Paper

The concept of ambient intelligence and decision support for telecommunications

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Abstract — The paper presents first the concept of AmI (ambient intelligence) and AmI scenarios of ISTAG (Information Society Technology Advisory Group of European Commission). The requirements of intelligence versus decision support are then discussed. Resulting challenges for decision support systems (DSS) in telecommunications are then outlined and conclusions presented.

Keywords — ISTAG, ambient intelligence, decision support for telecommunications.

1. The concept of ambient intelligence

European Commission has committees and advisory groups related to the Framework Programme. Committees are composed of the delegates of member or participating countries, advisory groups consists of experts selected and nominated by the Commission. Information Society Technology Advisory Group (ISTAG) works since 1999 on the vision of IST development in the 5th and 6th Framework Programme. This vision is summarised by the concept of AmI.
Shortly, *ambient intelligence is a future information society environment with intelligence embedded anywhere but in an unobtrusive fashion*, with the emphasis on:

- greater user-friendliness;
- more efficient services support;
- user empowerment;
- support for human interactions.

In AmI environment, people are surrounded by intelligent intuitive interfaces embedded in all kind of objects; this environment is capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way.

This concept can be illustrated by a "simple" example from housing telematics:

- imagine an ordinary room;
- a person coming and asking the room "Connect me to Maria";
- a wall changing into a huge screen;
- a hidden personal communication interface, capable of:
  - recognising the coming person and guessing who is "Maria";
  - making local broadband connection to the backbone network and searching for "Maria", who might be travelling;
  - displaying video communication with diverse options.

In other words, AmI is a vision of next big generation of communication culture that relates to internet such as internet relates to classical voice telephony.

2. Ambient intelligence scenarios of ISTAG

In order to determine critical aspects of AmI, ISTAG realised that socio-economic demand is decisive for broad acceptance of new technologies. Thus, the relevant question is: what aspects of AmI would people soonest buy? In order to answer this question, ISTAG asked the Institute for Prospective Technology Studies (IPTS) in Seville to develop "scenarios for ambient intelligence 2010". This date might seem optimistic for the implementation of actually a new paradigm of human communication, but IPTS developed [1] scenarios, 5 critical requirements, roadmaps, main research implications and opportunities, etc.; allthis was discussed and after corrections accepted by ISTAG. We shall shortly characterise these scenarios, together with comments on their possible realisation time. After all, IPTS did not realise that digital television was conceived 40 years ago and still is not broadly implemented.

Scenario "Maria" – road warrior. Maria is a travelling businesswomen, with only one personal communication device that helps her to organise everything – communicate broadly in business and with family, find data and files for business presentations, organise travel, find rental cars, organise business schedules, etc. The necessary technological requirements for this scenario include: a seamless and intelligent mobile-fixed broadband network, a novel personal communication device, etc. This might be realised in one or two decades, and the possible market demand would be immediately large after sufficient technological development.

Scenario "Dymitrios" – digital Me (DMe). Dymitrios is a personal communication device with sufficient intelligence to be a personal secretary simulating the actual person in diverse contacts of secondary importance, while recognising situations of prime importance and arranging actual contacts, including multilateral conferences etc. The necessary technological requirements include much higher demands on computer intelligence than in scenario "Maria" which implies that the scenario might possibly require longer, two to three decades, to be realised. Possible demand would also be not necessarily immediately large: there are social reservations to computers trying to outsmart people, known well to specialists in applications of decision support.

Scenario "Carmen" – traffic, sustainability, commerce. This scenario concerns ambient intelligence environment for travel and commerce. It assumes full automation of traffic, vehicle area networks, micro-payment systems for collecting fares, full integration with metro and other transportation networks as well as with goods distribution networks. Technological demands for this scenario are rather high: it demands full traffic and logistics automation. Thus, the time required to realise this scenario might be longest, possibly three or four decades. Possible demand would be immediately large, but after sufficient technological development.

Scenario "Annette and Solomon" – an ambient for social learning. This scenario concerns an ambient - an agent working as an automated mentor, together with local network environment combined with global resources for social learning, group dynamics, etc. The ambient combines distant education features with psychological educational aspects. Technological demands are not much higher than in the scenario "Dimitrios", hence the time for implementation might be two to three decades. Possible demand might be large, but there are various psychological and educational reservations, similarly as in scenario "Dimitrios".

Very interesting are critical factors for the implementation of the above scenarios, specified in the IPTS-ISTAG report. These factors are socio-political, business-economic, technological, etc. The main technological factors are listed as:

- very unobtrusive hardware;
- seamless mobile-fixed communication infrastructure;
- dynamic and massively distributed device networks;
- natural feeling human interfaces;
- dependability and security.

What is not listed in the critical technological factors, although obviously such a factor but overlooked by IPTS is:

- very fast development of computer intelligence and decision support methods, combined with telecommunication applications.

3. Computer intelligence versus decision support

Classical computer intelligence research is based on a natural objective that computer *should become* more intelligent than people. In opposition, applied decision support is based on the premise that computers *should serve people* (decision makers), in particular – *do not outsmart them*, because they otherwise *do not use* computer support.

The vision of AmI tries to overcome this dilemma by insisting that *computers and networks should become much more intelligent, but should nevertheless serve people.* It is decisive for future development and implementation of AmI whether we will be able to actually overcome this dilemma.

In research, the goal of making computers as intelligent as possible is fully legitimate. *In applications*, trying to outsmart computer users leads always to trouble.

For example, *impersonating* the actual person in the scenario "Dimitrios" might lead to serious trouble (since we might not know what our DMe has said on our behalf). In the scenario "Annette and Solomon", the ambient *pretending* to be the mentor might lead to psychological difficulties. It is well known in decision support history that when using optimisation techniques, researchers insisting that their user (e.g. designer) should be able to define a scalar objective function or utility function (that would actually *impersonate* the user) could not apply their techniques in practice. We can show many such examples.

Thus, the main challenge before us – specialists in computer intelligence and decision support – is to make computers *more intelligent but much more user-friendly than intelligent*.

4. Challenges for decision support in telecommunications

However, there is no doubt that the concept of AmI defines many new specific challenges for decision support and computer intelligence in telecommunications. It is not possible to list all such challenges, we shall show only some examples here. To these challenges belong:

Massive and diversified data processing. This includes data integration, warehouses, data models, data mining and knowledge extraction, all also in distributed network applications.

From data to sophisticated substantive models. Classical knowledge extraction discerning logical patterns from data relies only on a narrow definition of knowledge. In applied decision support, an important concept is that of *substantive models* – any type of models, be it in logical or analytical form, describing knowledge pertinent for given application. Substantive models are essential in engineering design, in business forecasting, etc. The development of such models is related to such subjects as the art and science of model

building, the standards for computerised models, special platforms and languages for model building, etc.

Challenges corresponding to ISTAG scenarios. We can list many computer intelligence and decision support challenges related to IPTS-ISTAG scenarios. For example, when starting with Maria, we need the detection not only of geographical location but also of close information and transportation service centres. The list of such challenges is enormous; recently, ISTAG Working Group 9 tried to define and list most of challenges related to software technologies resulting from AmI vision [2].

Specific telecommunication issues. There are also many specific issues in telecommunications that relate to computer intelligence and decision support and will have a direct relation to AmI vision. We list below only some of them:

- intelligent mobile services in 3rd generation (UMTS); DSS promoting such services;
- DSS promoting the use and management of digital interactive television networks;
- DSS in quality control of telecommunication services;
- DSS in electromagnetic spectrum management;
- DSS in regulation of interconnection issues;
- DSS in network management;
- DSS in enhancing dependability and security of telecommunication services; etc.

5. Conclusions

We shall list shortly here main conclusions:

- IPTS-ISTAG AmI scenarios might be futuristic, but they help to reflect on future developments;
- we should make computers and networks much more intelligent, but even more user-friendly and serving people than intelligent;
- we should promote the transition from data-based DSS to more sophisticated substantive models in DSS and model-based DSS;
- there are many specific challenges for decision support and computer intelligence in telecommunications;
- future civilisation will depend on the way how we shall respond to these challenges.

References

[1] *Scenarios for Ambient Intelligence 2010*, http://www.cordis.lu/ist/istag.htm

[2] *Software Technologies, Embedded Systems and Distributed Systems. An European Strategy Towards an Ambient Intelligent Environment*. WG9 Report v2.2.

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