Vodaphone Mobile Health Team

<u>Identifying relevant future technological developments</u>

1.What relevant technology trends are likely to impact on health and healthcare in the next ten to fifteen years?

In the health and healthcare environment it is possible to identify three working areas:

- Fitness and Lifestyle
- Preventive Healthcare
- Professional Diagnostics and Therapy

It is foreseen that all of the above have potential such that specific technologies and applications could be developed.

From the hardware point of view, it is necessary to take into account both the "User Plane" (sensors, user interfaces..) and "Network plane" (backhaul and core improvements). From the software point of view the need for new applications may also present themselves (aided by according the health recommendations bodies).

Recalling the "Ambience Intelligence" concept:

"The concept of Ambient Intelligence (AmI) provides a vision of the Information Society where the emphasis is on greater user-friendliness, more efficient services support, user-empowerment, and support for human interactions. People are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way."

The above concept - referring to electronic environments that are sensitive and responsive to the needs and presence of people - clearly aligns with health and healthcare requirements and the personalisation of service provision. This concept aims to improve the quality of life by creating the desired atmosphere and functionality via intelligent, personalised interconnected systems and services. It is foreseen that a wide range of new emerging technologies will open the possibility of providing health and healthcare services.

Such *Ambient Intelligence* environments are characterized by their ubiquity, transparency and intelligence:

- Ubiquity, because the user is surrounded by a multitude of interconnected embedded systems.
- Transparency, because the equipment is invisible and integrated into the background of the user's surroundings.
- Intelligence, because the system is able to recognize the people that live in it, adapt itself to them, learn from their behaviour, and even show emotion.

To fulfil future requirements utilising the *Ambience Intelligence* concept, the development of new enablers are required. In relation to this we can point out the following items:

1) User Plane

- Natural interaction: Visual recognition (e.g. face, 3D gesture, changes of position and location), sound recognition (e.g. voice, melody, translational research), tactile recognition …
- Miniaturization of sensors: mote sensors, "Smart dust", biosensors, nanotechnology… (For health applications it is very important to have an approach that assures the monitoring of vital signals in a non-invasive way to provide the maximum comfort to the user).
- E-textiles: smart clothes, wearable devices, processing power embedded in fabrics (ubiquitous computing), …

2) Network Plane

- Access Network:

  A. Mesh Networks technologies: Mesh concept relied to self-configuring network one are associated to the radio technologies field. Main benefits are their flexibility, robustness, simple rollout and higher path-loss saving, however it will be necessary to perform research in interference management, inter-cell coordination and also routing technologies applied to this context.
  B. Smart antennas.
  C. Wireless broadband technologies: B3G, WIMAX, WLAN evolution, RFID,…

- Core Network:

  A. IMS (IP Multimedia Subsystem): This technology can/will introduce the concept of applications in e.g. peer-to-peer interaction. Additionally, enablers e.g. "Presence" can improve the control of the user by health professionals or even, relatives.

3) Applications and Services:

- Solutions for macro scenarios (e.g. Fujisawa, `The city who cares´,..)
- Nano-bio-info-cogno applications.
- Translational applications.
- Ambient assisted living.
- Context and presence awareness solutions.
- Intelligence agents for decision support.
- Technical and semantic interoperability and intelligent tools: The interaction of multiple devices with possible different operating systems will require information exchange such that such information must be generic/ understandable for all devices/machines.

- Security platforms: Web services and Liberty. Reutilising the long established "client-server" approach, these technologies may enable interactions between users, health professionals and databases with medical information in a more secure and confidential way. Specifically the Liberty Alliance forum has developed a Web Services framework with the notion of "Identity" at it's core in such a way that privacy requirements of all actors are fully respected a very sensitive matter when dealing with medical records. The work from the Liberty Alliance project aims to allow secure exchange of information with the appropriate privacy safeguards.

4) Others:

- Battery improvement.

<u>Assessing the potential positive and negative impacts of relevant future technological developments</u>

2 What areas in the provision of health and healthcare could be positively or negatively affected by these developments?

With respect to the aforementioned Fitness, Prevention and Professional Care, Chronic disease management and rehabilitation are key areas. Today public health systems are much improved in the management of acute healthcare provision than e.g. chronic diseases management, where there much room for improvement. Early detection and effective prevention rather than aggressive intervention should be a future aim.

Positive Impacts: areas related to remote monitoring of patients, hospitalisation at home, informal carers, better management of patients thereby reducing the need for frequent one-to-one doctor-patient consultations.

Negative Impacts: Data protection remains imperative. Potentially more confidential information may be in the hands of 3rd parties and thus controls over the relevant databases should be in place.

3 What actions should be undertaken now to maximise positive impacts, or to prevent or minimise adverse effects?

- Involve health and healthcare professionals (physicians, GP, nurses, …) in the definition and design phases in addition to the testing of the solutions.
- Remembering that health and healthcare services are fundamentally people-orientated, technology should enhance human interaction not diminish or replace.
- Promote seminars and specific programs to inform stakeholders and create the culture of new emerging technologies for supporting life.
- Promote Research activities. This would require resources – primarily money - with the main source being the private sector. It is necessary to evaluate the implications of relevant future technological developments.
- Security developments: Ensure that Data Protection is fully applied or amended for additional preservation of user/patient personal data.

Evaluating the wider implications of relevant future technological developments

4 Do you have any concerns associated with the generation, release and subsequent use of personal data?

- Possibly the most important challenge to deal with. Technology can provide security but sometimes there are regulatory constraints and/or lapses that introduce delays - generating unfounded fears and concerns among the end users.
- The Patient shall be the single owner of his/her data. Utilising the specifications from the Liberty Alliance project could be the key to achieve this aim, at least from the technological point of view. However, at the moment there is no common consensus and there is not a common standard on how to generate, storage and process the medical data.

5 What medico-legal and ethical issues merit consideration when introducing new technologies, such as the responsibilities, processes and liabilities for decision making?

Firstly it is interesting to bear in mind the area being discussed.. Fitness for example, would probably be the least impacted area in this sense. On the other hand, the area of Professional Care brings significant responsibilities, processes and potential liabilities.

At the moment, roles on civil responsibilities and liabilities are not yet clear. It is quite complicated to find a global answer in these fields because both medico-legal and ethical issues are very dependant on the country (and sometimes at a regional level).

6 What regulations or other mechanisms (including standards) would facilitate the responsible development of relevant technologies?

Development of risk management, and comprehensive awareness of the legal and ethics in this area are essential.

In the wireless world, the 3GPP standardisation body could be involved although the experts of this forum do not focus on applications and software, rather the architecture and interface signalling of the interconnected entities in the mobile world. The OMA (Open Mobile Alliance) forum could be a good option to ensure a common criteria.

7 What infrastructure would be required to allow any new technologies to be used effectively?

Future introduction and implementation of IMS infrastructure by mobile network operators– is foreseen to be a new technology, which may reap benefits – particularly from an application point of view.

Regarding Network infrastructure, future mobile networks are likely to be based upon a distributed concept – however this is still under discussion.

In any case, additional/new infrastructure per se is unlikely to be required - it is more a question of technology at application level. However, Mobile Network Operators will

have to invest in infrastructure geared towards creating a Web Services framework within which data can be safely exchanged among partners.

8 What are the most likely promoters and barriers to the take up of new ICT devices and systems?

- Promoters: Apart from the ICT Industry, the main promoters ought to be the health authorities themselves. The experts within the respective Health Authorities are best able to collect the final users needs (patients, elderly people and their relatives). In a world where more and more people are becoming more self-aware regarding their own health and are likely to expect these kind of services in the near future. Other important stakeholders would see the unsurprising presence of representatives from the sectors of Insurance, Food, Drug and even Fitness.

- Barriers: Two immediate barriers come to mind:

    - Firstly storing of extremely confidential user/patient information,
    - Legal aspects: Medical regulations, national Health Systems constraints and legacy health systems that do not follow any standard and make very difficult the interaction with them.

9 What education and training would need to accompany the introduction of any technologies, and who would need to be involved?

Fundamentally, the main aim is to ensure that the end user does not require extensive technical skills to use any new technology i.e. “keep it simple”.

On the other hand, the professional users in the application of these new methods of health care might require some technical training. Nurses and outsourced coordination offices will be the main players in this field.

10 How are professional roles and responsibilities likely to be affected by the increasing use of ICT?

Those with such professional roles and responsibilities must be involved from the beginning of any introduction of a new technology in their respective field and their participation is vital to assure that any final solution address their requirements and will be useful in enhancing their day-to-day work.

11 How can the development of technologies that meet patients' and informal carers' needs and are practically useable be best facilitated?

Whilst usage of the term “informal carer” rises various questions, we have understood it to mean that this *informal carer* is not professional and thus not paid to care i.e. not an employee of the health authority/hospital/clinic. Therefore, the question of “Who pays?” for this technology development and subsequent utilisation is as crucial as the development of the technology itself.

Aside from funding such development, other facilitators could be:

- Effective Business case study(ies)

- Technology evaluation
- Integration of attention systems
- Remove barriers in sharing Knowledge (with security)

12 What are the potential impacts of the costs of any of these new technologies?

For widespread take-up new technologies, they will have to be relatively affordable. If not, the advantages brought about may not be employed. At all times patients rights must be respected.

However, affordable technology – like all sectors – often arrives due to large demand and the resultant economy of scale. This may not be the case for highly specialised technologies with a limited "market".

13 What are the implications of the international use of future technological developments, such as global use of health data, variability of ICT-enabled support, and interoperability?

Global use of future technologies may not be the case – as it is at present with many aspects of world health care.

Again, probably the main risk is security and the protection of patient information.

Are there any other important issues that have not been addressed by the questions above and that you think the working group should address?

REFERENCES:

- Philips, Ambient Intelligence in HomeLab
- European Commission, ftp://ftp.cordis.lu/pub/ist/docs/istagscenarios2010.pdf