

# Tele-medicine is a driver for quality of life improving broadband application“

Dr. Vincenzo Gullà

## Introduction

Today's ITC technology evolutions allows to communicate in a much easier and faster way than few years ago. The internet, the IP protocols along with the broad band networks growth is showing the new frontiers of interactive applications related with data, video and voice that are merely bringing new benefits to all.

This study wants to show how these technologies can be an aid to healthcare of elder people, provide medical healthcare to remote areas and how national health services can offer better quality assistance and benefit of cost saving.

## Broadband background

As stated by many regulatory bodies and as the majority of technologic world seem to have a common agreement, broadband is in somehow defined as a communication link having a transmission speed ranging form 144Kbps to 512Kbps. Other“ older technologies today still on the market place, such as ISDN can reach 128Kbps over twisted pair, so even if it could not be anymore considered in the field of BB technology, ISDN is really the precursor of today's BB digital links, as shown hereafter (Fig 1) were we have put together the last 20 years of technology evolution in terms of bandwidth growth [1]

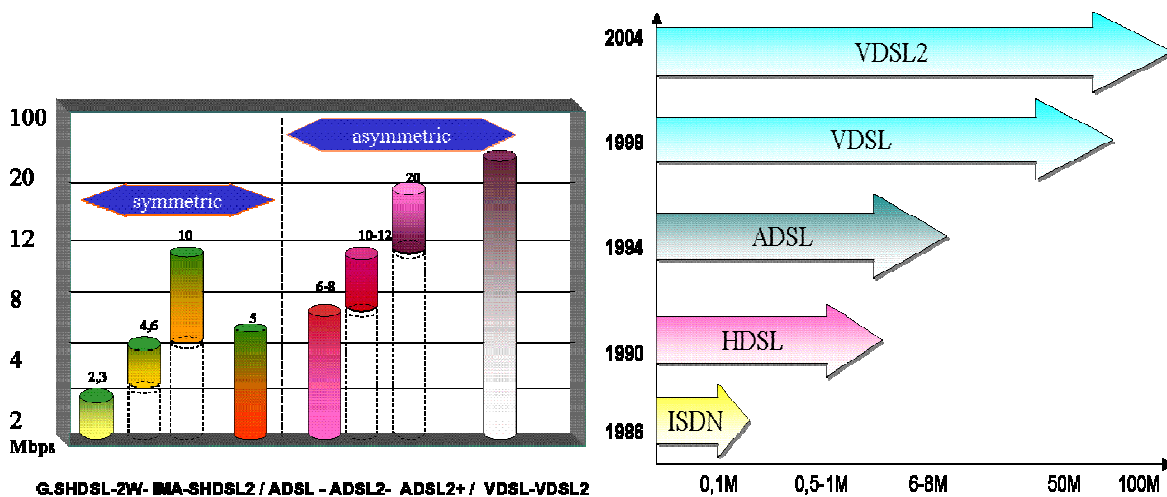


Fig 1

The BB candidates technologies are therefore : xDSL, Cable , Fibber and Wireless such as Wifi , WiMax and last but not least UMTS .

The most deployed technologies in the world remains DSL, due taking advantage of it's physical layer : twisted pair- being it related to the telephone lines, that have yet the

highest penetration ratio compared to any other technology deployed in the last 50 years. DSL takes advantage of the lower deployment cost compared to other technologies. Fig 2

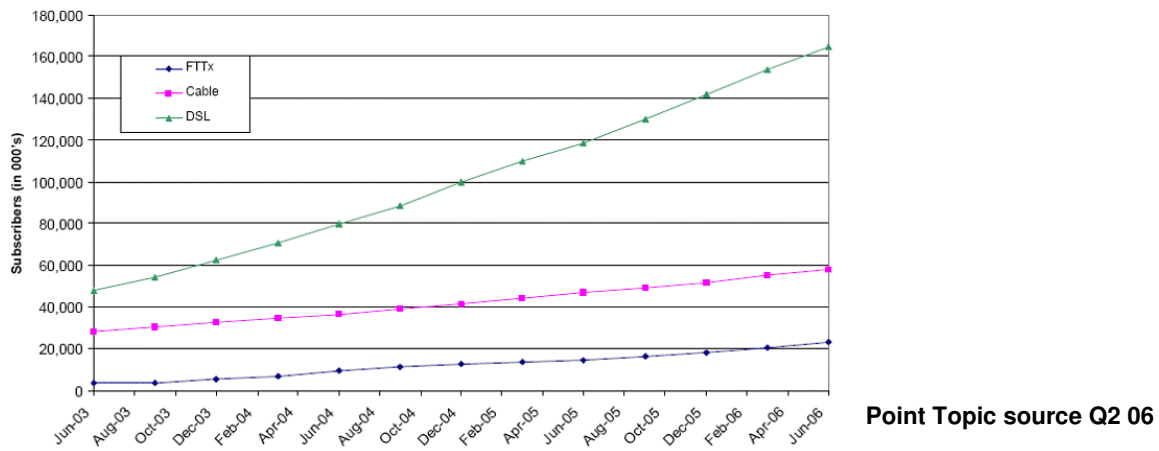
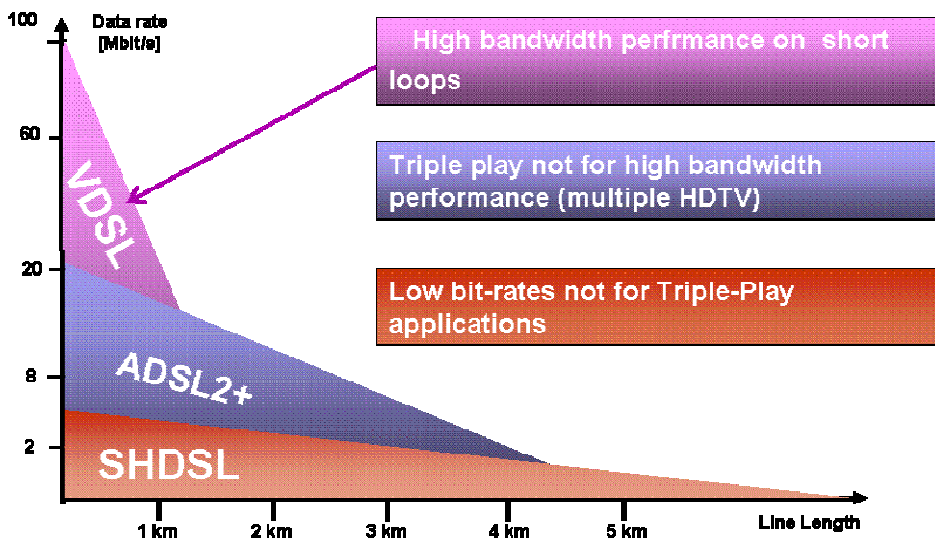


Fig 2

Second to DSL come cable technologies, they had a great moment in many countries thanks to the TV channel delivery service and latter taking advantage of IP technology , grooming together voice and data.

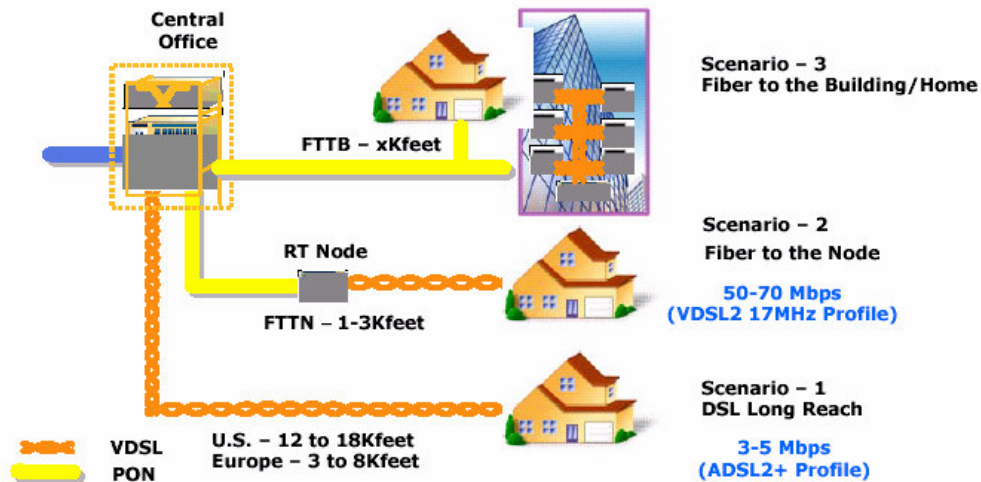
Some countries being penalized of bad/ old and sometimes to long twisted pair last mile loops, have higher cable deployment ratio compared to any other technology. Being it a shared technology among users, it has some bandwidth limitations for individual use, especially on the uplink or return channel and in rush hours .



Source: DSLForum

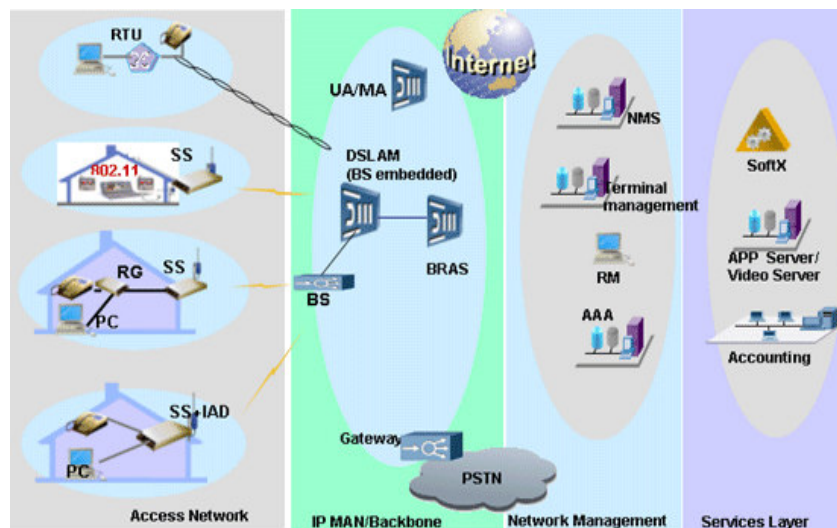
Fiber offers, with no doubt the highest bandwidth delivery technology, but suffers for higher deployment costs compared to DSL. The future will see hybrid networks where fiber gets closer to buildings and in some cases delivers directly to homes, in other, maybe the majority, it will take advantage of the new xDSL technologies such as VDSL2

in the last mile or even shorter loops, to deliver something near its theoretically potential 100Mbps broadband capability.



Then come Wireless technologies where Wifi (802.11) plays the main actor deployed role. Most country regulatory bodies don't allow outdoor deployment of such technology or put limited area constraints, that have limited the technology use to Wifi internet hotspots in public areas such as airports, train stations, hotel, schools campus etc. Indeed Wifi gives great advantages allowing links to internet from wherever you are event thou with a shared bandwidth.

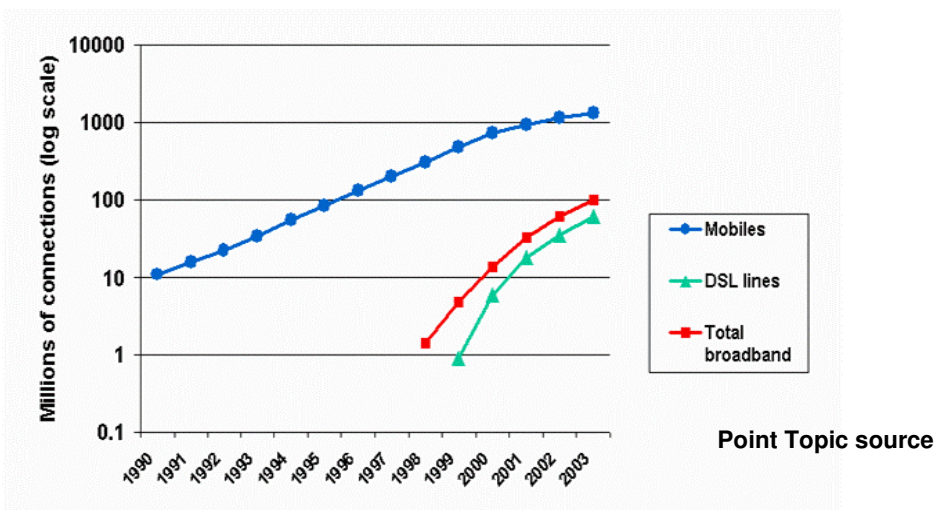
WiMAX (802.16) that is now being deployed addressing MAN applications, will show in the future more powerful perspectives and better economic opportunities having a larger bandwidth and a wider reach it will be heavily used to bring broadband in rural and remote areas and probably it will take over wifi hotspot business as well. Roaming is the critical aspect but it will not be a major barrier to wide deployment, at this technology is showing many economic advantages and will open to more portable application.



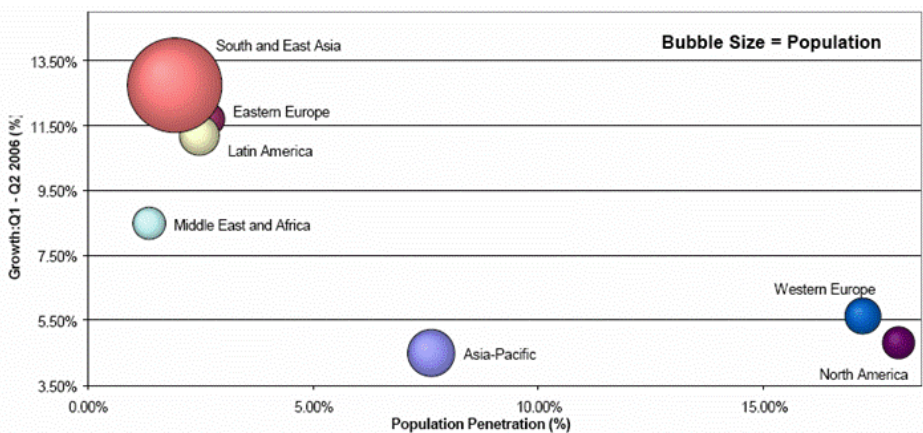
UMTS is the raising mobile technology, famous for its mobile video-telephony applications, and not only, having allocated an individual bandwidth of 128 to 2Mb, depending of environmental and network configuration constrains, it is a power full candidate for mobile broadband applications that will improve info-mobile services as well as fixed ones. Limitations to intensive use may come from economic aspects and cost evaluations . At the end most of the technologies will be addressed as complimentary and probably different broad band technologies will be adopted together to allow everyone from any place to access broadband links.

### ***BB Penetration***

Nevertheless broadband deployment has shown to have an impressive growth rate, in some cases even faster than mobile deployment, penetration has in many cases not yet reached a satisfactory rate.



Penetration rate of broadband is a very important issue. While some Asia Pacific countries are facing a sort of market saturation moment, other western countries suffer the digital divide effects, due sometimes to economic visions and other to technology issues.



All the above states one common vision that is to say broadband is the new thing, it is already conceived as a commodity for householders, in the same way is gas, water or electricity. End users have perceived the benefits of faster data links. Availability of

applications more near to their personal needs and living style, would be a driver to raise the demand in countries where growth it is still lacking.

### ***The Market highlights***

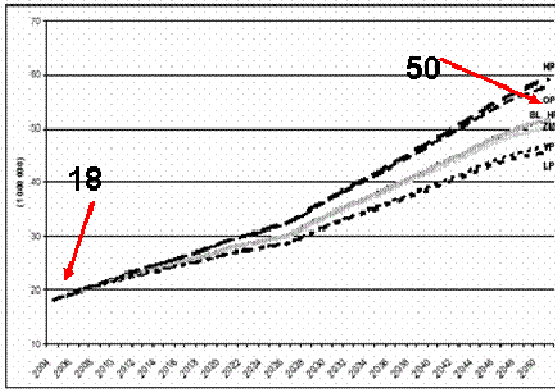
The IP broadband era has put Telecom companies under tremendous pressure. The new operators entering the IP market, eroding the incumbents analogue voice margins with an increasingly fierce competition, has forced the operators to invest heavily in broadband infrastructures and introduce more value added data services, to recover the continuous loss. In many cases telecoms had to redesign their business model with a much faster and dynamic market approach addressing innovation.

This is a heavy task for most but the broadband market today has shown that there are no survivors without innovation. The market is also showing signs of saturation, convergence is increasing fast and residential lines are decreasing as well, for instance in the United States lines have already decreased to 140 million and is expected to fall to 120 million by 2010. [3] The lesson learned is that to keep the market leaderships one must look very deep and understand the needs that become drivers and therefore business. We don't want to go in telecommunication business models details here, but highlight that broadband opens to many and more innovative opportunities and in this research attentions needs to be addressed to important raising requirements sometimes left beside my aggressive market plans but could represent a very promising market such as for instance social drivers.

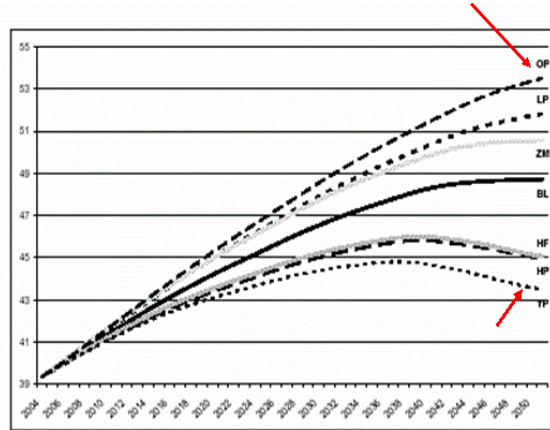
Symmetric or asymmetric connections delivered by broadband links offers wide amount of data interactivity as a basic feature and this makes the difference with other entertainment or communications media. Once the end user get used to this functionality he asks for more, understanding the usefulness and potentials of receiving and transmitting huge amount of data. Up to now this has been the predominant key factor pushing the demand for wider deployment of broadband worldwide. Multimedia applications such as download of music, films, pictures have raised the demand for more bandwidth availability and specially for Peer to Peer services, as well as leading the industries to invest in more entertainment media equipment and services (gaming set top boxes, IPTV, etc). But other than entertainment, TV or business applications broadband is a mean that has the power to improve men's quality of life. There are many fields of social applications not really addressed by the big economic players because of market immaturity, the numbers don't show a fast return of investments and the business models are not yet so profitable. Probably this is due to the fact the broadband economic playground should include players such as social stakeholders with a much longer mid term view. The benefits that a wide band interactive data transmission pipeline can generate in terms of social services is enormous and sometimes essential, not only to improve the quality of service delivery but also to allow a wider cost effective social services to end users.

### ***Population growth***

One serious and very dramatic factor being a concern for many governments in the western and eastern world is the fast growth of elderly people so called Baby Booming. The overage aging is growing fast. In the last 30 years in Europe the over 60's have raised for more than 50%. European statistics show a further increasing trend in elderly dependence as well.



Projected total population aged 80 years and over.  
Trend scenario variants, EU-25, 2004-2051.  
Source: Eurostat, EUROPOP2004



Projected median age, Trend scenario variants,  
EU-25, 2004-2051.  
Source: Eurostat, EUROPOP2004

Today there is one elderly inactive person for every 4, In Europe the number is expected to raise at a ratio of 1 elderly over 2 active persons.



This impressive growing factors positioned in the health care assistance environments draws an impressive increase of assistance and care requirements that will be or is already the new health care scenario, furthermore being the population ageing an irreversible factor there are no doubts at all that this event could not occur for some market or business factor. The question here is how to face this event with satisfactory solutions for both the health care stakeholders and the end users keeping in mind the two main factors: economy and quality of life improvement.

## Broadband Social aspects

### e-Health Highlights

Today's environment is a fast changing and ageing society, requiring new and more challenging needs. Most elder people in the western world live by their own or with family relatives, they sometimes are subject to age diseases, have difficulties to move, are unable to take care of themselves, or just feel lonely.


It would be desirable to have some sort of technological assistance that can keep an "eye" on them, keep their health under control, remote monitor vital parameters, advice

relatives of any raising need or alarming event, or allow to talk to a doctor when ever this is needed for physiological or medical support. In other words enables these people to be independent in their own homes , improving their quality of life. Nevertheless such solutions can give a very positive contribution to prevent unnecessary hospital admission or early de-hospitalization providing additional cost effective savings.

Broadband can play a crucial role in this irreversible social scenario. Broadband is not a technology that can just create an alternative way to inform or deliver TV and entertainment programs , it has a more concrete and excellent role that is to create live quality improvement applications and services for the benefit of all. [4]

Triple play makes possible to live monitor vital parameters, make a remote medical visit, assist a patients using technology which provides data, video and voice. The solutions does not necessary require inventing new sophisticated IT end user technologies or go so far to special developed computers .

US medics say virtual checkups can't replace one-to-one consultations. But they can help catch warning signs early and reach out to people in inaccessible areas



**Growing number**

Though there is little hard data tracking its growth, there is mounting evidence that more people are using telemedicine in the US.

The number of companies manufacturing home telecare devices in the last three years has risen to 15 and the Veterans Administration plans to double the number of patients it puts on its telecare list to 20,000 over the next year, said Jonathan Lindey, executive director of the American Telemed Care Association.

About 3,500 hospitals, clinics, schools and other facilities use telemedicine today, up from 2,000 six years ago, he said.

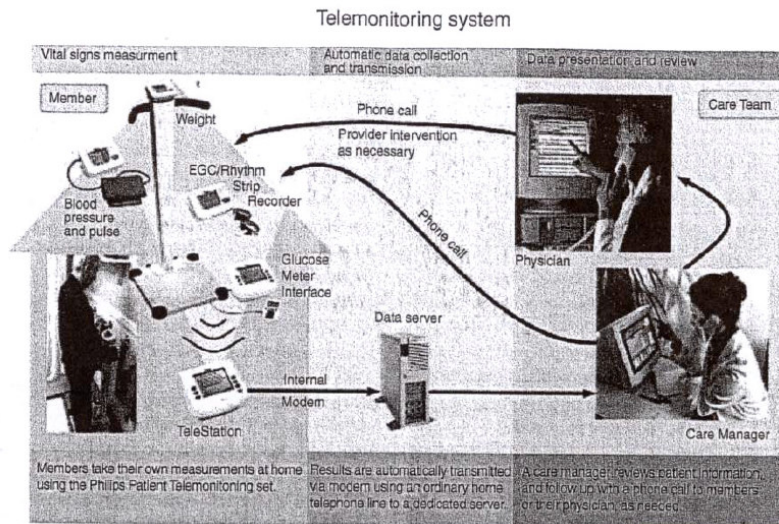
Several studies show that patients who use telemedicine make fewer trips to emergency rooms and hospitals. One study by Kaiser Permanente compared two groups of 600 patients and found the group that used the technology cut hospitalizations by 27% from May 1996 to November 1997.

As all the applications that succeeded the approach must be kept simple and easy to use. Thinking about the most common media equipment available in homes one will certainly drop his eyes on two home devices : TV set and telephone.



- **Telemedicine experiences**

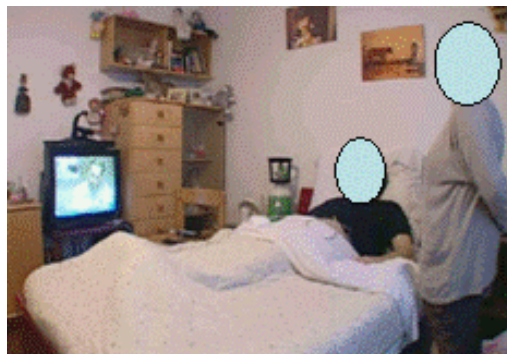
Studies carried out in many European countries have shown the benefits of telemedicine solutions in both home care and home assistance. The projects have initially used telephone based solutions for vital parameters monitoring in different pathology sectors and for elderly remote assistance. UK, Germany and the Netherlands conducted recently the TEN-HMS project (TRANS EUROPE NETWORK HOME CARE MANAGEMENT SYSTEM) . Scope of the trial was to compare the effects of managing heart failures with conventional nurse support and home telemonitoring, based on telephony vital parameters monitoring [5] .



Results have shown the advantages in terms of staff improvement efficiency, patient quality of life and health . Telemonitoring was demonstrated to be suitable for heart failure monitoring showing substantial reduction in mortality of patients under telemonitoring .

Other experience was conducted in Italy by the INRCA institute for elderly heart care. In this case the technical solution made intensive use of videocommunication to simulate a remote visit of the specialist and the patient in his own home.

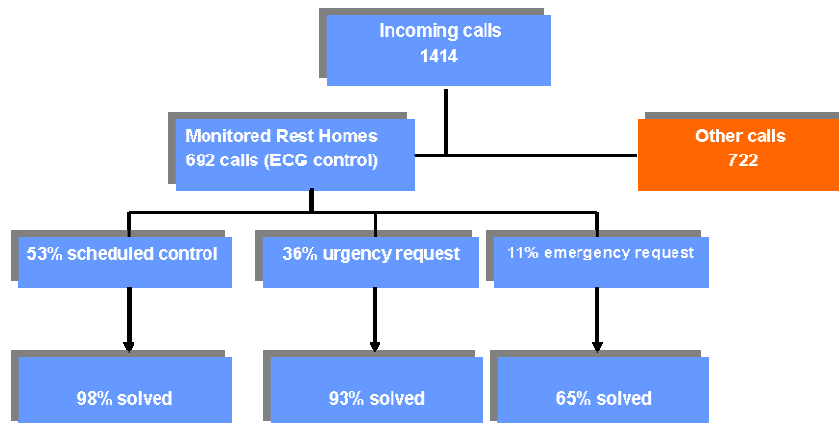
The trial conducted in the year 2000-2001 included Rest homes and private homes . The service provided was Post hospitalization monitoring for patients suffering of heart failures involving 89 sites .



The results achieved were impressive. A very high number of incoming calls that otherwise would have required hospital admission were solved directly with the doctors'



remote visit and vital parameters ( such as blood pressure, heart rate, heart and lung auscultation , etc) detection and control. [6] More that the 65 % of emergency calls were solved without moving the patients resulting and a further improvement in ones life quality.



Furthermore the connection to the homes were ISDN 128Kbps to allow two way videocommunication and data transmission. The doctors site was equipped with a vital parameter measurement software acting also as a database to store the patients history and visit results. Cost issues were in any how very high due to the type of equipment used, only professional videoconference systems were available and ISDN lines traffic was expensive . In anyhow the advantages show were that it was possible to delivery remote care with very good results. Other experience conducted in the Netherlands and Austria focused on videocommunication in elderly home care have verified the conditions for successful implementation of home care technologies . The trials were managed by two companies specialized in home care assistance . [7]

1. Volkshilfe Styria, an Austrian care-provider active in the state of Styria with about 1700 employees.
2. Sensire, a Dutch care-provider with about 15.000 employees.

The Austrian care provider Volkshilfe project was co-financed by the EU during July 2004 to July 2005. The project was based on POTS (analogue telephone lines with only 33.6kbps). In Q2 2006 Volkshilfe will enter the next phase of the project using specially designed equipment on broadband IP networks (up to 384kbps). Telekom Austria, the largest telecom provider in Austria, provided assistance with the project.

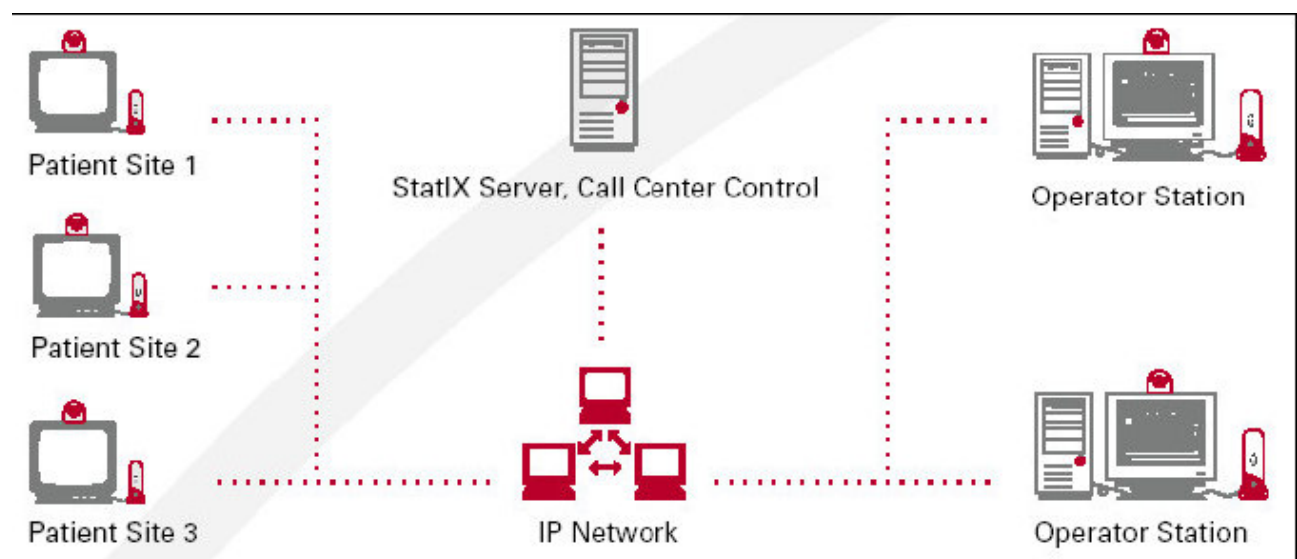
In 2003, the Dutch care provider Sensire, began to implement video communication over ISDN (128kbps). In 2006, Sensire's video network includes 700 installations mainly via broadband IP networks (up to 384kbps). The network services are provided by KPN, the largest telecom provider in the Netherlands.

Findings at the end of the trial highlighted :

- Call centre operators observed a higher level of accuracy and improved assessment of circumstances that lead to higher efficiency during the caregiver's on-site visit.
- A lack of technical knowledge appears to be a problem for the elderly, but after a short time clients are familiarized with the system and use it accordingly.

- Clients do not feel intruded upon. Instead they encourage the caregiver to call them to see how they are and to check their current condition.
- Ease of handling, good picture and audio quality, suitable design for the elderly (font size, symbols, readability...), compactness, and support are basic requirements for such a system.
- Clients prefer more frequent video visits compared to less frequent face-to-face visits.
- Nurses say that video could replace some home visits and is useful as an additional service.

The network configuration for delivery of IP home care services addressed by the two companies is shown hereafter. The patients home are equipped with either a TV set top box or a video telephone, both with data interfaces for electrometrical device monitoring. Tilting cameras with enhanced features such as zooming or remotely controlled make the call centre operations more simple and efficient. The quality of life for the elderly was much more improved as they could keep their usual life style feeling more safe and under control of expert care givers.



## ***Early de-hospitalization cost benefits***

Among the addressable Broadband health care applications showing potentials of return of investments for health care stakeholders, carriers and service providers is the early de-hospitalization or early hospital demission.

One of the major cost factors why healthcare is expensive other than staff is because hospitals provide a 24 h hotel service including access to monitoring by nursing and medical staff. Most patients choose for hospitalization because monitored by expert staff, but once a patient has been hospitalized he often remains there for long periods, due both to the critical phase management and secondly care assessment, causing unavoidable cost increments for the social structures.

It is unlikely that sending patients home too soon may result in early readmission unless the patient is somehow kept under control even after discharged by the hospital. The solution to this critical issue is to keep monitoring the patient in his own home environment.

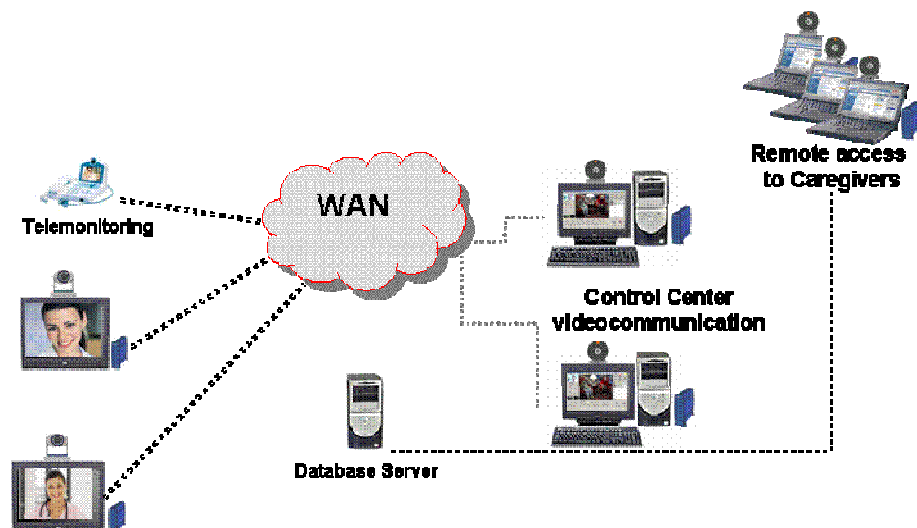
using tele-medicine. Such solutions experienced in many trials have shown their potentials to decrease both unwanted early readmission and hospital costs.

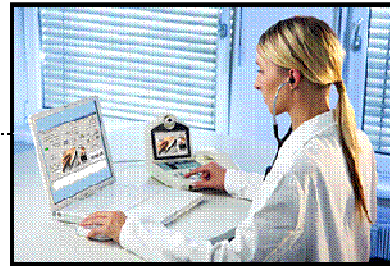
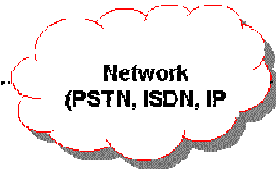
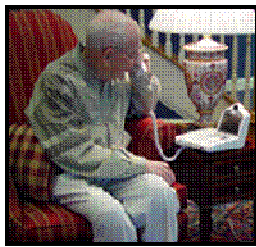
In the previous chapters we have exploited trials experienced in many countries and different health care delivery environments, all showing the medical, moral and quality of live validity of telemedicine solutions. In the following we want to show how these solutions can give a great contributions to make healthcare more cost efficient applied to early de-hospitalization.

The simulation basically shows that it is possible to reduce the number of hospital stay days, monitoring the patient in his own home. The parameters used to make this simulation are taking from the yearly health care statistics of an Italian Region (Marche) for a medium town hospital and can be easily applied to any other local model.

This business model shows the benefits that a medical health care structure can achieve, allowing cost saving and contemporary better use of health care infrastructures, as well as the quality of patients life being controlled in his own environment surrounded by his relatives.

The reference solution configuration is similar to those used in the Netherlands or Austria, A network of special TV set to boxes or video telephones in the patients home, connected to a video call center managed by the hospital department and care givers able to interface electro medical devises such as : SpO2,ECG, Weight scale, blood pressure, Vital parameters, etc. Equipped with special emergency and patients retrieval functionalities that allow the call center operator to have a continuous control. Bidirectional broadband links of at least 384Kpbs are sufficient to provide a very good image quality together with data and voice. The remote visit takes place on the home TV set and the patients is no longer forced to stay in the hospital or to face traffic jam or long waiting queue to get it own doctors health control .



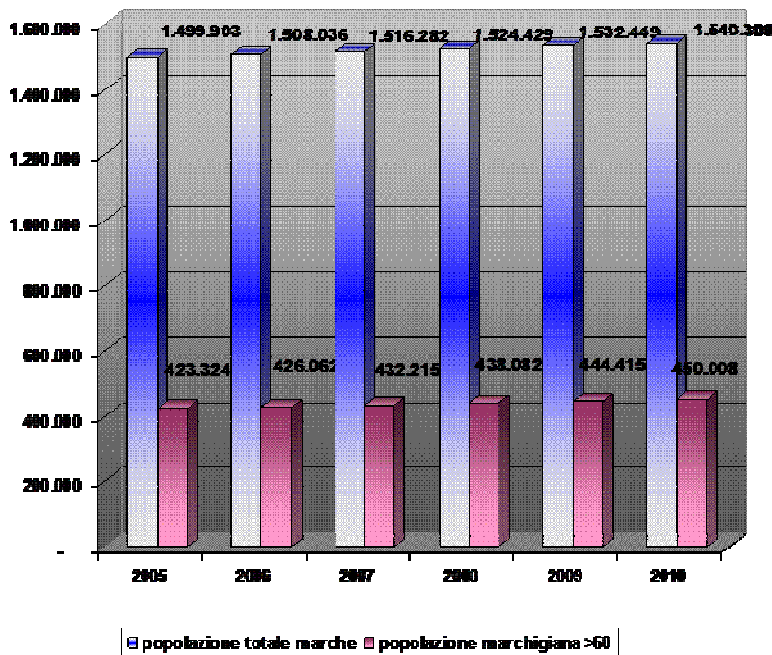


### ***Basic hypothesis***

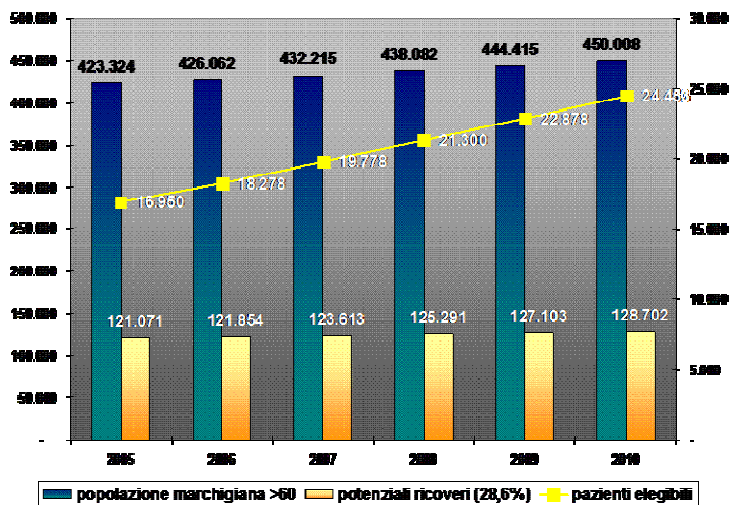
The simulation based on the following inputs:

Over 65 population trend statistics in the 2005-2010 time window (data provided by ISTAT)

- Percentage of hospital admission for over 65 observed during the 2000-2001 time window : 29% (data detected from a experimental project conducted by INRCA)
- Average yearly hospital admission growth :10%
- Early de-hospitalization potential patients 14% (+1%yearly increment)
- 36 health care structures ( hospitals and clinics existing in the observed Italian region)



- Overall population growth results in a overall increment of 2,6%
- Over 60 population growth is 5,9% ( ISTAT), double compared to the overall development.



- Over 60 population growth in 5 years time window increase of nearly 30.000 units
- 6% potential hospitalizations demand increase
- 16.960 patients representing the 14% of hospitalized units can benefit of early discharge .This number can increase to 24.000 in 5 years representing the 18% of the total demand

### Project data

- Average hospital admission : 9 days
- Average daily admission cost € 500 (DRG)
- 5 days hospital stay +4 days hospital home care assistance
- The Tele-video-monitoring system is installed at the patients home for the 4-7 days after hospital discharge)
- Home care assistance is provided by the hospital on a 24 hour basis
- Equipment finance amortization is assumed to last 3 years with 8% loan bank interest
- Installation, training and equipment maintenance is all included in the economic computation

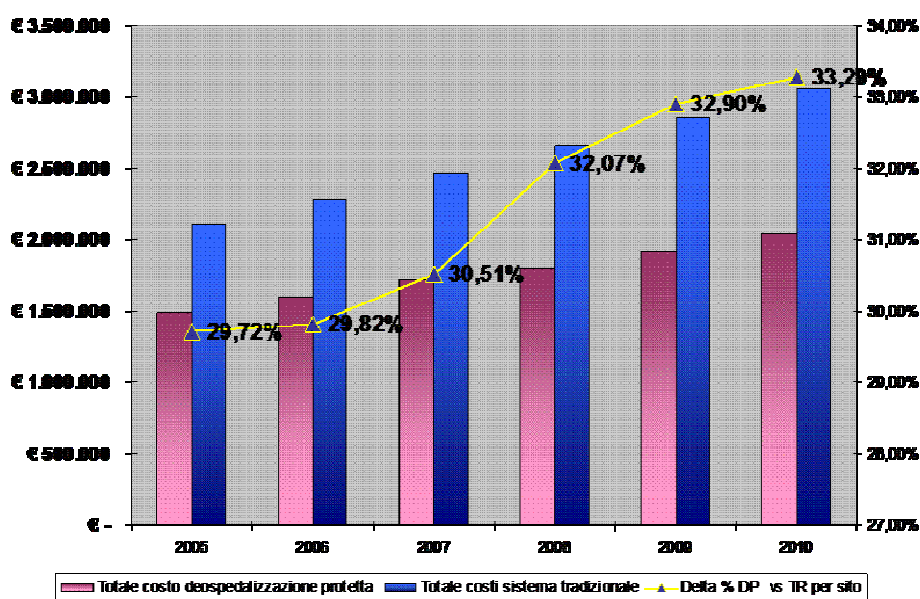
<i>Project data summary</i>	2005	2006	2007	2008	2009	2010
• <i>Home care terminals per year</i>	15	20	20	25	25	25
• <i>Video Call center post per hospital</i>	2					
• <i>Patients hospital per month under early discharge</i>	39	42	46	49	53	57
• <i>Patients per year</i>	471	508	550	592	636	679
• <i>Health care assistants (nurse)</i>	4	4	4	4	4	4

The service is provided directly by the hospital to early discharged patients. The previous mentioned trials have demonstrated that the “you see me I see you approach” guarantees continues link between care giver assistant and end user even when he is in its own home, that results in life quality improvement.

The end user has a more friendly approach and feels to be under safe control and receives assistance directly at home.

- ✓ Video is an aid to train and assists end user's family and relatives
- ✓ Patient is more confident with its own doctor and nurse
- ✓ Interactive video allows the remote operator to have complete knowledge and control of any event that could compromise end user's health or safe conditions

The economic benefits deriving from this computation are projected in the following graphics and one can notice that the cost saving trend is around 30% in the first year.



## Conclusion

This study shows that it is possible with today's triple play technology to provide very high quality and cost effective remote monitoring for home care applications. Broadband deployment has a chance to make this application even more feasible and cost attractive. No doubts on the quality of life improvement perception for patients and elderly people neither on the cost benefits achievable by care givers. It is essential in the very near future to find means, tools and solutions to provide more efficient and cost effective health care. The only way to achieve this objective is to allow medical and social assistant staff to be more efficient and provide support to a wider number of people without increasing costs, and the study provided is showing how this is possible.

It is indeed an opportunity that broadband stakeholders need to address in their research for new and more attractive applications

Broadband telemedicine today shows very interesting and promising return of investments to service providers, care givers and end users.

## **Biography**

### **Dr.Vincenzo Gullà,**

Dr V.Gullà born in 1955 in Boston USA ,has over 20 years of experience in the global telecommunications industry. Graduated in Electronic Engineering at the University of Rome, he worked in several technology areas such as Satellite communications, Mobile, Wireless, Positioning, High Definition video, Broadband , telecommunication services and markets. In the 1980's he was appointed as delegate of the Italian PTT for the ITU organisation.

During his carrier he worked with a wide variety of manufacturing and services providers including Alenia Spazio, Telespazio and Telecom Italia. Joined Aethra in 2001, taking responsibility of the Telecoms Marketing Department. After two years he took the role of Vertical Applications Market Director, focused on Video communication applications such as Telemedicine and Distance learning. He is very active in the broadband and telemedicine market. He covered the roles of Chairman of the European Market Focus Group ,Chairman of the DSL-Forum Marketing Committee, member of the Scientific Committee of Telemitalia and of EMIT 2006 and is now CEO of ADiTech, e new start up company based in Italy, focused on Telemedicine broadband applications

Dr.V.Gullà holds two worldwide patents for High definition broadband applications and more 20 publications .

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