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Ambient Intelligence: The Vision of Information Society

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1. Introduction

“Send this to Juan.“

“Get me a hardcopy quickly!”

If we catch our friend in his office talking this way not with his secretary, but with his fax machine, we would in best case consider him a very lonely man. Nevertheless, in some ten years this might be just an ordinary scene taking place everyday in millions of offices worldwide. Well, this is, approximately, what this report is about.

Ambient Intelligence (AmI) is a striking and to some extent provocative vision of the future society. Here are some definitions of this term:

“Ambient Intelligence is a distributed network of intelligent devices that provides us with information, communication and entertainment.”¹

“Ambient Intelligence is a network of hidden intelligent interfaces that recognize our presence and mould our environment to our immediate needs.”²

“Ambient Intelligence refers to an exciting new paradigm in information technology, in which people are empowered through a digital environment that is aware of their presence and context and is sensitive, adaptive and responsive to their needs, habits, gestures and emotions.”³

All this implies that the near future will bring us kitcheners that automatically switch off hot plates when we leave the apartment or, even more astonishing, TVs that automatically switch to another TV channel if it “judges” by our facial expressions that we don’t like the show which is on at the moment.

Ambient Intelligence is based on three key technologies: Ubiquitous Computing, Ubiquitous Communication and Intelligent User Interfaces. What do these expressions actually mean?

¹ Emile Aarts , Rick Harwig, “Ambient Intelligence”, URL: <http://www.research.philips.com>

² John Horvath, Telepolis, Making Friends with Big brother, URL: <http://www.heise.de/tp/english/inhalt/te/12112/1.html>

³ Taken from “Ambience Project”, URL: <http://www.extra.research.philips.com/euprojects/ambience>

Ubiquitous Computing means the integration of microprocessors into everyday objects like furniture, clothes or toys.

Ubiquitous Communication should enable these objects to communicate with each other and with the user.

Intelligent User Interface enables the inhabitants of the AmI to **control** and interact with the environment in a natural (voice, gestures) and personalized way (preferences, context).

Why did I point out “control”? Well, apart from all advantages it may bring, the Ambient Intelligence will raise some concerns over privacy and security issue. Some may also be afraid of alienation or of living in a virtual world. That is why Ambient Intelligence must be user friendly, controllable and secure. Besides it should be almost invisible and moreover it should be nowhere unless we need it.

The easiest and for the reader definitely the most interesting and comprehensive way to present the basic concepts of the Ambient Intelligence is through scenarios. There are many such scenarios which depict an usual day in the life of the ordinary people in a world where Ambient Intelligence has become ordinary thing to be found in the reports or in the Internet. However, the scenarios developed by European Union’s ISTAG appear to be the most appropriate for a detailed presentation, analysis and theoretical discussion. Therefore, I am going to present all four scenarios, but in that way that an appropriate analysis on critical social, technological and business issues follows right after the presentation of each scenario. After this has been done, all four scenarios will be compared along various parameters (e.g. How realistic are they? What aspect of life do they relate to? What makes them similar? What makes them different?)

When we say Ambient Intelligence we automatically think of the future. Well, even the report’s title contains the word “vision.” But, the first prototypes have already been developed. There are many teams both in Europe and in America working on Ambient Intelligence or similar projects. This is exactly what the last part of the report is devoted to: we will present the projects that have been realized or that are to be realized in the near future.

2. Scenarios for Ambient Intelligence

As already pointed out, among the plenty of scenarios I have found in literature, I find those created by the ISTAG the most appropriate for this report. This may be the right place to say what the ISTAG actually is. Well, this abbreviation stands for Information Society Technology Advisory Group, a team which works with the direct support of European Union and has at the moment 26 members coming from the whole Europe and not only from the EU. The first meetings took place in 1999. As for the objectives, this is what the ISTAG's first report says:

“Start creating the ambient intelligence landscape for seamless delivery of services and applications in Europe relying also upon test-beds and open source software, develop user-friendliness, and develop and converge the networking infrastructure in Europe to world-class”

The scenarios presented here show a number of plausible, internally coherent, illustrations of the future of Europe to which no probability is attached. Scenarios are not, and cannot be, either a projection of the future, or a prediction of the likelihood of a certain outcome. It is on purpose that none of the scenarios is entirely rosy and none is entirely dark. Each scenario contains positive and negative aspects that allow for a composite, even contrasted, picture of the future, but, after all, so is our contemporary world. This furthermore enables a fruitful discussion on this issue. The exercise was designed not to make value judgements since 'good' or 'bad', put in a specific context, mean different things to different people, whether due to their personal preferences or due to the cultural differences among the various cultures. There was also an attempt not to make the scenarios too complex in the sense that each scenario should have a character of its own with easily recognisable features. The scenarios are taken over in its entire length. This may appear to be unusual for a seminar paper, but I find it necessary in order to make the reader familiar with the term Ambient Intelligence. Finally, although ISTAG report focuses on Europe and its role in achieving the AmI, we shall ignore this and present a vision of AmI that is as general as this is possible. So, let us get started with the first scenario.

2.1 Scenario 1: 'Maria' Road Warrior

After a tiring long haul flight Maria passes through the arrivals hall of an airport in a Far Eastern country. She is travelling light, hand baggage only. When she comes to this particular country she knows that she can travel much lighter than less than a decade ago, when she had to carry a collection of different so-called personal computing de-

vices (laptop PC, mobile phone, electronic organisers and sometimes beamers and printers). Her computing system for this trip is reduced to one highly personalised communications device, her `PCom' that she wears on her wrist. A particular feature of this trip is that the country that Maria is visiting has since the previous year embarked on an ambitious ambient intelligence infrastructure programme. Thus her visa for the trip was self-arranged and she is able to stroll through immigration without stopping because her P-Comm is dealing with the ID checks as she walks.

A rented car has been reserved for her and is waiting in an earmarked bay. The car opens as she approaches. It starts at the press of a button: she doesn't need a key. She still has to drive the car but she is supported in her journey downtown to the conference centre-hotel by the traffic guidance system that had been launched by the city government as part of the `AmI-Nation' initiative two years earlier. Downtown traffic has been a legendary nightmare in this city for many years, and draconian steps were taken to limit access to the city centre. But Maria has priority access rights into the central corridor because she has a reservation in the car park of the hotel. Central access however comes at a premium price, in Maria's case it is embedded in a deal negotiated between her personal agent and the transaction agents of the car-rental and hotel chains. Her firm operates centralised billing for these expenses and uses its purchasing power to gain access at attractive rates. Such preferential treatment for affluent foreigners was highly contentious at the time of the introduction of the route pricing system and the government was forced to hypothecate funds from the tolling system to the public transport infrastructure in return. In the car Maria's teenage daughter comes through on the audio system. Amanda has detected from `En Casa' system at home that her mother is in a place that supports direct voice contact. However, even with all the route guidance support Maria wants to concentrate on her driving and says that she will call back from the hotel. Maria is directed to a parking slot in the underground garage of the newly constructed building of the Smar-tel Chain. She is met in the garage by the porter the first contact with a real human in our story so far! He helps her with her luggage to her room. Her room adopts her `personality' as she enters. The room temperature, default lighting and a range of video and music choices are displayed on the video wall. She needs to make some changes to her presentation a sales pitch that will be used as the basis for a negotiation later in the day. Using voice commands she adjusts the light levels and commands a bath. Then she calls up her daughter on the video wall, while talking she uses a traditional remote control system to browse through a set of webcast local news bulletins from back home that her daughter tells her about. They watch them together. Later on she `localises' her presentation with the help of an agent that is specialised in advising on local preferences (colour schemes, the use of language). She stores the presentation on the secure server at headquarters back in Europe. In the hotel's seminar room where the sales pitch is take place, she will be able to call down an encrypted version of the presentation and give it a post presentation decrypt life of 1.5 minutes. She goes downstairs to make her presentation... this for her is a high stress event. Not only is she performing alone for the first time, the clients concerned are well known to be tough players. Still, she doesn't actually have to close the deal this time. As she enters the meeting she raises communications access thresholds to block out anything but red-level `emergency' messages. The meeting is rough, but she feels it was a success. Coming out of the meeting she lowers the communication barriers again and picks up number of amber level communications including one from her cardio-monitor warning her to take some rest now. The day has been long and stressing. She needs to chill out with a little meditation and medication. For Maria the meditation is a concert on the video wall and the medication....a large gin and tonic from her room's minibar

2.1.1 *Socio-political issues:*

When I was explaining to some of my friends what the term ambient intelligence represents, almost all of them were a bit frightened. I am not saying this is the only impression they showed (on the contrary, they all admit this is very attractive and interesting vision), but it was shared by everyone. This problem may seem even more difficult if we take into account that all my friends were born in the period between late 70s and early 80s, which means they belong to the generation which is simply used to adopting new technologies, and even more importantly, the generation which is very eager to adopt the new technologies. It goes without saying that we then wonder: how will then the older react? What makes people actually being afraid of Ambient Intelligence?

As we saw in the Scenario 1, Maria's P-com ("key of keys") will contain many personal and confidential information about the user. How can we be sure that these information will not become accessible to those who may misuse them in some way? What protective measures are to be undertaken in order to prevent third party interference? Solving this problem would probably mean breaking the most important obstacle on the AmI's to a broad social acceptance. If Internet raised some concern over privacy, there is no doubt the same will happen to the AmI. But, we can safely claim that Internet is a part of everyday now, and we can hope that also here the same will happen with the AmI.

When we are talking about the privacy, confidence and security in the context of the AmI, there may arise certain problems regarding governmental services in one country or, even more difficult, between such services in different countries. Just like Ami it must be solved the question of individual privacy in the AmI world, there must also be found a way to secure the privacy of public institutions. ISTAG members agree that there will have to be signed many complex international treaties regulating this issue.

Since Maria's P-com contains all relevant personal documents, it is very likely that identity theft will be hackers' favourite game. Some people, particularly the elderly or those less educated, may simply refuse to accept their digital IDs. On the other hand, it is also very likely that the number of AmI opponents will decrease over time after AmI's security has been proved. It is therefore necessary to make people feel that they really have control over P-com or any other intelligent devices. In addition, P-com needs not to be always in operation,

especially if we don't need it. So, we have to be able to switch it off and remind ourselves how world looked like before AmI.

The last sentence in the Scenario 1 is: "For Maria the meditation is a concert on the video wall and the medication....a large gin and tonic from her room's minibar." This short sentence leaves a lot of room for speculating on what the members of ISTAG tried to say. Firstly, their intention may be to say that AmI is not going to free us from stress and other things making our life less easy, no matter how revolutionary this idea is and no matter what technological achievements will be made. However, we could also put it completely another way: if having gin and tonic is not regarded as an unhealthy way of releasing the stress, but simply like one of those "small pleasures", the authors' intention was maybe to prove that Ambient Intelligence is not going to be a virtual, but a very real world where people still know very well what they like and what they dislike.

2.1.2 Business environment:

In a world that will undergo that many changes, it comes very naturally that new products and services will emerge, but also that some will cease to exist for being unneeded. The same is true for the services. The AmI world can be seen from the business and economic perspective as a next step in the New Economy, since we shall reach the stage where it will be quite difficult to distinguish between the information and the physical product, since almost all products will be receivers and sources of information.

The most important gadget shown in this scenario is so-called P-com. P-com is also a product, just like, for instance, mobile phone, although it is more flexible than the mobile phone. This for example leaves a lot of room for designing fashionable P-coms, since there won't be any prescribed form of the P-com. It may be worn on the wrist or as a bracelet or it can be embedded in the clothes. The newest models can even be shown at the fashion shows in Milan or New York. We cannot neglect a lot of nearly invisible, but heavy-duty network infrastructure that will be invested by the customer offices, car rental companies, traffic management, hotels and so on and all this implies creating of both new products and new services.

As for the services, market is here primarily targeted at the high-wage business-oriented users. New services will also emerge, but it is also the way they are offered in the market that is significantly changed. It is very probable that there will be pre-packaged services that will be programmed into the P-com. These solution will refer both to standard services (ISTAG report here mentions central billing, network access management, programming) and special services (booking hotel rooms, renting cars, health services). Risk brokerage may also play an important role in the business world and will be carried out by specialist firms.

Furthermore, we can expect a great merger booms in the future, due to a partial unification of services offering. Some mergers we could not have thought of before (whether due to different nature of services or different corporate culture) may become reality. This might lead to creating huge global service operators whose size would by far exceed those of the today's biggest global concerns. It is also very likely that the banking sector will undergo dramatic changes.

2.1.3. Technological issues:

Scenario 1 points out the benefits that an individual living in the AmI world might have. As already said, the key novelty is this scenario is P-com. What does it consist of? What must be done in the technological field to make P-com reality?

P-com is meant to consist of two central components, both of which would have special tasks. These are:

- ?? A micro-sized radio software transceiver which would be able to interoperate with different wireless protocols (e.g. GSM) or even with satellite. If separated from its owner, P-com would automatically "die". It should operate on speech commands in order to avoid the use of keyboards.

- ?? ID key of keys would replace all current personal identifiers. It could be described as an extension of SIM cards, but due to its nature it should be fixed to the individual. Possible solutions are biometrics or chip implantation.

2.2 Scenario 2: 'Dimitrios' and the Digital Me' (D-Me)

It is four o'clock in the afternoon. Dimitrios, a 32 year-old employee of a major food-multinational, is taking a coffee at his office's cafeteria, together with his boss and some colleagues. He doesn't want to be excessively bothered during this pause. Nevertheless, all the time he is receiving and dealing with incoming calls and mails.

He is proud of 'being in communication with mankind': as are many of his friends and some colleagues. Dimitrios is wearing, embedded in his clothes (or in his own body), a voice activated 'gateway' or digital avatar of himself, familiarly known as 'D-Me' or 'Digital Me'. A D-Me is both a learning device, learning about Dimitrios from his interactions with his environment, and an acting device offering communication, processing and decision-making functionality. Dimitrios has partly 'programmed' it himself, at a very initial stage. At the time, he thought he would 'upgrade' this initial data periodically. But he didn't. He feels quite confident with his D-Me and relies upon its 'intelligent' reactions.

At 4:10 p.m., following many other calls of secondary importance answered formally but smoothly in corresponding languages by Dimitrios' D-Me with a nice reproduction of Dimitrios' voice and typical accent, a call from his wife is further analysed by his D-Me. In a first attempt, Dimitrios' 'avatar-like' voice runs a brief conversation with his wife, with the intention of negotiating a delay while explaining his current environment. Simultaneously, Dimitrios' D-Me has caught a message from an older person's D-Me, located in the nearby metro station. This senior has left his home without his medicine and would feel at ease knowing where and how to access similar drugs in an easy way. He has addressed his query in natural speech to his D-Me. Dimitrios happens to suffer from similar heart problems and uses the same drugs. Dimitrios' D-Me processes the available data as to offer information to the senior. It 'decides' neither to reveal Dimitrios' identity (privacy level), nor to offer Dimitrios' direct help (lack of availability), but to list the closest drug shops, the alternative drugs, offer a potential contact with the self-help group. This information is shared with the senior's D-Me, not with the senior himself as to avoid useless information overload.

Meanwhile, his wife's call is now interpreted by his D-Me as sufficiently pressing to mobilise Dimitrios. It 'rings' him using a pre-arranged call tone. Dimitrios takes up the call with one of the available Displayphones of the cafeteria. Since the growing penetration of D-Me, few people still bother to run around with mobile terminals: these functions are sufficiently available in most public and private spaces and your D-Me can always point at the closest...functioning one! The 'emergency' is about their child's homework. While doing his homework their 9 year-old son is meant to offer some insights on everyday life in Egypt. In a brief 3-way telephone conference, Dimitrios offers to pass over the query to the D-Me to search for an available direct contact with a child in Egypt. Ten minutes later, his son is videoconferencing at home with a girl of his own age, and recording this real-time translated conversation as part of his homework. All communicating facilities have been managed by Dimitrios' D-Me, even while it is still registering new data and managing other queries. The Egyptian correspondent is the daughter of a local businessman, well off and quite keen on technologies. Some luck (and income...) had to participate in what might become a longer lasting new relation.

2.2.1 Socio-political issues:

Communicating, creating new relationships and taking care of the old ones are very natural aspirations of all of us. Satisfying social needs takes a very good third position in a Maslow's hierarchy of needs. On the other hand, we note that the family and work have changed to a

great extent relative to few decades ago. Families get smaller, work schedules are flexible, people move much more and much easier than before, whether for living or just for paying a short visit to a friend. But the social needs are here to stay and that will not be changed in the near future. So, we here pose the question how could Ambient Intelligence improve the quality of human communication.

As already said, the main aspect of D-Me Scenario is human communication. AmI should help us satisfying our social needs, but that's not the end of story yet. The targeted communication (helping finding medicine; Egypt) is also going to be subject of dramatic improvements. This saves out time and our nerves and makes us feel more secure. Some may like it, some not, but if D-Me, or any similar products, is revealed one day and becomes accepted by the people, identities will become multiple and lives multiplexed. Families are going to become even more dispersed. It is doubtful however if we can blame AmI for it or not. Some may claim that the AmI will accelerate this process, which anyway seems to be inevitable. Therefore, the task of AmI will be to improve the possibilities of distance communication. When we are talking about the distance communication, it is hard not to mention quite new communication possibilities: communicating with totally unknown persons with the help of some "global matching brain". Some may advocate the opinion that this has been reached by the use of Internet, but this level of communication quality, as is described in scenario, has certainly not been reached.

Besides, this scenario shows the world as a place where the knowledge and information are shared, where spending time together and helping the aged are advocated for. So, this would be a place where so-called feminine culture would prevail, which means that the quality of life and solidarity are particularly appreciated. In order not to make this section an ode for AmI, we point out there are many concerns regarding this vision:

- ?? **PRIVACY:** Who are my data accessible to? How can I know they will not be misused, whether now or any time in the future?

- ?? **AUTHENTICITY:** People, and especially the "old guard", may prefer talking to real human being of flesh and blood than talking to their substitute machine.

?? ETHICS: People could wear several D-Me's which might offer a great deal of opportunities for using fake identities or even hide-and-seek behaviour motivated only by the need for entertainment.

?? CRIME: Misusing the D-Me's for ethically suspicious activities. There is no need to have any doubt that there are enough creative people who could know to make use of any "weakness" of the D-Me.

2.2.2 Business environment:

Of course, realizing this scenario would imply creating a plenty of new products and services, just like in the previous and in the following scenarios. On the other hand, there is only one product playing the main role in this scenario (D-Me), but that single product offers that many features that it will likely lead to very exciting market trembling.

To a certain extent, D-Me is similar to Maria's P-com: they both feature unseen performances, the purpose of both of them is to make our life easier, they even may be based on similar technological patterns (biometric authentication, e.g.). Additionally, it is very possible that the same terminal suppliers will compete to supply both Dimitrios and Maria. The companies could furthermore run similar marketing campaigns and have similar marketing strategies for both products.

Not all D-Me's will have the same performances, nor should they look the same, nor would the marketers would like it, because the possible market segmentation offers tremendous to the cunning market participants.

Just like P-com, the D-Me can also be a product that fashion designers or trendsetters will deal with. D-Me could furthermore be worn at the places where people are especially willing to meet new people (cafes, supermarkets, concerts...).

As for the services, we cannot be sure how the market will be organized and who will have access to which services. It would come as no surprise if access to some services would be simply forbidden or restricted, allowing the access only to certain parties fulfilling certain conditions. The core service of the D-Me would be matching activity. We can therefore think of authorized companies, whose primarily objective would be finding ideal actors for a certain

role or ideal player for a soccer team or taking care of elderly. As ISTAG report states: “social cohesion objectives in support of citizenship, community development and inclusion (e.g. of older people with heart or mobility problems) might point towards some public service provision to counterbalance the users that D-Me’s might acquire if driven only by fun or hedonistic drivers.”

2.2.3 Technological issues:

The technological issues on AmI have of course been the subject of many detailed analyses. However, we are not going to get into very detailed discussion, because many expressions would be out of scope of this text. There are two important roles D-Me should play and these are:

?? It should be micro-sized device with an integrated data capture capacity and wireless ad hoc network communication. Data capture refers to speech and speaker recognition, as well as voice machine interaction. Achieving requirements for these revolutionary technological changes does not seem to be reached until 2010. Therefore are needed focused researches (and advances, of course) in the field of multi-user, -environment, -language or mood-recognition, as well as in biological, behavioural and emotional pattern recognition. This may be an ideal moment to mention on of the major issues of AmI: the devices and the objects around us are expected to learn from our behaviour, and exactly this uploading of information into knowledge would be a big technological challenge.

?? The D-Me is meant to be a network device to services such as virtual matching or decentralized data warehousing. The latter is needed in order to secure the optimal and synchronous updating, backup and downloading of data. Decisions where to store data (in the device, in the network or in a centralized database) are mainly societal, but they have effects on the complexity of data retrieval.

2.3 Scenario 3 Carmen: traffic, sustainability & commerce

It is a normal weekday morning. Carmen wakes and plans her travel for the day. She wants to leave for work in half an hour and asks AmI, by means of a voice command, to find a vehicle to share with somebody on her route to work. AmI starts searching the trip database and, after checking the willingness of the driver, finds someone that will pass by in 40 minutes. The in-vehicle biosensor has recognised that this driver is a non-

smoker one of Carmen requirements for trip sharing. From that moment on, Carmen and her driver are in permanent contact if wanted (e.g. to allow the driver to alert Carmen if he/she will be late). Both wear their personal area networks (PAN) allowing seamless and intuitive contacts.

While taking her breakfast coffee Carmen lists her shopping since she will have guests for dinner tonight. She would like also to cook a cake and the e-fridge flashes the recipe. It highlights the ingredients that are missing milk and eggs. She completes the shopping on the e-fridge screen and asks for it to be delivered to the closest distribution point in her neighbourhood. This can be a shop, the postal office or a franchised nodal point for the neighbourhood where Carmen lives. All goods are smart tagged, so that Carmen can check the progress of her virtual shopping expedition, from any enabled device at home, the office or from a kiosk in the street. She can be informed during the day on her shopping, agree with what has been found, ask for alternatives, and find out where they are and when they will be delivered.

Forty minutes later Carmen goes downstairs onto the street, as her driver arrives. When Carmen gets into the car, the VAN system (Vehicle Area Network) registers her and by doing that she sanctions the payment systems to start counting. A micro-payment system will automatically transfer the amount into the e-purse of the driver when she gets out of the car.

In the car, the dynamic route guidance system warns the driver of long traffic jams up ahead due to an accident. The system dynamically calculates alternatives together with trip times. One suggestion is to leave the car at a nearby 'park and ride' metro stop. Carmen and her driver park the car and continue the journey by metro. On leaving the car, Carmen's payment is deducted according to duration and distance.

Out of the metro station and whilst walking a few minutes to her job, Carmen is alerted by her PAN that a Chardonnay wine that she has previously identified as a preferred choice is on promotion. She adds it to her shopping order and also sets up her home-ward journey with her wearable. Carmen arrives at her job on time.

On the way home the shared car system senses a bike on a dedicated lane approaching an intersection on their route. The driver is alerted and the system anyway gives preference to bikes, so a potential accident is avoided. A persistent high-pressure belt above the city for the last ten days has given fine weather but rising atmospheric pollutants. It is rush hour and the traffic density has caused pollution levels to rise above a control threshold. The city-wide engine control systems automatically lower the maximum speeds (for all motorised vehicles) and when the car enters a specific urban ring toll will be deducted via the Automatic Debiting System (ADS).

Carmen arrives at the local distribution node (actually her neighbourhood corner shop) where she picks up her goods. The shop has already closed but the goods await Carmen in a smart delivery box. By getting them out, the system registers payment, and deletes the items from her shopping list. The list is complete. At home, her smart fridge screen will be blank.

Coming home, Aml welcomes Carmen and suggests to telework the next day: a big demonstration is announced downtown.

2.3.1 Socio-political issues:

Just like the previous scenarios, the Scenario 3 assumes that people have already changed their habits and behaviour: doing shopping or going to work have already been significantly changed. The infrastructure is upgraded supporting the improved efficiency in transport and environmental management (which is the result of growing concern on pollution and global

warming). Devices are unobtrusive and secure and living in the smart houses has also become routine. The Scenario 3 assumes a radical redesign of the city infrastructure with a special emphasis on transportation (both of people and goods). Unfortunately, this does not mean that AmI will solve all transport and environmental problems, but it aims at reaching a situation that can deserve the attribute “tolerable.”

The major societal issues here relate to the question whether we would go too far in attempt to reach these improvements, or put another way, whether we would be forced to pay a too high price in order to enjoy the presented features of the AmI. Carmen got used to teleshopping, telework, car sharing, accident prevention systems and even engine-speed control which directly affects (say limits) the freedom of movement. Are there any pressures we would be faced with if forced to accept all these changes? This would probably lead to a give and take position, because the benefits we would enjoy (better environmental situation, less stress due to improved transportation) are not to be underestimated either. Furthermore, the scenario actually provides a lot of choices for Carmen when she is dealing with her everyday tasks and routine. Receiving the advice (e.g. proposing telework because of the demonstration downtown on the next day) will undoubtedly make her feel more comfortable.

Although sensors and all other devices are probably going to be cheap, we must not neglect the fact that there will be a huge number of devices and the costs of coordinating this network. Coordinating would be necessary, although it is foreseen that devices will have self-repairing software. These costs may hit where it hurts: some new taxes may be imposed (counterparts of the so-called subway-tax in some big cities), and this is always considered a significant social cost.

So, AmI and the features presented here are not to be understood as a golden key solving all contemporary problems of a city system, but it could be a further stage on the way to the nearly ideal city system.

2.3.2 Business environment:

It is generally believed that this scenario is further than the previous in timescales, and that not due to technological obstacles, but rather due to behavioural problems and institutional

and infrastructural obstacles. A “smart city” would demand a great deal of new smart devices and systems which would also lead to huge investments.

On the other hand, all these changes would lead to large-scale investments in traffic and transport technologies, which would include in-vehicle systems, like fitting cars with satellite positioning, remote engine management, vehicle tagging).

The new (or improved products) would be beacons, sensors, actuators, variable message signs, as well as computers to store databases. This would have very strong consequences for the manufacturers of smart materials. However, it is very difficult to estimate how much room there will be for the market participants, whether these products will be offered by many or only by some giant concerns.

Concerning the services in such an environment, there will be much room for the companies providing software necessary to make these complex systems function. What we mean here are distributed dynamic databases, self-organizing systems, self-repairing software. Dynamic data management services might emerge which would improve safety records and enable reaching environmental targets and control traffic volumes.

Scenario also predicts the further development of e-commerce. E-commerce might be a driver of different organizational patterns between the supplier and the retailer. The supply of products would be strictly on-demand.

2.3.3 Technological issues:

This is a scenario where both the traffic system and goods delivery system will build an intelligent network, since “every vehicle is a node, every good is tagged”.⁴ In order to implement this scenario, a whole traffic infrastructure must be renewed and the whole network of multifunctional sensors (traffic beacons, biosensors, biometrics, engine control sensors) must be installed. These sensors have some on-board process capabilities in order to support dynamic networking functions.

⁴ ISTAG Final Report, page 41

As for fixed location wireless sensors (e.g. those monitoring pollution levels or traffic volumes), it is highly likely there will be a need for autonomous power supply (e.g. able to run from storage or sun energy). Concerning PAN, the technological challenge would consist in miniaturization, low power sources, wirelessness, providing security, developing biosensors.

Besides, this scenario predicts the connecting of communication networks. According to the authors, the scenario is based on three levels of communication networks. The first level is the already mentioned PAN, where different PANs are capable of communicating to each other, but also to the second level of communication network. The second level includes the integration of multiple communication networks able to communicate with each other (i.e. VAN) that can communicate to PAN, but also to the home and office network. According to the ISTAG report authors, the third level of communication network is WAN integration of the two other levels that constitute the ambient Environment.

2.4 Scenario 4: Annette and Solomon in the Ambient for Social Learning

It is the plenary meeting of an environmental studies group in a local 'Ambient for Social Learning'. The group ranges from 10 to 75 years old. They share a common desire to understand the environment and environmental management. It is led by a mentor whose role it is to guide and facilitate the group's operation, but who is not necessarily very knowledgeable about environmental management. The plenary takes place in a room looking much like a hotel foyer with comfortable furniture pleasantly arranged. The meeting is open from 7.00 to 23.00 hours. Most participants are there for 4-6 hours. A large group arrives around 9.30 a.m. Some are scheduled to work together in real time and space and thus were requested to be present together (the ambient accesses their agendas to do the scheduling).

A member is arriving: as she enters the room and finds herself a place to work, she hears a familiar voice asking "Hello Annette, I got the assignment you did last night from home: are you satisfied with the results?" Annette answers that she was happy with her strategy for managing forests provided that she had got the climatic model right: she was less sure of this. Annette is an active and advanced student so the ambient says it might be useful if Annette spends some time today trying to pin down the problem with the model using enhanced interactive simulation and projection facilities. It then asks if Annette would give a brief presentation to the group. The ambient goes briefly through its understanding of Annette's availability and preferences for the day's work. Finally, Annette agrees on her work programme for the day.

One particularly long conversation takes place with Solomon who has just moved to the area and joined the group. The ambient establishes Solomon's identity; asks Solomon for the name of an ambient that 'knows' Solomon; gets permission from Solomon to acquire information about Solomon's background and experience in Environmental Studies. The ambient then suggests Solomon to join the meeting and to introduce himself to the group.

In these private conversations the mental states of the group are synchronised with the ambient, individual and collective work plans are agreed and in most cases checked with the mentor through the ambient. In some cases the assistance of the mentor is re-

quested. A scheduled plenary meeting begins with those who are present. Solomon introduces himself. Annette gives a 3-D presentation of her assignment. A group member asks questions about one of Annette's decisions and alternative visualisations are projected. During the presentation the mentor is feeding observations and questions to the ambient, together with William, an expert who was asked to join the meeting. William, although several thousand miles away, joins to make a comment and answer some questions. The session ends with a discussion of how Annette's work contributes to that of the others and the proposal of schedules for the remainder of the day. The ambient suggests a schedule involving both shared and individual sessions.

During the day individuals and sub-groups locate in appropriate spaces in the ambient to pursue appropriate learning experiences at a pace that suits them. The ambient negotiates its degree of participation in these experiences with the aid of the mentor. During the day the mentor and ambient converse frequently, establishing where the mentor might most usefully spend his time, and in some cases altering the schedule. The ambient and the mentor will spend some time negotiating shared experiences with other ambients for example mounting a single musical concert with players from two or more distant sites. They will also deal with requests for references / profiles of individuals. Time spent in the ambient ends by negotiating a homework assignment with each individual, but only after they have been informed about what the ambient expects to happen for the rest of the day and making appointments for next day or next time.

2.4.1 Socio-political issues:

We are all the witnesses of the emerging of the so-called knowledge society, a society where the demands on knowledge, skills and creativity are permanently rising. Therefore, the classical school education is no longer sufficient or at least no longer that appreciated by the society as it used to be. The modern trends include life-long learning or learning by doing. Learning now builds not only on formal school environment, but also on television or Internet. Therefore, even mobile phones can serve as knowledge sources. By its very nature, learning is a social process and, additionally, one of essential social processes. This scenario describes ASL- the Ambient for Social Learning. ASL is an environment which upgrades the level of learning and that by making learning more challenging and more interactive. Besides, students are important source of knowledge and they provide an important input for the learning situations of other. ASL is a physical space together with its ambient facilities and includes many linkages with similar places. Its design and purpose are very flexible, thus enabling the learning to many kinds of groups.

One of the main achievements of the ASL could be exceeding and removing learning and interacting obstacles set by numerous language and cultural backgrounds. We should also carry in mind that education level has become a discriminatory societal factor and it is highly unlikely that this is going to change in observable future. The access to the education should thus be easier, which might anyway turn out to be necessary, since there will be a growing

demand for new skills. It will therefore be necessary to develop mechanisms that will give chance to those willing to learn.

2.4.2 *Business environment:*

We immediately notice that realizing this scenario would imply creating a plenty of new products, whose performances would outperform everything we have seen in the three previous scenarios.

Firstly, the 3D visualization technology including real-time rendering of video and projection of holographs. Another striking thing about this scenario is manipulation of sound fields so that people can lead individual conversations in shared places. This would enable a lot of space for market participants due to very probable segmentation. Sound manipulating could be used everywhere: at business meetings, hospitals, orchestras, fashion shows, airports, discotheques.

Scenarios could possibly even more important for emerging new services. The ASL itself could be a service ran by private enterprises, foundations or by the government. This may be a big motive for creating efficient and profitable partnerships. The major service developments here use breakthroughs in knowledge management and co-operative work techniques, especially for private/public institutions. According to ISTAG, new services will be multimedia developers creating user-friendly toolboxes for self-production of content and multi-skilled project-oriented teams that are available to work with grassroots groups, firms or traditional educational providers. At the same time, ASL scenario offers opportunities for multi-channel (web-TV, mobile) services and for online storage, re-processing and retrieval of content on demand. All this calls for developing new skills, new services, new business models and new work processes. Since this scenario is quite far in timescales, it is difficult to predict how all this would exactly look like. Financing such AmI-based services might be considered to be of public interest. However, so far not much has been done to set thing in motion. The biggest progress has been made under the label knowledge management, whose task would be to develop community memory.

2.4.3 Technological issues:

The most dominant elements of Ambient Intelligence in the Scenario 4 are:

- ?? Technologies permitting the users greater empowerment over their own tasks and process in a learning environment. The system would provide a quick feedback on many issues, which is the result of ability to record and review experiences of past and present participants.
- ?? Using technologies capable of supporting social or learning processes. In order to reach this, a network for communication and a collective corporate memory must be provided.

The most important thing about the Scenario 4 is developing (creating) a connected set of physical spaces in which groups of students engage in different tasks which would involve individual and group experiences relevant to the curriculum and tailored to the needs of the group. Apart from necessary technology that are not specified to this scenario (networking, miniaturization, nanotechnologies, advances in software engineering), there are some requirements that refer directly to this scenario (according to ISTAG):

- ?? Recognition- tracing and identification of individual groups and objects
- ?? Interactive commitment aids for negotiating targets and challenges (goal synchronization)
- ?? Natural language and speech interfaces
- ?? Projection facilities for light and sound fields (visualization, virtual reality and holographic representation), including perception based technologies such as psychoacoustics
- ?? Reflexive learning systems (adaptable, customisable) to build aids for reviewing experiences
- ?? Knowledge management tools to build community memory

However, the main challenge is not the separate technologies, but in building useful combinations of the different technologies and developing these into a learning generator.

3. Comparison of the Scenarios

As already pointed out, the scenarios seem to be very appropriate for obtaining a basic idea about the Ambient Intelligence, and I firmly believe they present a great endorsement to the theoretical part of the paper. However, the four scenarios are only the parts of the mosaic, since each of them addresses only to some life aspects. On the other hand, the title of the report contains the word “society”, which means we are interested in what impact the AmI would have on the society as a whole. And the aim of this section is to provide such an insight by trying to put together the small pieces (scenarios) into the mosaic (society). We shall see what makes these scenarios different, but also what they have in common. Besides, I will try to avoid repeating of what has already been said on the previous pages, i.e. when the critical factors for each scenarios were analysed, although it will sometimes be inevitable.

The scenarios differ by two dimensions (this is also shown graphically in the figure 1):

- ?? Two scenarios refer to raising economic and personal efficiency, whereas the two other are driven by rather social and humanistic goals
- ?? Two scenarios show how AmI can make life easier for an individual, whereas the two other show how the whole community can benefit from AmI.

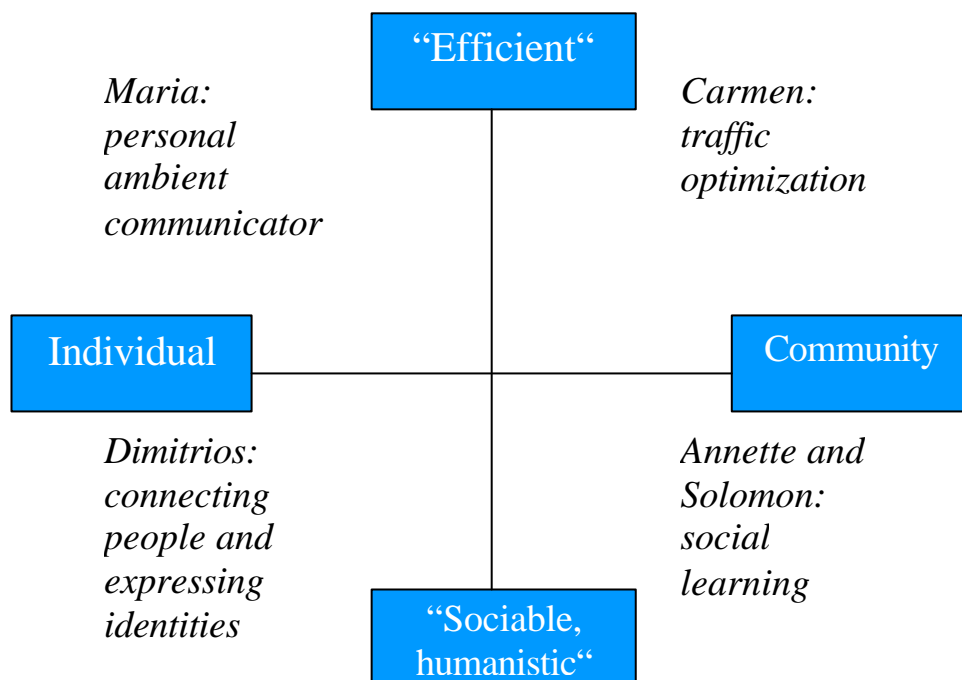


Figure 1: Structuring differentials between the scenarios (Source: Ducatel, K. et al.: ISTAG, Scenarios for Ambient Intelligence, Final Report)

However, it is hard to believe that the world is going to look exactly like predicted in the scenarios. Some plans may be abandoned, some new may be introduced, some may be modified. Anyway, it is not hard to notice that the scenarios also differ by how far away in timescales they seem to be at the moment.

Maria scenario seems to be the closest in terms of time. Firstly, no large changes in behaviour are foreseen, which means that both technological and socio-economic changes are relatively incremental build outs of existing approaches. The lead markets for AmI are business sector demands, which tend to be more efficiency oriented and less price-sensitive, which also contributes to proclaiming this scenarios “realistic”.

Dimitrios scenario is not to be seen as too far either. Technological factors may here play somewhat more important role than in the scenario 1. Furthermore, price could also be an obstacle to make a breakthrough to a mass market. As for the societal dimension, the changes relate to the willingness to reveal personality online. This is not to be underestimated, but his problem will fade out as soon as people get convinced that AmI is not to endanger their privacy. The emphasis is on play and social interaction rather than efficiency.

Carmen is not an unrealistic scenario either, but it lies further away than the first two. As for the social acceptance, it is assumed there would not be any particular “resistance”. Especially sensitive may be the introduction of the traffic management systems. The technological issues would include developing inter-operating sensor systems and dynamic database management. However, the biggest obstacle might be the necessity of huge investments in urban infrastructure and, even more, its financing.

Annette and Solomon scenario seems to be the furthest away in terms of time, and that both due to technological and socio-political factors. It assumes significant technological achievements such as high “emotional bandwidth” for shared presence and visualization technologies, as well as significant progress in computer supported pedagogic techniques. As for the societal challenges, they compose primarily fostering community life through shared interests.

The analysis that followed each scenario concentrated above all on features specific for that scenario, without comparing them. We then presented what makes these scenarios different. It goes without saying that in order to get a good insight, we also need to analyse what these scenarios have in common, or more precisely, what conditions must be met in order to realize any of these scenarios. This analysis will to a certain extent resemble the analysis of the single scenarios: we discuss the most important societal, business and technological common issues.

3.1 Social issues

In order to be accepted, AmI must be driven by primarily humanistic, and not technological goals. It is assumed that everyday life skills will rise because of rising opportunities and means of personal expression and interaction. At work too there are likely to be rising skill demands. Some will be higher requirements for the technological expertise, but if the AmI manifesto is to be achieved the main skills rise will be in social know-how and information manipulation. Therefore, there are still many vague issues, some of which may not become clear until AmI becomes reality. Can AmI reduce (mental) health risks from information stress, virtual identities and information overloads. There is also already discussed issue: privacy. Technological developments are outpacing regulatory adjustments. To what extent can people be protected in AmI landscape? Furthermore, AmI should be controllable by the ordinary people, otherwise there will be a lack of social acceptance. So, there is a need for developing technologies which will enable people to decide what level of access they have and when. Besides, the privacy is not only issue that may endanger the acceptance of Ambient Intelligence. We must not neglect that there are people who simply do not like this vision as it is presented in this book, regardless of privacy. This will also be a great challenge for the supporters of Ambient Intelligence. Encouraging sound the word of Mark Weiser: “Ubiquitous computing is roughly the opposite of virtual reality. Where virtual reality puts people inside a computer-generated world, ubiquitous computing forces the computer to live out here in the world with people.”⁵

3.2 Business issues

An interested reader may pose the following questions: Who will make AmI work? Who will produce it? Who will make money? How will AmI change the way people work, think and learn? These are all undoubtedly hard questions. On the other hand, some developments can

⁵ Taken from Ronan Sleep’s article “Ambient Intelligence: a UK perspective”

be predicted even now. According to the ISTAG report, the new emerging business landscape will have the following features:

- ?? Initial premium value niche markets where interfaces are needed to support human performance in fast moving and highly delicate situations.
- ?? High access-low entry cost based on a loss leadership model in order to create economies of scale.
- ?? Self-provision models based upon the network of very large user communities providing information at near zero cost. As for the way the companies act in the market, the most spread form will be partnerships and that due to two reasons. Firstly, very large sums of investment are involved. Secondly, the technological developments require cross-disciplinary and cross-sectoral capabilities.

3.3 Technological issues

A set of common technological requirements would look like this:

- ?? Hardware must be “very unobtrusive”. The reasons for this are pretty obvious, since AmI must be nearly invisible. It is thus necessary to make detailed researches in micro and optical electronics. Molecular and atomic manipulation techniques will be needed to produce smart materials and nanotechnologies. Besides, technologies needed to develop “mechanisms” for self-generating power usage in objects are also necessary.
- ?? A seamless mobile/fixed web-based communications infrastructure needs to be developed, for ubiquitous communication demands omnipresent communication. But, it is clear that the networks will be very heterogenous and complex. Therefore, it will be necessary to completely integrate mobile and fixed and radio and wired networks. Probably all the networks will be operating with some equivalent of the IP technology.
- ?? In the AmI world there will be uncountable interoperating devices. What is necessary here is that networks be configurable on the ad hoc basis due to a specific task with variable actors and components. As for databases, they should be accessible on demand from anywhere in the system.
- ?? The greatest challenge would consist in creating systems that are intuitive in use. Here we point to the important role of artificial intelligence. There is also need for developing interfaces able to recognize speech and gesture as well as those that are context sensitive and capable of information filtering and presentation.

?? There will be a great demand to provide security in such an environment. We have already discussed how sensitive this matter is in terms of social acceptance. But it is the task of technicians to provide the needed security, i.e. systems that are secure against deliberate misuse. The possible techniques are ID authentication, micro-payment systems or biometrics(fingerprints, iris scanning, speech).

4. Projects, researches, prototypes...

Although „only“ a vision, the Ambient Intelligence may prove to be not that far vision. Indeed, there are many teams worldwide whose objective is to study the necessary requirements for AmI (or some aspects of the AmI), or even to develop the first prototypes of AmI. These teams are active at the various institutes, universities, but it is also the business corporations that are more and more engaged in this field. Here will be presented some current projects, but also some of the first prototypes of the AmI.

4.1 Projects

4.1.1. OXYGEN

Oxygen is a project carried out at the famous American MIT with the support of research teams from the top companies, such as Philips, Nokia or Hewlett-Packard. And this is what the researchers want to see as the result of their efforts:

The handheld component of Oxygen, called Handy21, will be a device that can supply the correct data to whomever happens to be using it and will adjust its functions to suit the needs of the moment, acting as a phone, a remote control, or a camera. Instead of desktops, we'll have an environmental computer, called Enviro21, that disappears into the walls of our rooms and can see us, hear us, and respond to our commands. Network21, an intelligent network, will tie it all together.

Besides, the Oxygen must be:

- ?? *Pervasive*: it must be everywhere, with every portal reaching into the same information base;
- ?? *Embedded*: it must live in our world, sensing and affecting it;

- ?? *Nomadic*: its users and computations must be free to move around according to their needs;
- ?? *Eternal*: it must never shut down or reboot; components may come and go in response to demand, errors, and upgrades, but Oxygen as a whole must be non-stop and forever

At the partnership's kickoff meeting on MIT's Cambridge (Mass.) campus in June 2000, participants showed that they understand the limitations of the technologies they must use. For example, computers are a long way from being able to understand random human speech. Unless a computer knows you're talking about travel plans, it is unlikely to make sense of a statement such as: "I need a flight to Lisbon next Tuesday."

The most critical element of Oxygen is speech. Speech recognition on the Handy is a matter of good software and lots of computing power. But enabling people to communicate with the Enviro poses basic questions for acoustic engineering. Human beings can easily understand conversations in a room, even if other people are talking and the television is on. Computers lack our brains' ability to extract the sounds we want to hear from a noisy background. And current voice-recognition software is far from that.

The privacy and security issues were also broadly discussed among the participants of the Oxygen project. Yet, there are still many more questions than answers about how the individuals will be protected. One trial solution is the Guardian Angel, a system which allows health-care professionals, but only them, to monitor the patients in their homes. However, a more general solution is needed, and Rodney Brooks, director of MIT's AI Lab recognized at the start of the project that we did not have it yet.

4.1.2. OZONE

AIR&D consortium stands for the Ambient Intelligence Research and Development Consortium. The members of the consortium are Philips Research, Thomson Multimedia and the French INRIA, which again stands for the Institut national de recherche en informatique et en automatique. This French institute has been very engaged in AmI researches, since it also carries out researches in areas of networks, software engineering and optimisation of complex systems.

The first consortium's project is OZONE, which started in November 2001. What is this project about? This project aims at making the user interaction with devices and applications more user-friendly enabling new and better services. There are three basic orientations in this project. These are the following (also shown graphically on the next page):

- ?? Developing technologies for speech recognition while preserving user privacy. As we have seen, the user privacy is the crucial element for the acceptance of the AmI by the ordinary people.
- ?? Developing the software environment needed for these services.
- ?? Developing the needed hardware architecture. The solution considered is that of multiprocessors. The key challenge here is miniaturization and autonomy.

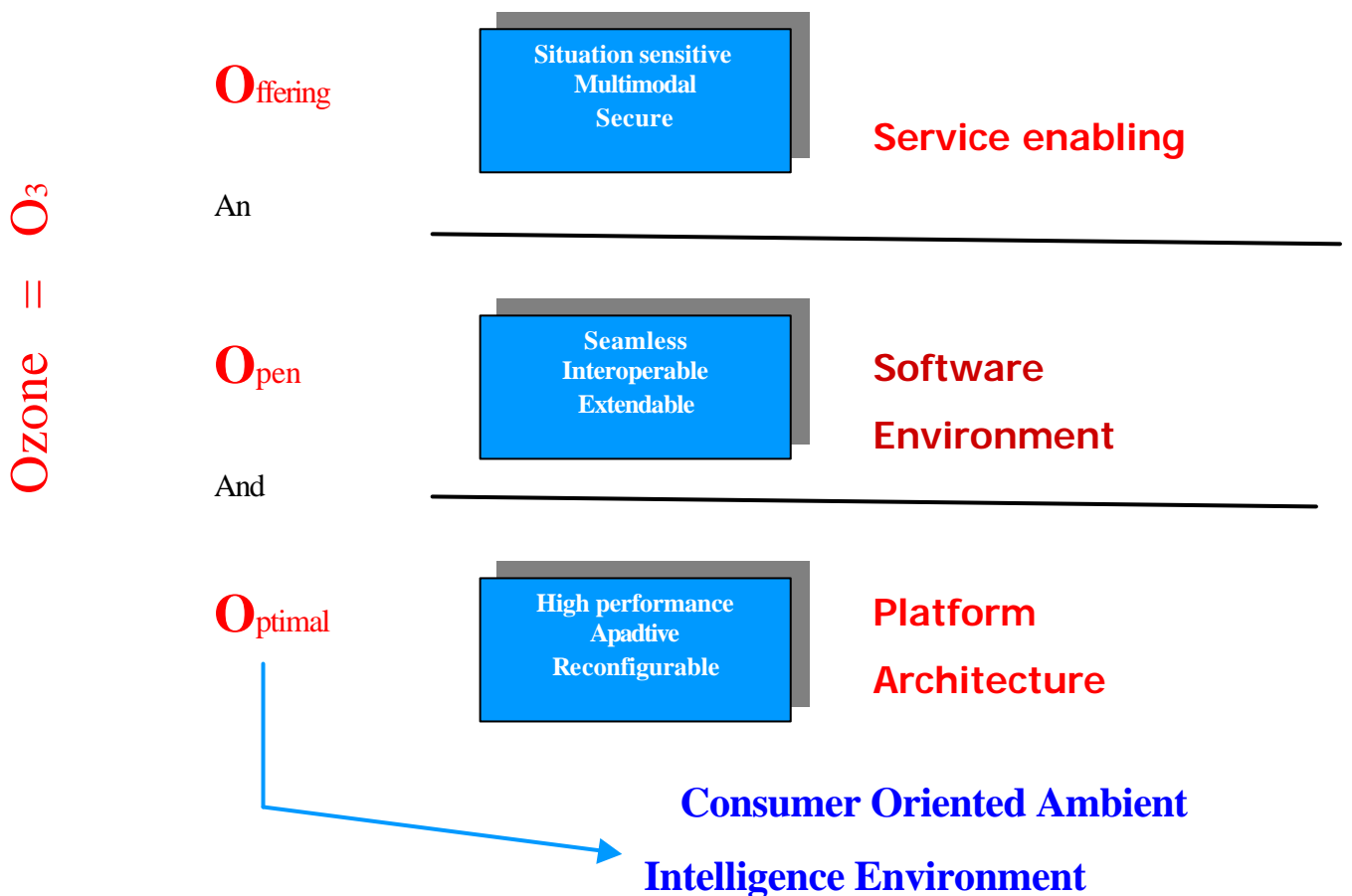


Figure 2: the objectives of Ozone (Source: <http://www.extra.philips.research.com/euprojects/ozone>)

4.2. “Intelligent house” Prototypes

4.2.1. EUNICA

EUNICA is a prototype of an intelligent household system, which was developed by a team of five undergraduate students from the Slovak University of Bratislava. EUNICA stands for Extensible Universal control of Appliances, and it is meant to deliver various home-related services to the user. Additionally, it is sensitive to the presence of people, whether house occupants or visitors of household. The appliances in the household are interconnected and this network is invisible. How far can the intelligence of EUNICA go? Well, the system is able to recognize each individual in the household and adopt behaviour to their needs. What is more, it is also able to recognize specific events, such as time or movement of the user. All this sounds great, especially if we carry in mind that the project was carried out by the undergraduate students, but how does this work?

The core of the system is the control unit. The appliances are connected to the control unit by various types of connections, such as Bluetooth connection, cable connection or power cord. Monitoring and controlling appliances is enabled through the use of the mobile JAVA based user interface devices connected to the control unit using the Bluetooth wireless communication technology. These devices are called eurecos, which apart from its symbolic meaning, also stands for EUNICA remote controls. How eureco looks like is shown in the figure 3. They connect user and the control unit by displaying information received from the control unit and sending user’s requests back to the control unit.



Figure 3: Eureco (Source: <http://www.dcs.elf.stuba.sk/csfdc>)

So, from the user's perspective, EUNICA represents a system which allows them to control household appliances by euecos. How can eueco recognize its current user? This works on the basis of biometrics, or more precisely, euecos are equipped with a fingerprint scanner. Another intelligent feature of the system is monitoring user's actions and, later, automatic adopting of their preferences (e.g. the preferred level of the light brightness is monitored, and then this level is automatically set, depending on who is in the room at that moment). Furthermore, EUNICA also provides access control. For instance, parents can restrict access to certain TV channels for children, or simply forbid „playing“ eith the household appliances to all children. Euecos can further be used to read e-mail or electronic newspapers. Security issue was considered very important while creating the EUNICA. So, the system intents to provide security in communication between the control unit and appliances, security in communication among the modules inside the control unit as well as preventing unconscious or conscious misuse of EUNICA and appliances (e.g. measured data on consumed energy are sent to energy providers without a possibility of user intervention, or more explicitly, misuse).

4.2.2. *inHaus*

„On the Internet, you can even take a look at the far side of the moon whenever you like, but you can't look to see whether you've left the hot plate switched on in the kitchen at home.“⁶ This may be a crucial reason why the intelligent house-oriented projects are that attractive for scientists. Besides, it is much easier to carry out experiments in a single house than experiments whose aim is to test the features presented in the Carmen scenario. Another large-scale experimental project is running in Germany. Innovation Center for the Intelligent House, or inHaus for short, is placed in Duisburg and was opened in April 2001. The project is supposed to last for five years. What makes inHaus stand out from similar projects is the fact that it is both a place for living and workshop for innovation. So, inHaus is actually not a single house, but a pair of connected buildings. On of the goals of the research is to find out how various appliances, components and infrastructures, which often operate on the basis of extremely different standards applicable in different professional fields can be made to work together in a single system and in a useful and efficient way.

⁶ Franz Miller: From the Fridge to the Bathtub, ERCIM News



Figure 4: All the installations in inHaus are hidden behind walls and tiles (Source: <http://www.inhaus-nrw.de>)

The system integration solutions are largely based in Internet technology, which can here be referred to as „embedded Internet“. With the help of these networks all appliances in any room can be controlled and this works either automatically or by manual keypads or telephone. A special feature is enabling the household occupants to connect with the appliances while they are at work as well as sending the messages to out of the house. Special attention has been given to new functions for saving energy: sensors in the room measure the temperature, humidity and air quality and automatically open a close windows. When the occupants leave the house, he heating switches itself down to economy level.

Beside inHaus, there are several similar projects taking place at the moment. One of them is the Living Room project which is conducted at the Institute of Electronics of the Tampere University of Technology in Finland where special emphasis is on developing user interface paradigmas and communication techniques for large collections of intelligent small objects. According to Franz Miller, beside these countries, experimental houses are in operation in the USA, Japan, Holland and Switzerland.

4.3. Other Prototypes

After we have read the scenarios and understood the subsequent discussion, we know that intelligent houses are not the only dimension of AmI. On the contrary, the other dimensions will probably be more challenging, whether due to their higher technological requirements or due to their cumbersome infrastructure which is needed for realizing the experiments. All this does not mean that other dimensions have not been touched at all. In the article „Designing for Ludic Aspects of Everyday Life“ it is said that “people do not just pursue tasks and solve problems, they also explore, wonder, love, worship and waste time.”⁷ These activities are captured by notion of Homo Ludens (thus „ludic aspects“). This article describes the project

⁷ Bill Gaver: Designing for Ludic Aspects of Everyday Life, ERCIM News

realized at the Royal College of Art, UK, by a multidisciplinary team whose task is to design new products that will fit into the vision of Ambient Intelligence. The team conceptualised about 20 products. The Data Lamp, for instance, allows images to be displayed in its facade or released to paint surfaces in a room. Dawn Chorus is an artificially intelligent bird feeder that also can train local birds one's favourite songs, while the Telegotchi is a virtual creature with no controls, allowing people to practice their psychic powers as they enter into a relationship with it.

It is more and more often that the scientists who make a single team are physically hundreds miles away from each other. That is why the Computer-Supported Cooperative Work Group of the German Fraunhofer Institute for Applied Information Technologies is developing ambient interfaces trying to overcome the distance and supporting distributed work groups with a shared environment of mutual information and orientation, thus providing a basis for the smooth coordination. Another project is called Wireless Wellness Monitor and is carried out at VTT Information Technology in Finland. This project's aim is to help persons successfully manage their weight. This self-monitoring system should enable easy weighting, taking place whenever it may be necessary, storage of results and the possibility of the personalized feedback, at any time and at any place. Scientists at Italian CNR are working on wireless sensor networks whose tasks would be monitoring of various environments, such as remote geographical regions, which is shown in the figure 5⁸, but also in industrial plants, office buildings. This would, of course, demand a lot of energy consumption and they thus concentrate on minimizing energy consumption. Illustration of the usefulness of the sensors: A sensor network is used to help rangers in a vast natural park. They provide information about animals, tourists, fire, flooding and so on. The rangers' mobile stations are embedded to the sensor network through the nearest sensor, which enables rangers to intervene if there are abnormal events going on.



Figure 5: Park monitoring scenario

⁸ Chessa, Stefano et al.: Fault Diagnosis in Wireless Sensor Networks, ERCIM News

5. Concluding remarks

It is not an easy task to describe, let alone discuss something that does not exist yet. However, it is a quite enough interesting and challenging topic and it actually makes pleasure discussing it, as well as discussing its possible consequences. As already said, the four scenarios presented here deliberately cover various aspects of life, but we do need to limit our attention only on these scenarios, because AmI is also meant to be a part of life aspects other than those here mentioned. For instance, we did not discuss, at least not at great length, how would AmI affect the everyday of elderly persons or of pre-school children. AmI would thus comprise even broader changes than here presented. Just like in the ISTAG report, we discussed three main issues regarding the AmI: business, technological and social. We could maybe have omitted one of these issues, but we did not, because all three seem to be appropriate for this report.

Since this report is written within the scope of the Business Intelligence seminar at the Faculty of Business, Economics and Computer Science, we just could not neglect the analysis of crucial business issues concerning single scenarios. We discussed what new products and new services may arise in AmI world, as well as how AmI might change the situation in the market and thus maybe cause the creation of completely new market structures. However, all possible answers in respect to the business issues must be taken with a great deal of caution. Whereas we can quite safely predict what will be the main technological and social challenges, we can talk about new products and services only in respect to those presented in scenarios, which are rather illustration and example of what the world might soon look like than pattern to which we must strive. Anyway, the concept of AmI is attractive, because it mends together computing, communications and consumer electronics, enabling new functionality that can stimulate further market growth.

The technological issues were discussed for the reasons quite opposite. When one thinks of the Ambient Intelligence, one always thinks of technological factors, regardless if he/she is engineer, businessman, doctor or journalist. So, we just did not want to be narrow-minded and limit our discussion only to those issues that are directly connected with the scope of the seminar. Besides, it is clear that developing new technologies is necessary prerequisite for creating Ambient Intelligence. The current projects and already developed prototypes show that Ambient Intelligence is not that far as it first looks like, at least concerning the

technology itself. But, even if many scientists are optimistic about the progress in this field (despite many unanswered questions), it is financing these projects that may present a big obstacle for further researches. On the other hand, we shall be wrong if we claim that every technological progress is always good and desired. Therefore, we here get into the sensitive area of social acceptance.

Social issues are here broadly discussed and that due to two reasons. Firstly, without social acceptance there will be no Ambient Intelligence. Secondly, the title of the report contains the word “society”, which somehow suggests to take social issues into account when discussing the scenarios. I dare to say that the social acceptance is crucial for the AmI, and thus even more important than technological issues. Security and privacy were often mentioned in this context, and we agreed that without providing them AmI will be sentenced to fail.

Nevertheless, it is not only about security and privacy. Some people do not simply like the idea of AmI itself, not only its possible consequences. But, speaking of AmI, we must carry in mind that this will not be a single product, but AmI comprises many features which base on same or similar technological principles. So, there will not be a rejection or acceptance of AmI as a whole, it will be AmI's single features that will succeed or fail to be accepted. So, the single features of the AmI will not share same destiny. For instance, it can be expected that every AmI achievement in the field of medicine will be accepted by everyone. On the other hand, products like D-Me (Scenario 2) would certainly come across a great deal of resistance, at least in the first stage. Moreover, people will wonder how AmI can support their values, individually, socially and culturally. Since set of values is different in Europe to that, for instance, in Japan, we can assume that AmI will differ to a certain extent in these two regions. The last, but not the least: it would be fallacy to expect a “big bang” which will suddenly introduce AmI, but it will gradually blend into our lives.

Michael Dertouzos, director of the MIT Laboratory cheered the AmI saying: “There’s been 40 years of people serving machines, and now it’s time to make the machines humancentric, so they’ll serve people.” If this comes true one day, it will mean Ambient Intelligence has succeeded. Objectives are set, motivation among the scientists is high, obstacles are perceived, but there is still a lot of hard work ahead. On the other hand, world has always been changing and there is no reason for it to stop changing and make progress. Although still a vision, Ambient Intelligence has good preconditions to turn into something more real.

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