storage is becoming very cheap, hence the emergence of MP3 players and USB keys. These and many more new technologies are being introduced and taken-up by millions of consumers in Europe.

2.2.2 Shifts in EU RTD Framework Programmes

Ambient Intelligence reflects in a certain way that views have changed on how to develop and support new ISTs. The focus has shifted from linear and deterministic models of technological change to a socially and culturally constructed process of innovation that features interactivity, and dynamic and continuous change in an interplay between research, development, design, marketing and the uses of new technology. The top down approaches characteristic for the 1980s have in the 1990s slowly been supplemented by bottom up approaches (OECD 1992; Smits and Kuhlmann 2004). Ambient Intelligence builds upon this change by systematically combining and integrating both top down and bottom up approaches. This means that Ambient Intelligence is certainly not only about users but also about ISTs, but it stresses the interaction between both. Ambient Intelligence therefore stands for an integrated and systematic approach to innovation. It starts from needs and looks for technical solutions rather than looking for where techniques can be matched with needs.

This can be illustrated with different European RTD Framework Programmes (FP) (Cordis Acts, online; Cordis Esprit, online; Cordis FP5, online; Cordis Telematics, online). ICT research has a long history within these programmes, starting with ESPRIT (European Strategic Programme for Research and Development) in 1984 (FP1) which was on ITs, in particular on the emerging information infrastructure. ESPRIT continued in the successive FPs and was in the meantime joined by RACE (Research and development in Advanced Communications technologies in Europe) and TELEMATICS, which is a merger of the more application-oriented programmes DELTA, DRIVE and AIM. The major focus of these ICT programmes moved gradually from hardware-based infrastructure initiatives towards software-based applications and services.

This was consolidated in FP5 (1999–2002), where these different programmes were merged under the common denominator of a "user-friendly information society". Although de facto the programme was more about developing useful and relevant applications for the information society, this move was important in terms of providing a common approach to IST innovation which is not only based on technological performance but also on awareness of the importance of user needs and user relevance. Users were defined mainly in terms of businesses, companies, industries but also the public sector and ultimately, the wider public as end-users were to be taken into account.

The IST programme within FP6 (2002–2006) builds further upon this trend by offering more focus and integration, the latter two also being the biggest priority in terms of budget and effort in FP6 ("Focussing and Integrating EU Research" [Cordis FP6, oline]). Furthermore, the IST programme has five thematic priorities. These are: (1) applied IST research addressing major societal and economic challenges, (2) communication, computing and software technologies, (3) components and micro-systems, (4) knowledge and interface technologies and (5) Future and Emerging Technologies (FETs). Ambient Intelligence is not one of these five priorities but given its horizontal nature, it is an authoritative guiding principle for most European IST research (Gago Panel Report 2005).

The central role of Ambient Intelligence in FP6 thus flags a double change in approaching IST innovation in Europe, first by offering a common vision on the future of the information society in Europe and second by the substance of the vision, i.e., an integrated and systematic approach to IST innovation. The latter issue will be elaborated further in the next section.

2.2.3 Designing Ambient Intelligence is Designing Social Structures

The integrated and systemic nature of Ambient Intelligence means that it represents a step beyond the current concept of a user-friendly information society (ISTAG 2001). It signals a move beyond user-friendliness and "usability" concerns to favour relations between people and their intelligent environment that are seamless, intuitive, natural and humanistic. Ambient Intelligence thus stands for a "people-friendly information society".

Usability research tends to objectify the relationship between people (as "users") and technologies. It deals with concrete human–machine interactions, based on functional translations of user requirements into the design of new artefacts. These are mainly routed within the traditions of behavioural science and computer engineering, but increasingly, efforts are undertaken to bridge both worlds and to take users seriously, especially within the fields of Human Computer Interaction (HCI), Computer Mediated Communication (CMC) and Computer Supported Cooperative Work (CSCW) efforts are.

With Ambient Intelligence, human–machine interaction is not just about a simple relation between an individual user and an individual artefact. It goes beyond the usual focus on individual users, especially when taking into account that AmI products and services will be intelligent, adaptable and networked, in contrast with stand-alone products. As Tuomi (2003) argues, machines are to be seen as media that connect systems of social activity. This means that designing a product actually means designing the structures for social interaction. Designing Ambient Intelligence consequently means designing social structures.

This is partly acknowledged in one of the latest reports of ISTAG (2003a; 2004a) where the concept of EARCs (Experience and Application Research Centres) is proposed as a new approach to prototyping necessary for

the successful development of AmI products and services. Functional, technical, social, economic and cultural requirements of systems gathered from users and stakeholders need to be put at the centre of the development process, revisited through design, implementation, checking and testing. Experience prototyping can be used to understand user experiences and their contexts, explore and evaluate new designs and communicate ideas to designers and stakeholders. This should "allow people to live in their own future" and should bring AmI research closer to the needs of citizens and businesses (ISTAG 2003a).

Such a view on IST innovation also has implications for the way the relationship between technology and society is conceived. Visions of the future of technology in society tend to be shaped by what the technologies have to offer. They often suffer from technological determinism (Marvin 1988; Flichy 1995). Every time a new technology pops up, revolutionary social changes are promised and promoted. They only look at what is technologically feasible and ignore the socio-economic context and user dynamics that are shaping the innovation process as well (Burgelman 2000). But Ambient Intelligence claims to be different, i.e., "human-centred".

Right from the start, the AmI vision explicitly focused on people, not on technologies. People need to benefit from services and applications supported by new technologies in the background and they need to be given the lead in the way systems, services and interfaces are implemented. The four scenarios that were developed in the 2001 ISTAG report also emphasised a key feature of Ambient Intelligence, which is that the technologies should be fully adapted to human needs and cognitions. According to ISTAG (2001), the social and political aspects of Ambient Intelligence will be very important for its development. A series of necessary characteristics that will permit the eventual societal acceptance of Ambient Intelligence were identified. These are carefully balanced between technological determinism and social reductionism. At the level of discourse, this is what makes Ambient Intelligence already different from earlier technology visions (Punie 2005).

2.3 IST, the European Social Model and the Lisbon Objectives

Ambient Intelligence as a concept has already gone through an evolution from when it started in 1999 to where it evolved now. This has to do with moving from a technology-based vision to increasingly interconnecting it with the specificities and challenges Europe is facing. The stronger and better this interconnecting is made, the more chances Ambient Intelligence has to really make a difference.

The so-called European model emerged in Europe after the Second World War, under the umbrella of what later became labelled as the welfare society (Calabrese and Burgelman 1999). The European model covers many different

policy areas (e.g., health, social protection, welfare, education) but also contains a set of common values that are based on four principles: (1) growth to enable full employment, (2) solidarity, (3) equal opportunities and (4) sustainability. There are of course differences between European countries in how these principles are applied, but overall this synthesises the main characteristics of the European model.

Important is that this current European model is being challenged in the mid-term to long-term future by new developments. These developments can be summarised under the headings of enlargement, ageing population and global competition. First, the May 2004 enlargement has raised the EU population with 20% to more than 450 million people while it only increased its GDP by 4.5%. It indicates that socio-economic disparities across the EU are becoming wider. This, moreover, is not only the case across the Union (i.e., between countries) but also between regions. Social cohesion is therefore so high on the agenda of the enlarged Union. Second, there are, however, also similarities between the EU15 and New Member States, especially in terms of demographics: old and new Europe faces the same demographic challenges. And this explains why the future of our health care systems, pensions and active employment is core concern too (European Commission 2004a). Third, global competition is the rule for almost all sectors of our economies rather than the exception. It demands for high flexibility and mobility in the organisation of labour and living in order to be competitive.

Demographic and social trends, such as individualism, diversity, mobility and the choice of personal life styles, all affect the structure of groups and communities and the ways we live and work. Mobile phones, for instance, are enablers of lifestyles that are increasingly individual and mobile. Household structures (family size and composition) are changing too, with a decline of traditional nuclear families and an increase of dual income households and single parent/single person households (Gavigan et al. 1999; Ducatel et al. 2000).

All the changes affect the four pillars of the European model while at the same time current ICTs and future AmI environments might affect them too (Clements et al. 2004). This becomes obvious from the following arguments:

– ISTs are essential for growth and employment. Firstly because the IST sector is a growth sector per se. The ICT equipment and services sector on its own right have grown from 4% of EU GDP in the early 1990s to around 8% and accounted for 6% of employment in the EU in 2000. R&D investment in the ICT sector accounts for 18% of overall EU spending in R&D (OECD 2002; COM_2004/757). The latter is also the case when looking specifically at the top 500 private R&D-investing firms in the EU (European Commission 2004b). Secondly, ISTs are also important for growth and employment because of their indirect impact. They are central to stimulating productivity and improving competitiveness. Between 1995 and 2000, 40% of the productivity growth in the EU was due to ICT (COM 2004).

- ISTs are essential for solidarity and cohesion because of their fundamental character to bridge the limitations of time and space. ISTs can bring people, regions and countries that are socio-economically disparate closer together. This is especially relevant now that the EU has enlarged with ten New Member States from regions that lag behind in terms of economic prosperity. Also better governance and smarter health can be realised via IST.
- ISTs are essential to develop and maintain equal opportunities in a knowledge society that is increasingly based on digital networks and electronic communications. Issues such as the digital divide, e-learning but also digital identities and privacy are key for developing a future Europe in terms of providing equal opportunities and chances to all. This is based on the idea that IST are designed and used to serve people and not vice versa.
- ISTs are essential to sustainability. There are significant opportunities for improving environmental sustainability through ICTs in terms of, for instance, rationalising energy management in housing (or other facilities), of more efficient and more safe transport (passenger and freight) and of enabling a product-to-service shift across the economy. There are rebound effects that need to be taken into account, but ISTs are expected to have a beneficial impact on environmental sustainability (Rodriguez et al. 2004).

As a result, IST provides a systemic technology as they touch upon the foundations of the post–World War II European society. It follows from this that a successful information society policy should be a holistic policy that takes into account technological, economic, political and socio-cultural issues.

This also explains implicitly why ISTs are regarded as crucial for realising the Lisbon objectives of a competitive and dynamic knowledge-based economy with sustainable economic growth, more and better jobs and greater social cohesion. ISTs are seen as key contributors to realising the Lisbon goals (EC 2002COM 2004). In the next section, some of the key social drives and IST applications to that end are described.

2.4 Foresight in IST in Europe

The discussion on the developments in (IST) in Europe is largely centred on societal questions. Europe has reached a consensus on the requirement that novel technological developments should be inspired by needful applications that support functional use within society in the large. More specifically, this implies to a large extent that novel IST developments should be driven by social rather than by technological factors.

2.4.1 Social Drivers

Factors that shape the speed of ICT progress can be technological, economic, social, or political and they are often interrelated. An overview of some of

the major drivers, trends and challenges for the future information society is provided by the FISTERA (Foresight on IST in the European Research Area) thematic network. FISTERA is an EC-funded network that aims to understand the key factors driving IST in a future Europe. In its review of the major scenario studies and foresights of the emerging information society, FISTERA has noted that especially the social drivers for future ISTs have remained particularly stable during the last years. The network has identified 15 key social drivers for IST R&D development up until 2010 and beyond. These are presented in Box 2.1.

Box 2.1 Social drivers for future IST

- Aging population and implications for health applications
- The maintenance of languages, cultures and life styles in an enlarged Europe
- Using novel ways of community learning and knowledge sharing
- Increasing demand for personal mobility
- The demand for improved public services
- Increasing requirements for personal privacy and trust
- Assuring ICT service security and robustness
- Complying with increasing "bottom line" ethical requests
- Bridging the digital divide
- Building ICT-related skills allowing social innovation (supporting ICT use and employing ICTs)
- Increasing demand for system integration and interconnection
- Ongoing globalisation of services and business
- Enhanced awareness of environmental issues and sustainable growth
- ICT-based applications for enhanced security (Compañó et al. 2004).

As areas to work on for the future, most foresights on IST in Europe list health care, ageing population, transport and mobility, education, governmental services, leisure and changing social relationships, including cultural diversity and migration. As drivers, these topics have changed very little over the past few years indicating that what drives socially the demand for ICT at the macro level is more or less constant. It provides a sound foundation for the creation of the European knowledge society. The only exception is "security". It became a major concern after the September 11, 2001 terrorist attack and ICT is now increasingly considered to provide indispensable tools for private and public security and defence (Compañó et al. 2004).

2.4.2 Promising IST Applications

FISTERA results provide an account of what the most important future IST application areas are, according to national foresight studies and a recent

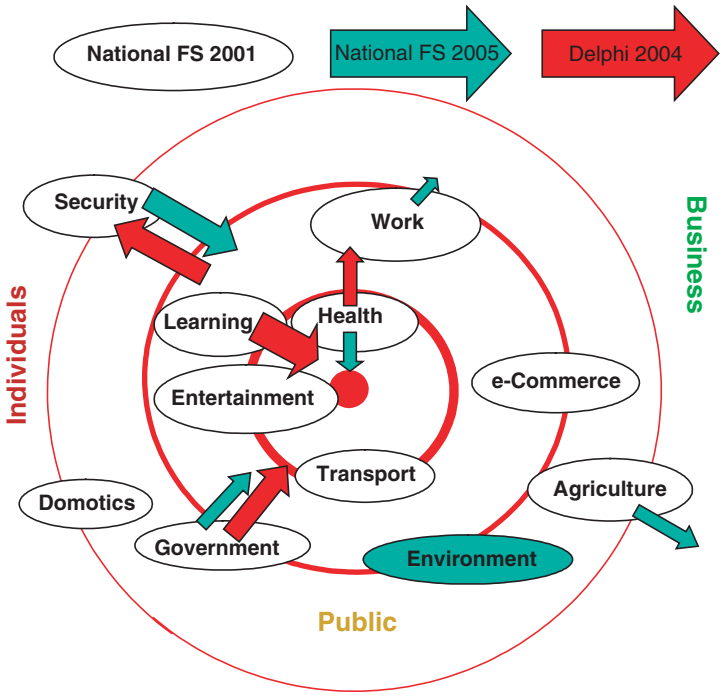

Fig. 2.1. Promising IST application fields (FISTERA 2005)

Delphi exercise (Popper and Miles 2004). Interestingly, the results show how some of the priorities have changed during the last years, by comparing the results of foresight researches undertaken in 2000/2001 with more recent ones and with a recent Delphi exercise done by FISTERA. The results are shown in Fig. 2.1. Importance is measured in terms of the appearance of the application fields. The most important application fields, i.e., the ones that are most frequently mentioned and/or most prominently visible in the different foresight exercises, appear in the centre of the graph, around the red dot and the first bold circle. As the centre of gravity moves to the periphery, the application fields are regarded as less important.

The 2000/2001 national foresight studies indicate that the major application areas for IST seem to related to, firstly, health care, learning, entertainment and transport. Second order importance goes to governmental services, e-commerce and work. The outer circle of importance consists of agriculture, security and domotics. It might be surprising that security is perceived to be less important, but that might be the result of the fact that until September 11, 2001, foresight studies treated security as an aspect of individual technologies, e.g., security of IT from virus attacks, security of the food chain from diseases like BSE, security from natural disasters like flooding, etc. (Compañó et al. 2004).

The green arrows highlight the changes according to the more recent foresights. Health becomes the single most important domain. Government applications move to first order of importance. Security becomes now more prominent, after September 11. Environmental concerns and quality of life emerge as new topics, at the expense of work-related and agriculture-related IST applications.

An online Delphi executed in 2004 with 413 experts confirmed on the one hand the importance of learning and egovernment but decreases the central role of health on the other hand. Also, security applications are seen as less prominent, as is shown by the red arrows in Fig. 2.1. In the next section, four of the most promising IST application fields are further developed within the context of the opportunities offered by Ambient Intelligence.

2.5 AmI Innovation in Europe

The vision of an intelligent environment based on the convergence between ubiquitous computing, ubiquitous communication and intuitive, intelligent interfaces has the potential to respond to these challenges and social drivers in a "European way", i.e., in a way that respects the basic European areas of consensus mentioned above. More provocative in this respect is the book of Jeremy Rifkin where the European Dream is contrasted against the American one.

The European Dream emphasises community relationships over individual autonomy, cultural diversity over assimilation, quality of life over accumulation of wealth, sustainable development over unlimited material growth, deep play over unrelenting toil, universal human rights and the rights of nature over property rights and global cooperation over the unilateral exercise of power (Rifkin 2004).

In addition to the central role of Ambient Intelligence for the key areas of growth, employment and competitiveness, it promises to take on board values such as inclusiveness, diversity, quality of life and sustainability in addressing these key areas. Four cases are now developed to illustrate how Ambient Intelligence could address socio-economic realities and challenges in an innovative and European way. The cases are linked to the most promising IST application fields as mentioned above: (1) sharing of knowledge, learning and experiences, (2) Ambient Intelligence in health care, (3) Ambient Intelligence in eGovernance and (4) Ambient Intelligence and biometrics identification, building upon the potential of ICT for security.

2.5.1 Sharing of Knowledge, Learning and Experiences

There is a potential for Ambient Intelligence to play an increasingly significant role in social learning and the exchange of knowledge, particularly now that network infrastructure and network access are becoming ubiquitous. The

challenge would thus be mainly on realising smart content, i.e., content that is produced and controlled by the users themselves and that adapts itself to changing contexts and situations, and on enhancing and improving content manipulation, storage, archiving and retrieving technologies.

An example of the potential of Ambient Intelligence to support spontaneous learning and to establish a "collective learning memory" is described in the ISTAG Scenarios on Ambient Intelligence in 2010 (ISTAG 2001). One of the scenarios was "Annette and Solomon". It describes a meeting of an environmental studies group that is led by a human mentor but facilitated by an "Ambient" knowing the personal preferences and characteristics of the participants (real and virtual). The scenario implies significant technical developments such as high "emotional bandwidth" for shared presence and visualisation technologies, and breakthroughs in computer supported pedagogic techniques. But it also presents a challenging social vision of Ambient Intelligence in the service of fostering community life through shared interests. The current popularity of chatting, weblogs and peer-to-peer computing indicates there is an interest in digitally enhanced sharing of (rich) content.

Ambient Intelligence could prove to be relevant for such a purpose, as it will able to integrate and communicate tacit, context-dependent knowledge more easily than current-day technologies can. Social learning might be facilitated in such an AmI environment since it can bring people from different backgrounds and different contexts closer together. The intelligent environment would facilitate the sharing of experiences by making the necessary translations (Van Bavel et al. 2004). A first step towards this environment would be provided by linguistic translations, as described by ISTAG (2004b) as a "multilingual companion" that makes multilingual and cross-lingual information access and communication virtually automatic. Such a companion would be extremely useful in enlarged Europe but the grand challenge would be to also encompass Europe's cultural diversity (and thus not only linguistic diversity).

Digital content for entertainment, culture and leisure that is shared amongst people would require, however, a re-assessment of digital copyrights. This needs to be seen in the context of what can be described as a Virtual Residence (Beslay and Punie 2002), a common space for digital content that is shared amongst family members and peers. This could not only give rise to new and unexpected (grassroots) uses of content but also create opportunities for new business and/or revenue models that are based on usage rather than on ownership of, for instance, a physical copy. In the same way as for instance someone can step into your car and listen to "your" music, one should be able to invite others to access and enjoy – perhaps temporarily – digital content. A major challenge for the realisation of this will consist of the management and control of access rights to these digital assets.

2.5.2 Health Care

Health care is a priority in Europe and is central in the European social model. It will become probably an even more important priority in an enlarged EU,

where considerable regional and national differences in health care systems exist and where the population is ageing. The social challenge is to keep the costs of healthcare systems under control while at the same time maintaining a high quality service. eHealth applications are expected to contribute to addressing this challenge by reducing costs and by delivering better and more efficient health care. More specific advantages are easy access to various medical experts and to efficiently exercised second/third opinions, early diagnosis, improved disease tracking and prevention measures and better record keeping.

But Ambient Intelligence in the context of eHealth could be more than maintaining and improving existing health care systems. It could support a paradigm shift in health care delivery by focussing on the autonomous citizen (i.e., proactive with respect to her/his own health, enabled to self-care, seeking services for prevention and disease management and aware of lifestyles) and independent living (i.e., living autonomously and safely as long as wished).

Today, medical files are primarily managed by medical institutions and not by the patients themselves. In the future, the user will need to get more control over this because medical information will not only be gathered via existing institutionalised forms (e.g., anamnesis, hospital check-up, etc.) but also via direct sensor-based monitoring, at different levels: in the body (implants), embedded in clothes (smart fabrics, so-called eWearables) and at dedicated places such as the smart home. All this monitoring of (health) information needs to be managed (e.g., medical files), secured and protected against, for instance, unauthorised access. The use of interoperable systems will be crucial for the exploitation of collected data in the context of the European mobility of citizens and patients. An additional benefit relates to biomedical research (e.g., by using data-mining in monitored data) provided that privacy protective rules are taken into account.

Moreover, AmI-based health care applications or Ambient Care (Cabrera et al. 2004) would be based on a holistic view of human "wellness" (physical health is one component, but not the only one). Moreover, focusing on prevention rather than on cure is more inclusive with regard to socially or physically vulnerable groups (dependent elderly and disabled, children, etc.). ISTAG (2003) envisages a "Ambient Care System" that is responsive and proactive, that places the user in control of their health care management, including communication with professional careers, friends, family and the wider community. Ambient Intelligence would for example help older and disabled people who remain in their own homes for longer by providing them and their carers with increased safety and reassurance, and supporting treatment, rehabilitation and care. Moreover, this would not necessary lead to loss of personal contacts and social interactions at the expense of virtual and remote (medical) encounters. There are also new opportunities for sociability offered by Ambient Intelligence. (Cabrera and Rodríguez 2004) describe for instance a scenario whereby AmI-based assistant technologies enable elderly people not only to live autonomously for longer but also to retire elsewhere while staying connected at the same time.

2.5.3 eGovernance

eGovernment has become an explicit component of both public sector reform and information society initiatives (e.g., eEurope). ICTs are seen as crucial instruments for the modernisation of public services in terms of increasing efficiency and of providing better services to citizens and companies, and ultimately, to strengthen democracy. The social changes Europe is facing (cf., infra) combined with the potential of Ambient Intelligence could however provide a unique opportunity for re-thinking the role of public services in society. A workshop organised by the Institute for Prospective Technological Studies in March 2004 focussed on developing a balanced vision of what eGovernment in the EU would look like in 2010, taking into account Ambient Intelligence (Centeno et al. 2004).

The vision that emerged from the workshop defines eGovernment in the EU in the next decade as an enabler for better government in its broadest sense. It places eGovernment at the core of public management modernisation and reform that not only pursues cost-efficiency and effectiveness but also the creation of public value. The latter is a broad term that fits within the European model as described above and that encompasses the various democratic, social, economic, environmental and governance roles of governments. Concrete examples of these roles are the provision of public administration and public services (health, education, social care); the development, implementation and evaluation of policies and regulations; the management of public finances; the guarantee of democratic political processes, gender equality, social inclusion and personal security; and the management of environmental sustainability and sustainable development.

Four key components would constitute the vision: more user-centric, more knowledge-based, more distributed and more networked. More user-centric means that the needs of citizens and businesses will guide the delivery of eGovernment services rather than the specific demands of people as consumers of public services. This would constitute a shift towards giving the user more control over eGovernment services and ultimately towards empowering users in the process of democratic participation. Emphasising the role of knowledge in government is nothing new but the diffusion of ICTs, the development of the knowledge society and the potential of Ambient Intelligence enable to revitalise the discussion on the role of knowledge in government. More knowledge-based government implies a shift from providing information towards more efficient creation, management and use of knowledge in interaction with citizens and businesses in order to create public value. This means that governments become more flexible and adaptive to changing and diverse environments and needs. More distributed eGovernment opens up the possibilities for a stronger involvement of intermediaries (private, social and public partners) in the delivery of public services and in the exercise of democratic governance. Governments will need to better understand the

potential of these actors, in order to develop more innovative and longer term collaborative models and partnerships with them. Finally, there are several trends in public administrations in Europe towards the development of a networked eGovernment, which will require strong co-ordination and collaboration among all actors (also citizens and businesses). Networked eGovernment is crucial for knowledge creation, sharing and dissemination, and for the creation of public value (Centeno et al. 2004).

Ambient Intelligence would offer new models to delivery of government that are mobile, always available, anywhere and via any device. Specific but not exclusively for the eGovernment domain is that these services need to be trusted, secure and, above all, need to respect identity and privacy of citizens and businesses. Many services can be delivered based on an authentication that not necessarily identifies people or that contains lots of personal and private data. Since Ambient Intelligence does enlarge considerably the possibilities for surveillance, people could refuse to live in an AmI environment where governments but also companies and other people know too much about each other. The challenge here is to find a right balance between protecting privacy and providing secure and useful services (ISTAG 2001; Clements et al. 2003). In the next section, the issue of electronic identification is further elaborated.

2.5.4 Biometric Identification

An enlarged EU will be increasingly characterised by a high level of mobility, not only of people but also of devices and goods. In combination with the characteristic of modern society to become networked and digital, a strong need for electronic identification emerges. Technologies such as RFID and biometrics provide new tools for more reliable identification. They also establish connections between the real and digital world. This is crucial for future AmI environments where the real and the virtual will become closely intertwined and maybe even merged. Identification technologies are necessary access points to AmI environments. Without automatic and seamless identification, Ambient Intelligence will not function, e.g., adapting the environment to person needs. Biometric technologies are an important technology for reliable and seamless identification, quite apart from the present-day security concerns as a result of September 11, 2001.

Biometric identification is a technique that uses biometric features such as fingerprint, face, iris, voice and signature to identify human beings. Biometric features are deemed “unique” although some are less “distinct” than others and thus less useful for automated identification purposes. Biometric technologies can provide more convenience and security to the processes of (automatic) authentication and identification. Identity authentication consists of verifying that people are who they claim to be while identification is focussed on discovering the identity of unknown people. Access to physical premises can be

done just by speaking to a microphone or looking through a camera that are located next to the door. For digital access, biometrics can replace the use of many different and complicated passwords. In contrast with passwords that can be forgotten or keys that can be lost, biometrics are, in theory, always available (Maghiros et al. 2005).

Biometric technologies are high on the political agenda, both in Europe and abroad, as a response to the September 11 terrorist attacks and the concerns about threats to global security. There are already many experiments with biometric-based border control at airports and passports will increasingly contain biometric data in the future. It can be expected that once the public becomes accustomed to using biometrics at the borders, their use in commercial and other civil applications will follow. This "diffusion effect" signals the possibility of increased acceptance of biometric identification as a result of governments' initiatives to use biometric identification. Such a diffusion of biometrics could be an important enabler for the realisation of Ambient Intelligence provided it is done in ways that respect European values, traditions and legal frameworks. Biometrics can, for instance, also protect privacy because authentication can also be done without necessarily revealing a person's identity. Submitting a registered fingerprint can just be enough to get access to a service. Providing it is recognised that biometrics are never 100% accurate, that the necessary fallback procedures are foreseen and that the purpose of biometric applications are clearly defined, opportunities for a European way of deriving maximum benefit from the deployment of biometrics could be available (Maghiros et al. 2005).

2.6 Conclusions

Ambient Intelligence will be everywhere, anytime, always on, but on demand and thus only when needed and under control of the person. The concept is, in a certain sense, not new or revolutionary since the bridging of time and space has been on the agenda of IST research for many years. The need for IST to be user-friendly, embedded and unobtrusive has also been raised for several years already. More recently, the "service" notion of IST is more and more highlighted, i.e., the notion of technology in the service of mankind in contrast with people needing to adapt to the technologies.

What is really new is that Ambient Intelligence aims at integrating all these features in a way that it allows the IST community to offer Euro-specific responses to the main societal, social and economic challenges of Europe. At the core of the AmI concept is the ambition to offer world-class services and competitiveness whilst at the same time caring for well-being and diversity. In this article, four cases are described to illustrate this but many more and many different application fields are to be developed.

Ambient Intelligence is therefore more a new conceptual approach to IST innovation or even a paradigm than a well-defined set of technologies or social practices. For Europe, and the EU in particular, Ambient Intelligence is also a unique concept to promote a way of making sense of IST research in Europe that is based on European strengths and values and that is not driven by military and/or defence-related inspirations. It is not just anecdotic but rather significant to note that in French, the acronym "AmI" means "friend", hence the title of this article: an encounter between technology and society of a different kind.