The teleassistance platform: an innovative technological solution to face the ageing population problem

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***Abstract*—Due to the continual increase in the life expectancy both in developing and developed countries, the elderly population is growing dramatically. The special necessities of this group of population in terms of social care and healthcare are a major issue for the Public Institutions and the Private Service providers, which are unable to cope with the new situation without modifying the current care model. This article presents the Teleassistance Platform, proposed and developed by Telefónica I+D as a tool to create a new model to deliver high-quality health and social services to the elderly and people in dependant situations.**

I. Introduction

The average age of the population is increasing. While in 1950 elderly (people aged 60 or more) were only the 8% of the World population, the percentage has now reached the 10%, and this value is expected to be over a fifth of the total population [11]. This trend, usually referred as *population ageing* [1], is observable in developed and developing countries, although it has not yet been spread to the less developed countries,

Two main factors are the cause of population ageing:

- A decline in fertility, which means that the number of people that can act as caretakers is diminishing. This creates a situation in which the National Health Systems are no longer affordable: the working population is not big enough to support the current coverage and quality of service for an increasing group of people that do not pay national insurance.
- An increase in the life expectancy of the population. The elderly are prone to suffer from chronic conditions, both physical (e.g. cardiovascular diseases, diabetes…) and mental (e.g. senile dementia, Alzheimer…), presenting also comorbidities. Therefore, they represent a growing group of population with a set of special necessities that need to be taken into account and covered by the Public Institutions, so the impact of chronic conditions is minimised and we are not only prolonging the number of years to be lived, but also extending good quality of living for those years.

Developed and developing societies are facing not only the problem of the ageing of the population, but also undergoing a set of deep transformations in their structures: the "traditional" family model, in which three generations of the same family (grandparents, parents and children) live in the same house, is obsolete.

Futhermore, the incorporation of women in the labour market has caused them to stop performing the role of caretakers for their elder relatives. So, the elderly now live in their own homes or in residences, far from their relatives, or perhaps with no relatives at all. In this situation, the social interaction network of the elderly is also changing; there is a high risk of suffering from isolation and depression. Therefore, our societies need to provide the appropriate mechanisms to avoid these situations, making available to the elderly tools and services to reinforce their existing social relationships, and even creating new social networks, so that they have varied social interaction.

Public Institutions are aware of the challenge that this changing situation constitutes. In this sense, there are several initiatives that are being deployed, e.g. the WHO (World Health Organization) has adopted the term *active ageing* to describe this necessity of approaching the ageing process as a positive change. It is defined as *"...the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age"*[12]. The European Commission is also taking specific actions to promote research and development activities in this area, as the Ambient Assisted Living Joint Programme (AAL169), which is a funding activity aimed to promote Ambient Assisted Living (AAL) [3] as a tool to:

- Extend the time people can live in their preferred environment.
- Support maintaining health and functional capability of the elderly individuals
- Support carers, families and care organisations
- Increase the efficiency and productivity of used resource in the ageing societies

Together with this initiative, The European Commission has fixed particular action points into its sixth and seventh

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Framework Programmes (FPs) to focus resources on subjects such as "eInclusion" (FP6), "Ambient Assisted Living (AAL) for the Ageing Society" (FP6), or "Independent living and inclusion" (FP7). Some of these projects will be presented in Section IV, as examples of integration and testing of the Teleassistance Platform.

Finally, European Governments are also taking certain actions to cope with the Ageing Population problem, by promulgating particular laws to ensure the quality of living of elderly and people in any dependant situation, as it the Spanish Law of Dependency, which came into force in 2007.

This situation is a challenge, but also an extraordinary opportunity to technological developers and ICT-based service providers to design and develop new teleassistance products that will serve to:

- Make the health and social care model sustainable, by reducing costs to Public and Private Institutions in terms of material and human resources.
- Provide new services to make active ageing a reality, so the elderly are able to live in their preferred environment for a longer time, enjoying a healthy social life, and minimising the impact of chronic conditions.

The success of any teleassistance solution depends on its level of compliance with the real need of every actor involved in the telecare model (that is, users, medical doctors and, caregivers), as well as its reliability [8]. In order to extract a set of requirements and desirable characteristics for the Teleassistance Platform to satisfy the needs of all the parties involved, Telefónica I+D performed, following the DELPHI methodology [8], an exhaustive study, which has also served to estimate the evolution of the model in the short, medium and long term specifically in the case of Spain.

One of the conclusions extracted from this study is that **reassurance** is a very important feature of the system, that is, the more relevant services from the point of view of the users are those which offer information about the condition of the person. In this way, the more relevant services for each group of actors will be:

a) The elderly/teleassisted people: those services which offer the possibility of instant consultation and assessment by a qualified professional, physical monitoring and videoconference.
b) Carers (relatives or professional carers): Videoconference, telemonitoring of vital signs, coordination and access to other medical and social elements.
c) Service providers: videoconferencing service, vital signs case history, possibility of interaction with other service providers.

This article presents the Teleassistance Platform, an ICT (Information and Communication Technologies)-based tool to deliver high-quality health and social care to the elderly, as well as to any person in a dependant situation. The platform has been designed following the results of the aforementioned DELPHI study.

The paper is organised as follows: Section II describes New Generation Networks, the foundations on which the Teleassistance Platform is built. The architecture of the platform will be covered in detail in section III, while section IV will present a set of real scenarios in which the Teleassistance platform have been tested. Finally, the conclusions extracted from these use-cases will be exposed on section V.

II. Next Generation Networks: The technological basis for the teleassistance platform

ITU (International Telecommunication Union) defines a Next Generation Network (or New Generation Network) as "*a packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies*." [4]. A Next Generation Network (NGN) is able to offer unrestricted access by users to different service providers. It also supports mobility, allowing consistent and ubiquitous provision of services to users. Furthermore, it will allow a fast integration and delivery of new applications for the final user.

The reliability of these networks is also higher than the one provided by the traditional networks, e.g. for voice service it is 99,999%.

As this is an evolving technology, there is no closed-standard based model for NGN at the present time, and the terms is currently used to name the mechanisms used to offer voice services over IP-based networks (IP, Internet Protocol, is a packet-switching communication protocol [9])

The ETSI (European Telecommunication Standards Institute) has created an specific group of competence for fixed network and for the migration from the traditional switched circuit networks to packet switched networks, which will serve to create the NGN. This group, named TISPAN (Telecoms & Internet converged Services & Protocols for Advanced Network) is working on the set of standards that will serve Industry as a basis to the development of NGN systems. On its first release, which was approved on 2005 [10], the components of a NGN system where presented. These components are:

- Client networks and terminals
- Access networks
- Core network
- Connection to other networks and service providers

Fig. 1 contains a schema of the different interfaces defined for the NGN network, including not only the intra-NGN interfaces, but also the connection to other networks.

As mentioned, the core network of the NGN is built upon IP as transport technology and based upon the IMS (IP Multimedia Subsystem), an architectural framework defined by the 3GPP (3rd Generation Partnership Project). IMS was originally intended for Mobile Networks, but it has also been adopted as reference for the deployment of the NGN.

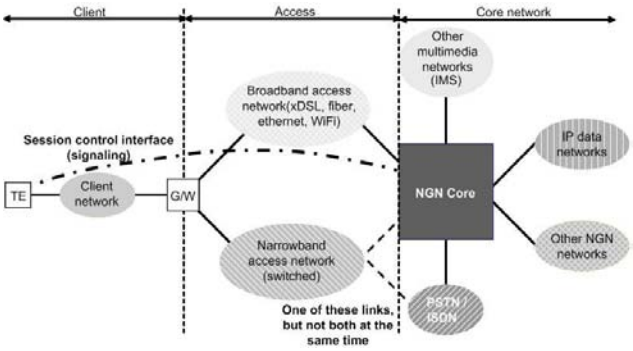

Fig. 1 Interfaces for the NGN. These interfaces have been defined in the TISPAN NGN Definition, Release 1 and include both the communications with the terminals of the users as well as with other networks.

Finally, as a summary of the properties of NGNs, some of their more relevant characteristics are:

- Packet-based transfers, opposed to the traditional circuit-based model
- NGNs support a wide range of services, applications and mechanisms (including features for real-time video transmission)
- Generalized mobility, that is, users can access to the network from many different points, and
- Convergence of services between Fixed Networks and Mobile Networks.

These characteristics make the NGN a natural choice for the design and deployment of the Teleassistance Platform.

III. Architecture of the Teleassistance Platform

The Teleassistance Platform serves as a backbone to deliver telecare services to the elderly and people in dependant situations. This backbone is used as a basis to deploy specialised services, covering aspects such as:

a) **Vital signs and health condition monitoring:** a set of biometric sensors (e.g. scales, blood pressure sensors…) can be located in the preferred environment of the elderly, and transmit, via the Teleassistance Platform, information about his/her health status to qualified professionals so they can evaluate their general health conditions. Besides, these sensors are able to raising alarms in case an emergency occurs (e.g. abnormal blood pressure measurement). Therefore, the elderly acquire a higher degree of independency, feeling more self-confident and able to live in their own home for longer.

b) **Social interaction:** in order to make active ageing a reality, having a good health condition is of paramount importance, but also having a dynamic social life is basic. The Teleassistance platform delivers services such as videoconferencing, so the elderly are able, even when they have mobility problems, to keep in touch with their friends and relatives, minimising the impact of a possible isolation and the risks derived from it.

c) **Ambient Intelligence:** The Teleassistance Platform also provides home automation services, so the elderly are able to be self-autonomous to perform their activities of daily living.

As it has been already mentioned, one of the main characteristics of a Teleassistance service from the technical point of view is reliability, being a good QoS also a requirement for this kind of services. Moreover, users can access to the services from many different fixed or mobile points. Therefore, Next Generation Networks will be the technological choice for supporting the core of the Teleassistance Platform, as they provide features to cope with all the aforementioned requirements.

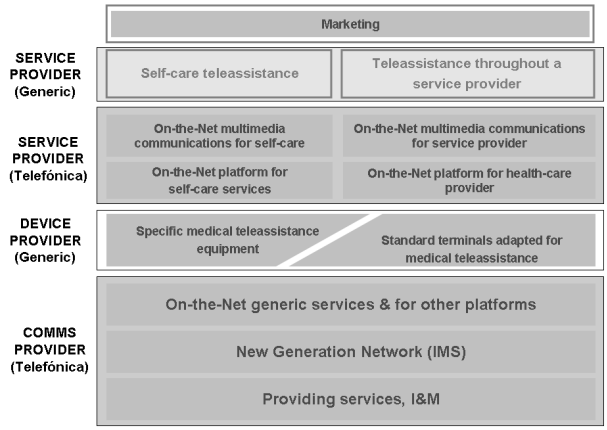

Fig. 2 Architecture of the Teleassistance Platform developed by Telefónica I+D. The figure reflects not only the different layers of the platform, but also the different industrial partners involved in each one of them.

The Teleassistance platform is organised following a layered model, as it can be seen in Fig. 2. Each one of these layers will be described here below, going from the lowest layers to the highest ones.

1) **Providing services, I&M**. This is the lower layer of the system, the physical medium that supports the Teleassistance platform.
2) **New Generation Network (IMS)**. As presented in section II, this is a packet-based network which uses developed using the IMS architecture.
3) **On-the-Net generic services & for other platforms.** This is the first service layer of the architecture. It provides a set of general services that will be common to other higher layer services, as well as providing interconnection capabilities with other networks, e.g., particular home automation networks.
4) **Specific medical equipment/Standard terminal adapted.** This layer includes two types of components: medical devices (and associated services) used into the Teleassistance Platform to monitor the health condition of the elderly and the standard telecommunications terminals, adapted to provide the specific services and features related to the Platform.
5) **On-the-Net platform for self-care/health-care provider services.** The services included in this layer provide telecare features in terms of health interaction. As it will be depicted later, there are two different models of delivering healthcare services: self-care and services given by a provider.
6) **On-the-Net multimedia communications for self-care/service providers.** Layer 5 contained all health-

related services, while this layer will contain all the services related to the social interaction capabilities provided by the Teleassistance solution.

7) **Self-care/through a service provider teleassistance layer.** This is the higher-level layer of the model. Includes the two different models that can be followed to provide teleassistance services.
8) **Marketing layer.** That is, the Teleassistance Platform as a product needs a Business Model and a commercialisation phase to reach the market. This is not a conventional product; therefore, a tailored business model has also been designed, in order to guarantee the commercial success of the Platform.

Besides the layer model, Fig. 2 provides also information regarding the different actors involved in the process of delivering teleassistance to their final users. Also, the two different service providing models are represented. The actors involved in the process will be presented next, while the two care models will constitute the end of this section.

There are four different actors implicated in the delivering of teleassistance services to the elderly, they are:

- **Communication Services Provider**, that is, a *carrier* to make feasible the connection among all the components of the system from a technological point of view.
- **Device provider**, a hardware manufacturer to provide all the required sensoring and interaction equipments to deliver healthcare and social care services.
- **Service Provider**, to include in the platform the teleassistance specific services, not to give *connectivity* support, but *functionality* support. Therefore, the service provider will use the infrastructure deployed by the Communication Services Provider to deliver its own services.
- **Generic service provider**, that is, a Public or Private institution, or an insurance company that will tender the services provided by the platform to the elderly (its final users).

To finish with the description of the architecture of the Platform, the two care-delivering models are presented:

- *Teleassistance through a service provider*, that is, Public (hospitals, care institutions…) or private (insurance companies, private foundations…) that will deliver the services to the elderly, e.g. as a part of their services portfolio to differentiate from the competition in the case of the insurance companies.
- *Self-care*: The Teleassistance platform provides a set of tools that can be used autonomously by the elderly. That is, making the active ageing objective a reality.

IV. Field of application: Real tests

The Teleassistance Platform has been defined as a backbone to deliver high-quality care services to the elderly, even though the Platform as it is, does not include any services. Therefore, the technological development of the Platform itself has to be combined with the development of the set of application and services that will be provided by means of the Teleassistance Platform. This set of services is being developed as part of the participation of Telefónica I+D in several research projects, both at European and National level in the ambit of eHealth, Social Inclusion and Ambient Intelligence. Furthermore, these projects will serve as an excellent trial environment to test the real performance of the Teleassistance Platform. The aim of this section is to give a brief description of some of these projects.

a) **TeleADM** [7]. Spanish country-level project aimed to enhance the self-autonomy of people in dependent situations by means of ICT. Its main objective is the development of new Ambient Intelligence services for Smart Home environments in order to provide:
   - Remote monitoring of the home automation devices
   - Remote monitoring of biometric parameters
   - Multimedia services (e.g. videoconference)
   - User control of the home automation devices.

   This project is carried out in cooperation with the Andalusia Foundation of Social Services (FASS), a social services provider at regional level in Spain. Therefore, the technological developments in this project are endorsed by the broad expertise of a Public Institution in delivering social care and support to the elderly.
b) **AmiVital** [6]. National project in cooperation with other Spanish companies, universities and institutions focused on development of a personal digital environment to promote the health and well-being of its final users. This project is founded by the CENIT Programme of the Spanish Ministry of Industry, Tourism and Trade. AmiVital is aimed to deploy technological tools to support the self-dependence and the personal well-being of, among others, the elderly and people suffering from chronic conditions. It also proposes a development framework for those tools, based on technologies and information and communication tools to model, design, implement and deployment of Ambient Intelligence devices.

   The objectives of this project are in keeping with the aforementioned concept of Ambient Assisted Living [3].
c) **SHARE-it** [5], which stands for "*Support Human Autonomy for Recovery and Enhancement of Cognitive and motor abilities using Information Technologies*", is an FP6 European Research project within the Ambient Assisted Living (AAL) in the Ageing Society objective. The focus of SHARE-it falls into the development of a smart system to allow the elderly and disabled people to remain in their preferred environment for a longer time. It is based on a set of home automation and biometric sensors to extract information about the status of the elderly person and his/her surrounding environment which will be sent to an Agent-based platform in order to perform certain actions in an autonomous way to help the elderly person in performing his/her daily activities or to detect emergency situations. This

project includes a set of trials in Home Environments in order to evaluate the real performance of the system.

d) **CAALYX** [2] (Complete Ambient Assisted Living Experiment) is also a FP6 European Project within the AAL in the Ageing Society objective. It is aimed to reinforce the self-confidence of the elderly, so they remain self-autonomous for a longer time, being able to live in their own homes more years. The result of the project will be a system to receive and perform real-time processing of signals coming from a set of sensors that will be worn by the elderly person of located within their usual environment. The sensors will provide biometric measurements to evaluate the health status of the elderly and fall detection, so an alarm can be raised when an emergency occurs. The data retrieved will be processed and used to provide information to medical doctors, relatives, caretakers and the elderly person him/herself about his/her health status. The system will also make available social interaction services, such as videoconference, and leisure activities, such as an integrated TV-system, in order to help the elderly to maintain good mental health.

This project also includes two trials with the elderly in a social care residence and in real home environments.

The services developed into these projects will populate the Teleassistance Platform to deliver complete telecare solutions to the elderly and people in dependent situations.

V. Conclusion

The average age of our societies is increasing, being the elderly a group which is growing rapidly within the population. Hence, the Health and Social care systems in our countries have to take specific actions to be able to cover the special necessities of the elderly (e.g. suffering from chronic conditions, high risk of isolation…) and to make active ageing a reality. The costs associated to these actions in terms of investments, in infrastructure and in human resources make the traditional care model no longer affordable, and innovative solutions are required to cope with the Ageing Population Problem. ICT actors play a central role in this framework in order to design technological tools to deliver high quality health care to allow the elderly to be self-dependent so they can live in their preferred environment for a longer time, having a good quality of living. This yields a reduction of the costs of the health and social care model: the delay on the institutionalisation of the elderly means that fewer beds would be required in hospitals and care institutions and that the ratio of patients per professional care giver would diminish, so the quality of the offered service would be higher.

This article presents the Teleassistance Platform, a technological approach to the Ageing Population problem proposed by Telefónica I+D. The core of the platform relies on NGN, a packet-switched network whose characteristics are very suitable in terms of reliability and performance to provide telecare services.

The Teleassistance Platform is a backbone to offer services, following two different models of care: self-care, so the elderly person plays an active part in his/her own care; or by means of a service provider (public or private), which will make available the services to the elderly. Thus, it offers a set of services to make the elderly person feel more self-confident and autonomous, which results in a new and sustainable Health and social care model.

Finally, several research projects in which the services that will "fill" the Teleassistance Platform have been presented. These projects involve also trials with real end users, so the benefits of the Platforms have been extensively tested.

References

[1] Fougère, M., Mérette, M. "*Population Ageing, International Equity and Growth: Analysis with an Endogenous Growth Overlapping-Generations Model*", International Conference *Using Dynamic Computable General Equilibrium Models for Policy Analysis*, June 16, 1998, GI. Avernaes, Assens, Denmark

[2] http://caalyx.eu

[3] http://www.aal-europe.eu/aal-joint-programme

[4] http://www.itu.int/ITU-T/studygroups/com13/ngn2004/working_definition.html.

[5] http://www.share-it.eu

[6] http://www.tid.es/documentos/sala_prensa/AmIVital.pdf (Spanish).

[7] http://www.tid.es/documentos/sala_prensa/teleadm.pdf (Spanish).

[8] Fernandez, L.C., de Andrés, I., del Árbol, L., Roser, M.., "*Qualitative Study: Model Evolution in Teleassistance and Healthcare*" presented at the 2007 International Educational and Networking Forum for eHealth, Telemedicine and Health ICT, Luxembourg.

[9] Postel, J. "RFC 791: Internet Protocol", September 1981.

[10] Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); "*NGN Release 1; Release definition*", March 2006.

[11] UN, Department of Economic and Social Affairs, Population Division, "*World Population Prospects. The 2006 revision. Highlights*",.http://www.un.org/esa/population/publications/wpp2006/WPP2006_Highlights_rev.pdf

[12] World Health Organization, "*Active Ageing: A Policy Framework*", contribution to the Second United Nations World Assembly on Ageing, Madrid, Spain, April, 2002.