

# ***BRINGING IT INTO THE HOME***

**A Landscape Documentary of  
Assistive Technology, Smart  
Homes, Telecare and Telemedicine  
in the Home in Relation to  
Dependability and Ubiquitous  
Computing.**

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# Contents

<b>1</b>	<b>INTRODUCTION .....</b>	<b>3</b>
1.1	KEYWORDS: .....	3
<b>2</b>	<b>HOME NETWORKING.....</b>	<b>4</b>
<b>3</b>	<b>ASSISTIVE TECHNOLOGY IN THE HOME.....</b>	<b>8</b>
<b>4</b>	<b>SMART HOME TECHNOLOGY .....</b>	<b>11</b>
4.1	BOB ALLEN FROM <a href="http://www.stakes.fi">HTTP://WWW.STAKES.FI</a> COST 219 AND INCLUDE .....	11
4.2	DAVID GANN, JAMES BARLOW AND TIM VENABLES, SPRU: UNIVERSITY OF SUSSEX ( <a href="http://www.sussex.ac.uk/spru">WWW.SUSSEX.AC.UK/SPRU</a> ).....	12
4.3	ROBIN BURLEY: INDEPENDENT CONSULTANT.....	12
4.4	STEVE BONNER (INSTALLER): EDINVAR HOUSING.....	12
4.5	ABB UK .....	12
4.6	JEREMY LINSKELL: DUNDEE UNIVERSITY HOSPITAL, EATS .....	12
4.7	TWEED AND QUIGLEY: QUEENS UNIVERSITY, BELFAST, <a href="http://www.qub.ac.uk/tbe/arc/research/projects/equal.html">HTTP://WWW.QUB.AC.UK/TBE/ARC/RESEARCH/PROJECTS/EQUAL.HTML</a> .....	12
4.8	MALCOLM FISK: LIVERPOOL JOHN MOORES UNIVERSITY .....	12
4.9	ROGER ORPWOOD, BATH INSTITUTE OF MEDICAL ENGINEERING BATH UNIVERSITY: ( <a href="http://www.gloucestersmarthouse.org.uk/">HTTP://WWW.GLOUCESTERSMARTHOUSE.ORG.UK/</a> ).....	13
4.10	ANDREW SIXSMITH UNIVERSITY OF LIVERPOOL: PLANECC.....	13
4.11	MARY MARSHALL: UNIVERSITY OF STIRLING: ASTRID .....	13
4.12	SALFORD UNIVERSITY: MARCUS ORMEROD AND PAM THOMAS.....	14
4.13	PORTSMOUTH UNIVERSITY:.....	14
4.14	GLOUCESTER SMART HOME:( <a href="http://www.gloucestersmarthouse.org.uk/">HTTP://WWW.GLOUCESTERSMARTHOUSE.ORG.UK/</a> ).....	14
4.15	THE ROBERT GORDON UNIVERSITY: <a href="http://www.rgu.ac.uk/subj/search">HTTP://WWW.RGU.AC.UK/SUBJ/SEARCH</a> .....	14
4.16	OTHER USEFUL WEBPAGES .....	14
<b>5</b>	<b>TELECARE AND TELEHEATH.....</b>	<b>16</b>
5.1	DAVID BRADLEY AND S J BROWSELL, ABERTAY UNIVERSITY ( <a href="http://www.abertay.ac.uk">WWW.ABERTAY.AC.UK</a> ) .....	16
5.2	JEREMY PORTEUS ANCHOR TRUST: ANCHOR/BT.....	16
5.3	KEVIN DOUGHTY: TECHNOLOGY IN HEALTHCARE.....	17
5.4	SPRU, UNIVERSITY OF SUSSEX, THE TCPI PROJECT .....	17
5.5	THE ELECTRONIC HOUSE CALL (EHC): GEORGIA INSTITUTE OF TECHNOLOGY ( <a href="http://www.bitc.gatech.edu/ehc/index.html">HTTP://WWW.BITC.GATECH.EDU/EHC/INDEX.HTML</a> ) .....	18
<b>6</b>	<b>ASISTIVE TECHNOLOGY.....</b>	<b>20</b>
6.1	LAURA GITLIN, THOMAS JEFFERSON UNIVERSITY, PA.....	20
6.2	IMPACT ( <a href="http://www.fz.hse.nl/causa/impact/">HTTP://WWW.FZ.HSE.NL/CAUSA/IMPACT/</a> ) .....	21
6.3	TAURUS ( <a href="http://www.lboro.ac.uk/taurus/index2.htm">HTTP://WWW.LBORO.AC.UK/TAURUS/INDEX2.HTM</a> ) LOUGHBOROUGH UNI .....	21
6.4	CoRE: ALAN TURNER-SMITH, THE CENTRE FOR REHABILITATION ENGINEERING, UNIVERSITY OF LONDON ( <a href="http://www.kcl.ac.uk/depsta/kcsmd/mep/core.htm">HTTP://WWW.KCL.AC.UK/DEPSTA/KCSMD/MEP/CORE.HTM</a> ) .....	21
6.5	INCLUDE ( <a href="http://www.stakes.fi/include/">HTTP://WWW.STAKES.FI/INCLUDE/</a> ).....	22
6.6	INTEGER ( <a href="http://www.integerproject.co.uk/">HTTP://WWW.INTEGERPROJECT.CO.UK/</a> ) .....	22
<b>7</b>	<b>TYPES OF TECHNOLOGY, AVAILABILITY AND RELIABILITY .....</b>	<b>23</b>
7.1	SMART HOME TECHNOLOGY .....	23
7.2	TELECARE, TELEHEALTH TECHNOLOGY AND RESIDENTIAL GATEWAYS.....	26
7.3	ASSISTIVE TECHNOLOGY.....	27
<b>8</b>	<b>CONCLUSION .....</b>	<b>28</b>
<b>9</b>	<b>BIBLIOGRAPHY.....</b>	<b>29</b>

## **1 INTRODUCTION**

Over the last century, the domestic environment has adapted and gradually become progressively more reliant on technology to carry out common household tasks, such as cooking and cleaning. The all-encompassing nature of technological innovations, though often couched in ergonomic jargon has often proved to be less than beneficial for many people. What was perceived to be labour saving has often been found to not be the case. The recent rise on technologies that have become commonplace within the home are no exception although they can be of considerable benefit to the user if used appropriately and designed appropriately. The rise in the smart home industry in the last decade has demonstrated that technology is willing to be embraced by society and this is borne out by the rise in computers, DVDs and other high-end technology sales worldwide. Technology can be assistive and enable people to achieve a better quality of life through their appropriate use. The introduction of telecare and telemedicine systems demonstrate that technology does not necessitate being confined to purely domestic arenas but can be extended into a wider socio-technical context.

This paper reviews the issues relating to technological dependability issues and the home in relation to disabled and older people. It will also consider the role of risk and acceptability. The intention of this paper is not to provide a review of literature as such, rather a landscape review of the key people and their thinking in the area of the smart home, telecare, telemedicine and assistive technology.

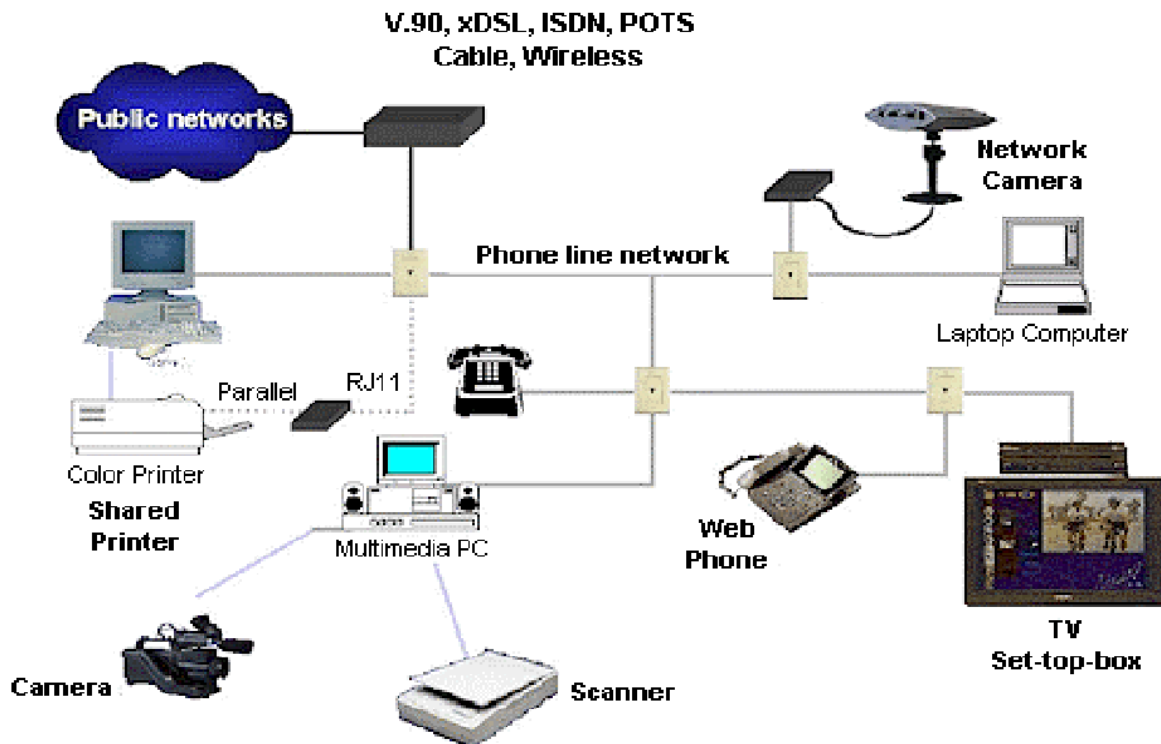
### **1.1 Keywords:**

home networks, smart home, assistive technology, ubiquitous computing, dependability, home automation, domotics, telecare, telemedicine,

## 2 HOME NETWORKING

The increase in home networking is having great effects on the lives of older and disabled people. A home network allows a residence to be connected to the outside world through a residential gateway that passes information down an ISDN or DSL phone line. Home networking allows the home to become a fully connected entity that can be controlled externally as well as internally. The increase in telemedicine and telecare as initiatives that extend beyond the conceptual into the real world are only possible through the home network. The smart home (automated home, domotic, intelligent home), in which devices are interconnected and programmed to act in predetermined patterns has been extended through the home network to allow external monitoring and control. For a disabled or older person, home networking offers the potential for their home to be programmed to monitor and respond to cues whilst allowing the occupant the safety and reassurance that should a fault develop or a problem occur within their home then the correct people will be informed by the technology within the home network (Figure 1).

Figure 1: A pictorial representation of a potential home network

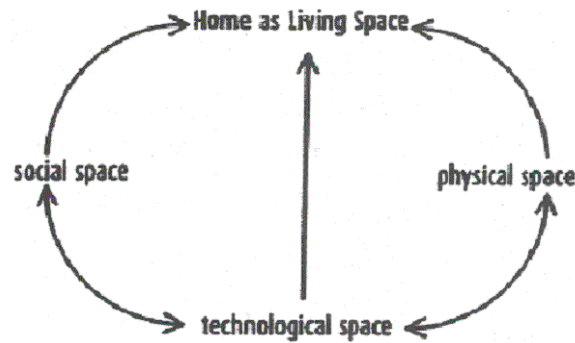


Source: Venkatesh, et al (2001a)

The home network has problems as well as positive aspects to it. One problem is caused by the ISDN/ADSL/PDSL connection that is “always-on”. This means the permanently connected home could potentially face threats from external hackers. Moreover, this “always-on” connection means that the system is open to potential viruses or malevolent programmers. This requires that the home network should have an updateable virus checker and a firewall to deter hackers.

The technological home of today and tomorrow embraces technology within its structure. Venkatesh and Sanjoy (1999) and Venkatesh et al (2001a & 2001b) considers that the role of technology is integrated into other living spaces, such as physical, social to make up the whole notion of home (see Figure 2).

Figure 2: The spatial relationships within the home



Source: Venkatesh, and Sanjoy (1999)

Within Venkatesh and Sanjoy’s model, technology (technological space) interacts with all other spaces. Even though the model is flawed by its lack of interaction (physical and social space must interact: ask the child who used to be shut in a cupboard for being naughty), it does provide an excellent framework to consider the importance of technological innovation within the home. As the 21<sup>st</sup> Century begins, technology can be used to enable people to derive a better quality of life through the appropriate use of technology. The home network can allow isolated individuals to retain contact with the world around them as well as allow for external monitoring of people who require this. The home can be transformed from an area that was perceived as a living space into a unit of sub-environments such as the social, physical and technological.

Figure 3: Sub-Environments within Domestic Space

A.2 Sub-Environments <sup>#</sup>						
	Food Management	Household Maintenance Finance	Leisure/ Recreation Entertainment	Social/ Family Communication	Work/ Employment	Family/ Development/ Well-being
A.1 Family members (as adopters and users of technology) <sup>**</sup>	Primarily adults (parents)	Primarily adults	Whole family	Whole family	Primarily adults	Children and adults
A.3 Household activities targeted for technology use <sup>**</sup>	Meal preparation and consumption Washing dishes Grocery shopping	Family shopping Cleaning Tax preparation Family budget	Watching TV Holiday travel Movies Games	Telephone conversations Family communication Holiday reunion Correspondence	Job-related activities Telecommuting	Children's education Adult education Family fitness dieting Holiday gathering
A.1 Configuration of household technologies #	Kitchen appliances Automobile ATMs Computer Home shopping (Online)	Washer, dryer Automobile ATMs Computer Online Home banking	TV, VCR, stereo Automobile Computer Multimedia Online services	Telephone answering machine Fax Computer/email Internet Online services	Telephone answering machine Fax Automobile Computer Internet	Typewriter VCR Telephone Computer Internet

\*\* Elements of Social Space;

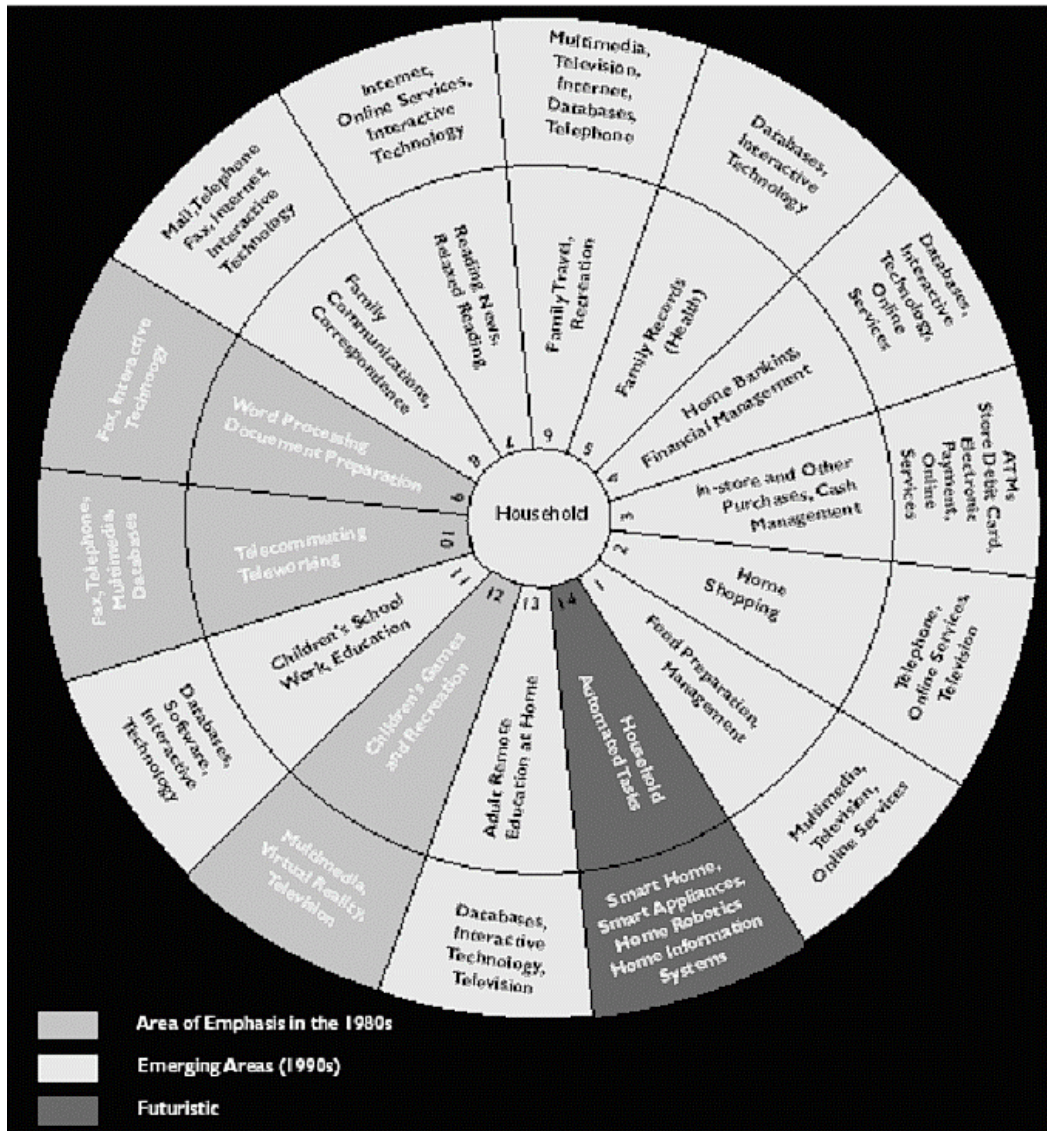
# Elements of Technological Space

Source Venkatesh 1996

The sub-environments contain elements of traditional domestic life as well as more complex ‘post-modern’ technological interrelationships. Moreover, as the interrelationships between sub environments begin to breakdown or extend, other areas of technological penetration will become more important. A clear and practical use of technology is the introduction of smart homes, telecare

and telemedicine, to allow people with possible illnesses or disabilities to retain a quality of life within their own home. Smart homes assist in undertaking operational tasks, telecare enables a person to remotely accessed by medical staff as well as be monitored and telemedicine allows a full medical service to be brought into the home of the person requiring the specialist service. The application of technology from the medical field into the home raises a number of interesting issues that will be considered below.

Figure 4: The Technological Wheel



Source: adapted from Venkatesh (1996)

The home network provides considerable interest for observing ubiquitous computing as technology is extending beyond the single computer to networks of computers within the home each undertaking specific roles and tasks within the new technological domestic unit. The home network allows each occupant of the house to have contact with people externally, through the web, videoconference, net meeting etc as well as within the home through internal monitoring. As Figure 5 illustrates, the role of technology is within the home is extensive. Moreover, the application of this technology extends into a number of areas which are enhanced by home networks.

**Figure 5: Key Areas of R & D in Community Care Technologies**

<b>Technology area</b>	<b>Applications</b>
Supporting life at home	Smart house Multimedia environmental control Systems to support cognitively impaired people Assistive devices Aids for daily living 'Design for all' products
Remote care and services	Alarms/security Monitoring systems Telemedicine
Mobility and transport	Navigation systems within large buildings Accessibility information systems Advanced wheelchairs Road transport informatics
Control and manipulation	Compensatory devices Assessment tools
Restoration and enhancement of function	Optimised hearing instruments Portable communication equipment Rehabilitation systems Fitness devices
Interpersonal communication	Voice Text Video
Alternative media	Text interpretation Electronic newspapers Television text captions and audio description Multimedia translation systems Alternative interfaces
Access from a distance	Information access Teleshopping Telework Distance learning Entertainment and leisure
Key areas of research and development in community care technologies	

Source: Porteus and Brownsell (2001, 21)

The home network appears to be a reflection of the twenty first century, as computer operating systems are adopting protocols that should easily interface with home networking products, and manufacturers are redesigning their products to allow for greater standardisation and interoperability.

### 3 ASSISTIVE TECHNOLOGY IN THE HOME

*The International Standards Organisation (ISO, 1992) defines assistive technology ("technical aids" in their terminology) as: "...Any product, instrument, equipment or technical system used by a disabled person, especially produced or generally available, preventing, compensating, relieving or neutralising the impairment, disability or handicap." The term Assistive Technology (A.T.) is applied to any device or system, technically based, that has been designed to help a disabled person overcome problems associated with their disability. At one extreme, a pair of spectacles could be referred to, as an assistive technology device. AT equipment can be taken to fall into one or more of the following application areas:*

- *· Inter-personal communication systems – devices designed to assist the user communicate face to face with another individual using either written text or artificially uttered speech.*
- *· Environmental control systems – devices designed to permit the user exercise a greater degree of control over devices and functions within their immediate vicinity*
- *· Curriculum access systems – those devices designed to allow a person with a disability take part more fully in the conventional learning process.*
- *· Vocational or Employment access tools – as previously, but specifically designed to interface with existing business systems, e.g. normal computer systems.*
- *· Leisure access systems – specialised devices that allow the user access to recreational systems or artistic endeavours.*

Bob Allen (2001) ICAN Project

Assistive Technology (AT) has been defined in the US as "a broad range of devices, services, strategies and practices that are designed to increase the functional competencies of persons who have disabilities. An Assistive technology assessment answers the question which technologies and strategies can I use to improve my functioning during a specific activity? A formal assistive technology assessment is provided by someone who is recognized as a provider of assistive technology services by public and private funding agencies [usually an occupational therapist (OT) or social worker]." Also "Assistive technology" is defined by the Technology-Related Assistance Act of 1988 (Tech Act), P.L.100-407, and the Individuals with Disabilities Act of 1990, (IDEA), P.L.101-476, as "any item, piece of equipment, or product system, whether acquired commercially off-the-shelf, modified, or customized, that is used to increase, maintain or improve the functional capabilities of individuals with disabilities." ([http://www.idonline.org/ld\\_indepth/technology/nalldc\\_guide.html](http://www.idonline.org/ld_indepth/technology/nalldc_guide.html)). These American definitions mean that technology can be reduced to specific equipment within the home. A number of items of technology are not *per se* assistive in nature, where as others, which might not be initially be considered to be assistive, but can fall into this category. The essence of these definitions is that AT is concerned with maintaining and improving the functional capabilities of individuals who would otherwise be impaired. In other words, AT is concerned with extending the quality of life for people with cognitive, physical, emotional or social disabilities, encompassing all ages.

The IMPACT group has provided a useful checklist (Figure 6) illuminating the different types of assistive technology that are available:

Figure 6: A variety of available Assistive Technologies

Physical	Vision	Hearing	Communication
<p><i>Non-technical:</i>                      Organisation of home                      Elimination of hazards</p> <p>Personal assistive devices:                      Reachers                      Lightweight cutlery with enlarged handles                      Dressing aids (e.g. stocking aids, button hooks, elastic shoelaces, dressing sticks)                      Walking aids (e.g. canes, crutches, rollators, walking frames)                      Wheelchairs (manual, electric)                      Devices for incontinence (e.g. pads, special underwear)</p> <p><i>Adapted items:</i>                      Toilet raisers                      Shower chairs                      Bath aids (e.g. bath boards, seats, handrails, grab bars, lifts)                      Bed raisers                      Raiser cushions or high chairs                      Shopping bags with wheels                      Environmental control units                      Electrically adjustable beds</p> <p><i>Housing adaptations:</i>                      Removal of thresholds                      Widening the doorways                      Change of bathtub to a shower                      Choosing non slippery floor materials                      Replacing light switches, automatic lights, remote control                      Adding light                      Install a stair lift                      Install handrails                      Install sliding doors and drawers                      Environmental control units</p> <p>Devices to help carers:                      Lifts and hoists                      Alarm phone systems                      Attendant manoeuvred wheelchairs                      Electrically adjustable beds</p>	<p><i>Non-technical:</i></p> <ul style="list-style-type: none"> <li>• Organisation of home</li> <li>• Improved lighting</li> <li>• Use of colour contrasts</li> <li>• Elimination of hazards</li> <li>• Organising and labelling</li> </ul> <p>Accessible printed material:</p> <ul style="list-style-type: none"> <li>• Large print</li> <li>• Braille and Moon</li> <li>• Talking books/magazines</li> <li>• Electronic books and newspapers</li> </ul> <p>Personal assistive devices:</p> <ul style="list-style-type: none"> <li>• For improving vision (e.g. field expanders and telescopes)</li> <li>• For reading (e.g. typoscope, magnifiers, PC with speech synthesis, Braille or enlargement, CCTV, electronic reading machines)</li> <li>• For writing (e.g. guides for writing on paper, adapted computer peripherals and software, Braille printers, note-takers)</li> <li>• For mobility/walking (e.g. canes, orientation and navigation systems)</li> </ul> <p>Adapted everyday items:</p> <ul style="list-style-type: none"> <li>• Telephones (e.g. large buttons, number storage, dialling aids)</li> <li>• Alerting devices (e.g. door alarms, talking clocks)</li> <li>• Kitchen utensils (e.g. talking adaptations, tactile/contrast surfaces, cutting boxes)</li> <li>• Eating and drinking (e.g. plate guards, non-slip mats)</li> <li>• Taking medication (e.g. dose containers, measures)</li> <li>• Games and leisure (e.g. using tactile or colour contrast, or audio interfaces; balls with bells inside)</li> </ul> <p><i>Information and Communication Technologies</i></p> <ul style="list-style-type: none"> <li>• Watching TV (e.g. screen magnifier, spectacles, high resolution set, audio description, talking teletext)</li> <li>• Computers and other devices with electronic displays (e.g. screen readers and speech synthesis, accessible public kiosks)</li> <li>• On-line services (e.g. radio reading, remote reading, electronic newspapers and books)</li> </ul> <p><i>The future</i></p> <ul style="list-style-type: none"> <li>• Orientation and navigation using satellites and mobile phones; talking signs</li> </ul>	<p><i>Non-technical:</i></p> <ul style="list-style-type: none"> <li>• Talk in a relaxed manner</li> <li>• Make your mouth visible while talking</li> <li>• Don't shout or talk loudly</li> <li>• Support speech with natural arm movements</li> <li>• Don't change topic too suddenly</li> <li>• Speech-reading</li> <li>• Sign language</li> </ul> <p>Personal assistive devices:</p> <ul style="list-style-type: none"> <li>• Hearing aids</li> <li>• Cochlear implants</li> </ul> <p>Adapted everyday items:</p> <ul style="list-style-type: none"> <li>• Flashing doorbell</li> <li>• Flashing telephone bell</li> <li>• Vibrating alarms</li> </ul> <p><i>Information and Communication Technologies</i></p> <ul style="list-style-type: none"> <li>• Induction loop systems in public places</li> <li>• Text and video telephones</li> </ul> <p><i>The future:</i></p> <ul style="list-style-type: none"> <li>• Speech to written text translation by computers</li> <li>• Smaller hearing aids</li> </ul>	<p><i>Non-technical:</i></p> <ul style="list-style-type: none"> <li>• Giving time to communication</li> <li>• Using mimes, pointing, gestures</li> <li>• Writing</li> <li>• Labelling things with symbols</li> </ul> <p><i>Personal assistive devices:</i></p> <ul style="list-style-type: none"> <li>• Voice amplifiers</li> <li>• Artificial larynges</li> <li>• Headset or hand held microphones</li> <li>• Picture communication boards</li> <li>• Symbol charts and books</li> <li>• Communicators</li> <li>• Alarm phones</li> </ul> <p>Adapted everyday items:</p> <ul style="list-style-type: none"> <li>• Easy to read books, papers and magazines</li> <li>• Tape recorders</li> </ul> <p><i>Information and Communication Technologies</i></p> <ul style="list-style-type: none"> <li>• Text telephones</li> <li>• Fax machines</li> <li>• Memory dialling telephones</li> <li>• Computers with special ways of operation (e.g. operated with eye movements, mouth sticks)</li> <li>• Speech synthesisers and programs for speech synthesis</li> <li>• Voice recognition systems</li> <li>• Bliss telephony</li> </ul>

Source: Increasing the IMPACT of assistive technology Conclusion module, version summer 1999, p18-19

The standard TV remote control could be seen as an AT device as it enables people to change channels or programme the video without moving from their seat. The issue of dependability of systems relates closely to the way in which different technologies interact. Market research has shown that most people cannot or do not know how to programme the video, due to the complexity and lack of usability of this operation. If the remote controller for the television turned the lights out with each use instead of switching channels, then this would be considered unreliable. Yet, technology is still liable for unintended consequences such as blowing fuses or causing some part of a system to not work as intended (through interference or other causes). There is also a growing trend away from diversification of technology into integration, which can be witnessed in the high street stores purveying hi-fi stereo units as opposed to separate pieces of equipment. This is useful for manufacturers as there is reliability level that is built into these designs so individual components should not conflict with each other. These systems also have a level of built in obsolescence the integrated system is only as reliable as the least reliable component of it.

This overview will consider the main people and companies working in the area of technology in the home and will consider the work being undertaken by people researching into smart home technology, telecare and telehealth, and assistive technology.

## 4 SMART HOME TECHNOLOGY

SMART home technology is the utilisation of standard devices to perform complex actions. The heart of smart home technology is that devices can be communicated with and act on the communication. There are four main types of smart home technology, mains borne (e.g. X10 and Powerline), Busline (e.g. Konnex [formerly EIB, BatiBus and EHS] or LonWorks), Radio Frequency (e.g. Bluetooth) and Infrared (e.g. Various). There are a number of high profile key figures working in the field of assistive and smart home technology. The following is not meant to be an exhaustive review of key personnel, but a landscape overview of the most relevant personnel and their work in relation to dependability of smart home technology. Initially an outline of the key personnel or groups is presented that is followed by a brief discussion on the issues that have been determined in relation to dependability of systems and devices.

**Figure 7: Services offered by smart homes**

Service Group	Examples include			
<b>Building</b> - based on monitoring the performance of the building	Heating and energy efficiency	Gas/water supply	External and internal lighting	Fire alarm
<b>Security</b> - based on the safety and security of residents	Doors and window opening/closing/locking	Selective access control	Personal alarms	Intruder alarms
<b>Home control</b> - operated by the individual to facilitate independent living	Doors and window opening/closing	Opening/closing curtains	Turning on and off lights	Using equipment
<b>Telecommunication</b> - provide access to information and communication services	Information on recreation and local services	Library services	Shopping services	Meals services

Source: Porteus and Brownsell (2000, 22)

Smart homes tend to provide rudimentary control over the home. Figure 7 illustrates that typically a smart home operates within four service groups. These groups provide operational functionality rather than proactive intelligence. This demonstrates that a smart home is only as smart as the person who has programmed the device configurations.

### 4.1 Bob Allen from <http://www.stakes.fi> COST 219 and INCLUDE

Bob Allen has worked on a number of different EU projects of which the most notable are COST 219 and INCLUDE. Both these projects sought to determine the efficacy of smart home technology in relation to disabled people. COST 219 initially investigated the usability of a wide range of technology including smart homes and indicated that a buslined smart home was more efficient and reliable than single protocol systems such as X10. The COST 219 project and the INCLUDE project also considered the utility of a wide range of assistive technologies and focused considerable time on the use of telephony equipment. COST 219 promotes research into the field of telecommunications and teleinformatics with the aim of proposing solutions to the problems related to the needs of disabled and older people in providing access to new telecommunication and teleinformatic services. The COST 219 project were the first to consider and evaluate the relevance and usability of smart home technology for older and disabled people. For details on INCLUDE see below.

#### **4.2 David Gann, James Barlow and Tim Venables, SPRU: University of Sussex ([www.sussex.ac.uk/SPRU](http://www.sussex.ac.uk/SPRU))**

Gann et al worked with Joseph Rountree and EQUAL to determine the use of smart home technology for older people. They developed two demonstration houses, one in York and the other in Edinburgh (Edinvar's AID house) to test the technology and determine the most efficient. The York house was designed using a LonWorks protocol system and Edinvar was developed using EIB (European Installation Bus *now* Konnex). The results of these investigations were published in Gann et al (1995), Barlow, J. and Gann, D. (1998a and 1998b), Gann et al (2000) and Venables and Taylor (2001). The aims of the Aid House / Smart Home project were threefold. Firstly, to produce a model user specification for the development and use of Smart Homes in the affordable and social housing sectors. Secondly, to assess the likely markets for Smart Homes and thirdly, to evaluate supply-side issues and lessons from integration and installation in the two demonstration sites. This project has been extensively reviewed by researchers at the University of Sussex. They concluded that the development of the market in Smart Homes would remain slow until there was better understanding of user needs on the part of suppliers and designers.

#### **4.3 Robin Burley: Independent Consultant**

Former Director of Edinvar Housing. Robin Burley was instrumental in developing 'barrier free housing' a mainstream concept. Edinvar were one of the first housing providers to embrace smart home technology with the development of the Edinvar flat in Edinburgh which was part of the Gann et al (2000) study sponsored by Joseph Rountree Foundation. Since leaving Edinvar, Robin Burley has been working as an independent consultant in the field. He is one of the people behind the development of 150-house development in West Lothian, which is using technology for older people (see Kinder 2000). This is being undertaken in conjunction with Tunstall community alarm systems.

#### **4.4 Steve Bonner (Installer): Edinvar Housing**

Steve Bonner is an EIB, LonWorks and Tunstall skilled installer who installed many of the smart homes featured in this paper as well as other lesser-known ones such as the Glasgow dementia flat. Steve Bonner now works for Edinvar as consultant in smart homes and assistive technology.

#### **4.5 ABB UK**

ABB UK has been instrumental in the installation of a number of smart homes for disabled and older people in the UK. They have worked closely with universities and health and social care providers. Peter Haseler and Kevin Henman are the key people with the greatest experience in this type of venture.

#### **4.6 Jeremy Linskell: Dundee University Hospital, EATS**

Jeremy Linskell is the head of a number of steering groups concerning the use and introduction of Smart home Technology throughout Tayside. As an integral person in the CUSTODIAN project, he subsequently has trained and obtained the EIB certificate of proficiency, allowing him to install EIB technology. He is a strong advocate of high-end technology, as his work at EATS requires that he meets the needs of users through appropriate technology.

#### **4.7 Tweed and Quigley: Queens University, Belfast, <http://www.qub.ac.uk/tbe/arc/research/projects/equal.html>**

As part of COST 219, Queens University became involved in assessing smart home technology for older people. The publications from Quigley and Tweed make useful reference material in this area. They have experience of X10, EIB and LonWorks technology as well as telecare systems. They also have addressed issues such as cost/benefit analysis of the equipment for health authorities.

#### **4.8 Malcolm Fisk: Liverpool John Moores University**

Malcolm Fisk has been involved with assistive technology and smart homes since 1995 and has an abundant output of written material. His main concern is appropriate technology to

meet needs, but also considers some of the problems associated with using technology without due care and forethought. Fisk (2001a) suggests that smart homes are useful as they provide the following functions:

**Figure 8: The functions of a smart home**



Source: Fisk (2001a, 30)

He goes on to suggest that lifestyle monitoring and ethical issues need to be considered within any design. Fisk (2001b) contends that systems should act proactively as well as reactively, to prevent as well as alert.

#### **4.9 Roger Orpwood, Bath Institute of Medical Engineering Bath University: (<http://www.gloucestersmarthouse.org.uk/>)**

The Gloucester Smart House has been set up to show the range of ways that technology can assist people to live independently and as a test bed for product development. The focus is on people with dementia and cognitive impairment. The guiding principles are that the technology must be discrete and that technology shouldn't take control of the environment away from the client completely. The focus of this development is the use of discrete monitoring. The house is also available for people with dementia and their careers to stay a few days and test out the equipment.

#### **4.10 Andrew Sixsmith University of Liverpool: PLANEC**

PLANEC is a fourth framework project that is developing a PC-based system for the planning, monitoring and evaluation of services for elderly people. This would aid in promoting cost-efficient care of elderly people, monitoring and evaluation of existing care systems and strategic planning, modelling of alternative strategies for care policy and their consequences. He is also involved in SIMBAD (Smart Inactivity Monitor using Array-based Detectors and Enable-Age (Enabling Autonomy, Participation and Well-being in Old age: The Home Environment as a Determinant of Healthy Ageing)

#### **4.11 Mary Marshall: University of Stirling: ASTRID**

ASTRID sought to develop and evaluate smart home technology for people with dementia. The consortium comprised of Sidsel Bjørneby, Mary Marshall, Steve Bonner, and Brian Frisby from Northamptonshire Social Services. The team built a demonstrator smart home as well as developed and tested various technologies such as memory assistants etc. The ASTRID project produced a guidance pamphlet on using technology within dementia care. The purpose of the guide was to:

- Introduce health and social care professionals, and carers, to the potential of assistive technology and to the various issues including ethical ones, that arise from its use.
- Provide a framework for assessing the needs of people with dementia living at home and their carers, encouraging the use of technological solutions, where appropriate, as part of the overall care plan.

This project/consortium is still working but is now running under the title ENABLE (<http://www.enableproject.org/>)

#### 4.12 Salford University: Marcus Ormerod and Pam Thomas

Salford University Department of Architecture are involved with smart home technology and disabled people. The team are seeking to locate where smart home technology can be used to assist people to the maximum effect. Currently this research has taken a theoretical analysis in the consideration of technology in relation to the social model of disability.

#### 4.13 Portsmouth University:

Portsmouth university have been involved in the design, construction and monitoring of a small group of new homes designed to take advantage of a network of "smart" sensors and controls to maximise independence for disabled tenants and achieve high environmental performance standards. A joint research project with John Grooms Housing Association and Portsmouth City Council match-funded by the Housing Corporation, in collaboration with Portsmouth Disability Forum. Portsmouth are currently building 3 residences for older people.

#### 4.14 Gloucester Smart home:(<http://www.gloucestersmarthouse.org.uk/>)

This project has developed a smart house within which they are testing monitoring devices such as bath shut offs and cooker monitors as well as looking at appropriate communication for the delivery of alerts to the user. The consortium include Bath institute of Medical Engineering, Dementia Voice and housing 21. The team used EIB technology to make the house smart and Kevin Henman from ABB installed the system.

#### 4.15 The Robert Gordon University: <http://www.rgu.ac.uk/subj/search>

The Robert Gordon University (RGU) in conjunction with The university of Porto, University of Reading, Edinvar housing, The Tayside Consortium, and the European Installation Bus Association undertook a three year EU project that developed a software suite of tools that enable non technical people design smart homes to meet the needs of people with disabilities. The software tool is freeware and available for download from the RGU site ([www.rgu.ac.uk](http://www.rgu.ac.uk)). During this time the SMART Thinking website was developed ([www.smartthinking.ukideas.com](http://www.smartthinking.ukideas.com)) which acts as a focal point for highlighting the use of appropriate technology in this field and two smart homes were designed and installed in Dundee. The first of these was a demonstration home and the second was for a couple who required special accommodation if they were to be successfully reintegrated into the community after leaving the Royal Victoria Brain Injury Rehabilitation Unit. Since completing CUSTODIAN, (the software tool) they have been working exclusively on designing appropriate technological residences for people with a range of disabilities. They are currently designing 40 new build residences for adults with learning disabilities in Aberdeen.

#### 4.16 Other Useful Webpages

The following are useful URLs to smart home manufacturer sites.

- EIBA: (<http://www.eiba.com/home.nsf>) The developers association of European Installation Bus technology (a partner in Konnex).
- LonWorks: (<http://www.lonworks.echelon.com/>) The developed of LonWorks Technology
- X10: (<http://www.x10.com/homepage.htm?|logo>) The developers of X10 Technology
- CEBus: (<http://www.cebus.org/>) Another Busline technology manufacturer

- EHSa: (<http://www.ehsa.com/>) European Home Systems Association (a partner in Konnex)
- Bluetooth: ([www.bluetooth.com](http://www.bluetooth.com)) The main Bluetooth website
- BatiBus: ([www.batibus.com](http://www.batibus.com)) A Busline smart home manufacturer (part of Konnex)
- Siemens Smart Home: (<http://www.siemens.ie/House/Smarthome.htm>) a description of Siemens concepts of EIB smart homes.
- Orange: (<http://www.orange.co.uk/orangeathome/intro.html>) developers of the wireless WAP enable smart home for the family or 2005
- 

For further websites on smart homes, telecare and assistive technology see:

<http://www.smartthinking.ukideas.com/links.html>

Or

<http://www.equator.ac.uk/devices/>

## 5 TELECARE and TELEHEALTH

Telecare and Telehealth are the natural extensions of smart home technology as the concern is to use technology to monitor the health and assist medical remote medical diagnosis of users. This is still a relatively new area of research although a large number of groups are involved in this area (see: <http://tie.telemed.org/>). The two groups below reflect the two research establishments that have been considering the field longer than the others.

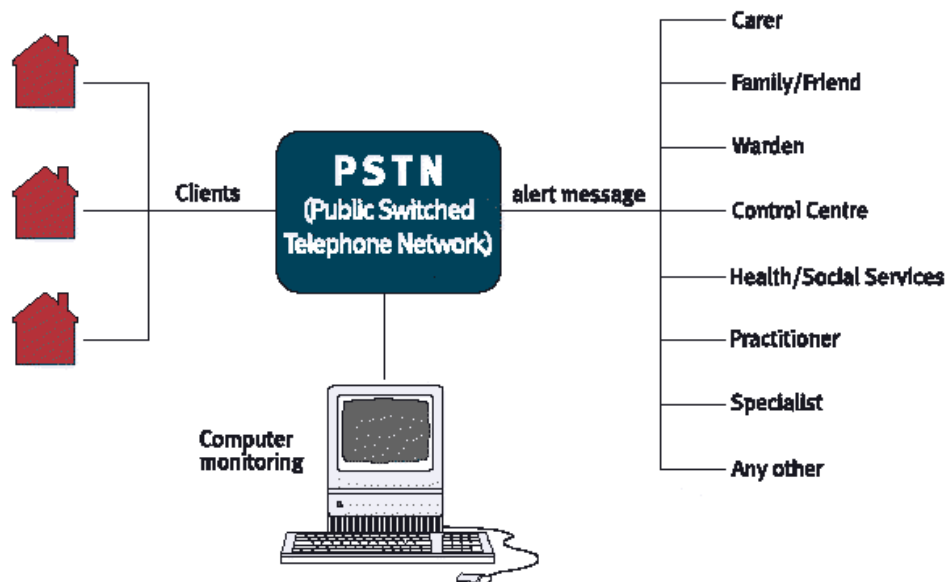
### 5.1 David Bradley and S J Brownsell, Abertay University ([www.abertay.ac.uk](http://www.abertay.ac.uk))

Bradley and Brownsell have been investigating the use of telecare within a remote village in Scotland where a test telecare system was set up. Users, especially doctors found the system to be effective, although a number of ethical issues needed to be overcome. The conclusions from the project are that telecare and telehealth are useful and important for individuals in isolated areas. Moreover, they perceive that telecare systems rather than smart homes are more appropriate for users. Brownsell has also undertaken work with Jeremy Porteus and the Anchor Trust/BT see below.

### 5.2 Jeremy Porteus Anchor Trust: Anchor/BT

Anchor Housing Trust is a major provider of sheltered and warden assisted accommodation in the UK. They have collaborated with BT to place sensors around some of these individual homes. The data collected provides an indication of how the occupant interacts with their environment and provides a measure of security. The data is transmitted to the Warden's flat (which may be off-site). This increased level of support was the main reason that most residents agreed to the trial, though there is clearly a concern that control of the distribution of the information must remain with the resident. Collection of such data (movement sensing, toilet usage, food preparation etc.) allows a pattern of daily living to be developed. This is an extremely powerful predictive tool that can be used both to alert carers to a potential crisis and in the longer term to monitor a person's well being. Anchor are currently involved in a new build development for older people in Kendal.

Figure 9: The Monitoring System for Anchor



Source: Anchor trust (1999, 3)

A key feature of the Anchor project and that of Kevin Docherty's work (see below) is the idea of life style monitoring in which patterns of daily activity are recorded over time and a general pattern of the occupants activities are discerned from the data. The pattern of activity is then used as a yardstick from which to determine when out-of-the-ordinary events occur and thus alerts are sent on these occasions. The main dependability issue is that false alerts should

not be triggered by no-standard events that are acceptable (for example friends coming to the house to visit or Birthdays etc). Porteus and Brownsell (2000) collected over 5,000 days of lifestyle data which was cross referenced with detail histories of the occupants in order to obtain the full picture of the occupants patterns. The application of refrigerator magnetic reed switches was used as an early indicator that the resident was awake and normal patterns of daily activity were determined and tested.

### 5.3 Kevin Doughty: Technology in Healthcare

Kevin Doughty has been working in AT for a considerable time designing AT devices which are configurable into a smart home system. He is the founder of Technology in Healthcare. OPAL – The Older Person's Assisted Living flat is a single bedroom home in which a number of sensors and assistive devices have been installed in a way that demonstrates their non-intrusive nature and their potential for automatically detecting problems through continuous monitoring. The project is designed to show how an existing dwelling can be easily modified to support independent living. Doughty has been involved in a number of other technology projects designing devices to enable disabled people. These include CarerNet (an Integrated and Intelligent Telecare System), a Smart fall and activity detector (FRED), Automatic shut offs on gas detection and cooking appliances (INGRID, HETTIE, CHARLES, SIBIL, EMMA and TONI), FLORA (Flood Response Alarm), Distress alarms (BELINDA and BRENDA), an anti scolding device (WALTER), a night wandering alert device (AWEN), TED (the electronic doctor telecare system, and DIANA (a telecare system for supporting dementia sufferers). Other devices include reminder devices (MARIA, EDITH and BETTIE), Video surveillance (VIOLET, DAVINA and DAVID), and is developing a smart home interface (MIDAS). Doughty has also been instrumental in the installation of four systems in County Durham within sheltered managed homes (see Doughty 2000a & 2000b). Doughty considers systems can be used to indicate emergency situations but can also be designed to monitor the resident and alert when there are significant changes or declines in the occupants health.

### 5.4 SPRU, University of Sussex, The TCPI project

(<http://www.sussex.ac.uk/spru/imichair/projects/template.cfm?content=telecare.cfm>)

SPRU are currently researching telecare into three forms of telecare initiatives, TCPI, eHealth and Medicate. According to James Barlow who heads these projects, there are three more projects to follow soon. The rationale behind the projects is as follows:

- Continuous health monitoring, screening, routine diagnostics, health risk appraisal, basic counselling, advice and information provision.
- Improved security and safety in the home.
- Promotion of independence.
- Integration with existing products designed to help with daily living.

Telecare can potentially help to meet the objectives of providing care in the community by optimising resources, supporting independent living and enhancing the quality of face-to-face contact with carers. However, suitable models for its implementation have so far proved elusive. Trials have tended to be small-scale, generally focusing on one particular medical condition. Moreover, the focus has been on improving communications between remote medical staff. The TCPI project will demonstrate to industry, government and users, which approaches to telecare, are potentially most effective. Beneficiaries could include:

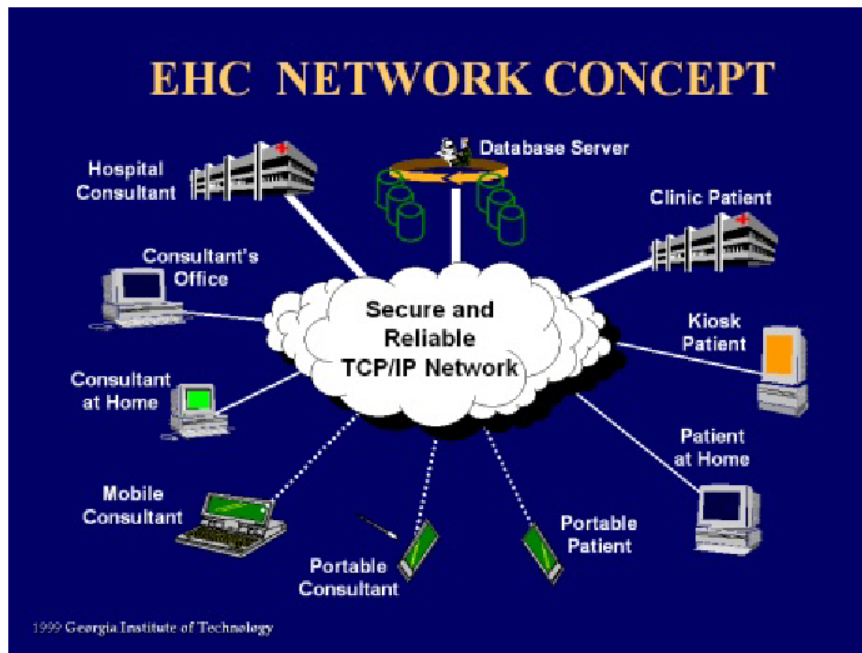
- People who require health services, through the introduction of efficient customer-centred, flexible approaches to telecare.
- Health care, social services, housing, voluntary and charitable organisations, by demonstrating the possibilities of telecare, and ways to improve value for money and customer satisfaction.
- Central government, by demonstrating opportunities for service modernisation, policy formulation and resource planning.
- Industry, by identifying market opportunities for telecare products and services

For more information see: Tang, Gann and Curry (2000)

**5.5 The Electronic House Call (EHC): Georgia Institute of Technology**  
<http://www.bitc.gatech.edu/EHC/index.html>

The EHC system is a telecare system developed by Georgia Institute of Technology that enables residents to remain at home for a longer period prior to hospitalisation. It provides a link between the home and other key people and databases where medical information about the occupant are stored.

**Figure 10: The Electronic House Call system**



Source: <http://www.bitc.gatech.edu/bitcprojects/ehc/indexEHC.html>

Occupants can use the computerised system from their home and receive accurate monitoring of their conditions from their own homes.

**Figure 11: A screen shot of the EHC GUI**



Source: <http://www.bitc.gatech.edu/bitcprojects/ehc/indexEHC.html>

This project is currently trying to be commercialised by a company called CyberCare Inc. that was formed by the partners of the project to exploit the developed tools.

## 6 ASISTIVE TECHNOLOGY

There are a number of excellent centres in the UK who are undertaking useful work in the area of AT. It is difficult to single out any without losing a large wealth of potentially useful projects. Below a list has been compiled based on the authors use of the work by the members of the projects.

### 6.1 Laura Gitlin, Thomas Jefferson University, PA: <http://jeffline.tju.edu/CWIS/DEPT/chord/index.html>

The inclusion of Laura Gitlin is due to her work for the past ten years on the use of Assistive Technology with reference to older people. She is one of the few exponents to equate technology with benefits whilst understanding the difficulties with its usage. Although she is not wholly concerned with technology from a systems perspective, she has written extensively on the appropriate use and inappropriate use of technology to enhance older people's quality of life. She takes a person centred approach in her fieldwork and analysis as the following figure 12 demonstrates.

**Figure 12: Gitlin's recommendations for home modification for people with dementia**

- Observe each room of home
- Evaluate individual capabilities, family concerns, and environmental features
- Involve family members and, if possible, the person with dementia in the evaluative and decision-making process
- Introduce small, incremental changes to the home environment
- Use role-playing or demonstration to instruct in use of new strategy
- Readjust environmental strategies based on family feedback as to what worked best
- Provide family with information about the disease process and how to obtain other environmental strategies in the future

Source: Gitlin (2001)

Gitlin's importance extends beyond the person centred approach as a considerable body of her work has been looking at why older people take up or reject technological interventions in their lives. Figure 13 demonstrates some of the key findings from her work.

**Figure 13: Gitlin's reasons why devices are used or abandoned**

#### REASONS FOR DEVICE USE AND ABANDONMENT

- Tasks made easier to perform
- Comfortable to use
- Provides emotional security
- increases safety
- Improves function
- Facilitates independence
- Enhances ability to get around

#### REASONS FOR DEVICE ABANDONMENT

- Client's functional ability improves
- Use of one device contingent on use of another
- Lack of knowledge about how to use device
- Poor fit with environment or person's need
- Device lost, forgotten, or never taken home from hospital
- Device failure
- Preference for personal assistance
- Feelings of embarrassment
- Denial of need

Source: Gitlin (1995)

Clearly, in any system designed for older or disabled people, it is important to consider issues of usability, yet Gitlin's work considers issues that would not traditionally be considered by developers, such as embarrassment.

## 6.2 IMPACT (<http://www.fz.hse.nl/causa/impact/>)

Currently available assistive technology and ICT enables disabled and elderly people to more fully participate in daily life. From a technological perspectives, these technologies are often state-of-the-art and results of intensive R&D activities. From a human perspective, these applications make the difference between being able to participate in society or not. However, from a social perspective, these applications too often are restricted to a small number of persons. Dissemination of the achievements to a larger group of users is hampered by shortage of resources and unstructured and insufficient information on what is currently available for which purposes. It is deeply frustrating to know about all the available products and R&D activities in assistive technology and still meet professional carers and end-users not having any knowledge about basic concepts of assistive technology. While IMPACT can unfortunately not address the shortage of resources, it does aim to increase the awareness of and knowledge about assistive technology amongst professionals in health and social services. These aims are to be pursued primarily through a survey of existing and the development of new educational materials for pre- en in-service usage in different European languages (using both traditional methods as well as multimedia). The newly developed educational material would consist of student's manual, teacher's manual, case studies, software and sample data. Potentially, a European network will be established bringing together persons from user groups, educational partners and service providers.

## 6.3 TAURUS (<http://www.lboro.ac.uk/taurus/index2.htm>) Loughborough Uni

TAURUS provide a consultancy service for companies wishing to make the most of new market opportunities - 'the grey pound' as well as conducting research into the design, usability and safety of products for older people. They also provide information and training, make representations on key standards making bodies and co-operate with voluntary and statutory agencies to improve quality of life in ageing populations through design and technology. They intend to promote awareness of inclusive, appropriate and safe design

## 6.4 CoRE: Alan Turner-Smith, the Centre for Rehabilitation Engineering, University of London (<http://www.kcl.ac.uk/depsta/kcsm/mep/core.htm>)

Alan Turner-Smith is a central figure in the development of appropriate technology for older and disabled people and has been a member of a number of Government investigations into technology in this area. CoRE are an AT research group which also act as a teaching department. They are currently involved in a six projects:

1. **Provision of Electronic Assistive Technology:** Frequent enquiries from consultants and schools concern the feasibility of connecting together items of Electronic Assistive Technology (EAT). CoRE has investigated how EAT is currently supplied in the region and how its provision could be co-ordinated technically and across the various funding agencies, healthcare services, and community services.
2. **Effective Models for Service Provision of Assistive Technology:** With the changes to the structure of the NHS over recent years extremes of models of service delivery are evolving. CoRE is conducting a survey to record the performance of these models of service, and is analysing its findings to highlight the optimum mix of models that will ensure a consistent, responsive and sustainable service across the country
3. **TELEMATE:** TELEMATE introduces an educational concept that allows integration of all required areas of knowledge by participants with all educational disciplines and levels. This enables a single framework to provide a common pattern for the development of training packages in all European countries, allowing exchange of knowledge and personnel to the benefit of users.
4. **MAPS:** The objective of MAPS is to develop an interface for amputees, where physical data for the stump can be gathered over a period of time in normal action. The concept is called the Sensor Socket (SES) and aims to incorporate relevant sensors into sockets that are used as interface between the stump and the prosthesis. The system includes telecommunications equipment needed for sending data from the SES and receiving it remotely.

5. With the **Reading University Research Group for Inclusive Environments, Research Projects: Peter Lansley and Kings College London, (<http://www.rdg.ac.uk/ie/research.html>) REKI**: The research is concerned with the introduction and use of a wide range of AT in existing (older) housing occupied by older people, as opposed to new building initiatives. There is likely to be considerable variation in the feasibility and cost of introducing AT which will not only relate to user needs but also to the age, type and standard of property. If AT is to be introduced on any significant scale to support care in the community of older people, it must be easy to use, cost effective, flexible, easy to install and maintain, and compatible with other technologies and services.
6. **WAYFINDER**: Older Users' Perspectives on Mobility-Related Assistive Technology Research

### **6.5 INCLUDE (<http://www.stakes.fi/include/>)**

The INCLUDE project is a 4 year cooperation between the main European experts on the issues of telematics applications and elderly/disabled people. The goal is to ensure, that issues of importance for these groupings are optimally addressed at programme, sector and project level within the Telematics Programme. INCLUDE has set up a database and website that is updated containing information on Accessibility, Universal Design, designing accessible products and marketing these products. INCLUDE aspires to assist companies and developers in designing appropriate technology to meet the needs of disabled and older people.

### **6.6 INTEGER (<http://www.integerproject.co.uk/>)**

INTEGER is a consortium of over 150 companies promoting "intelligent technology for managing the systems within the home and for communications to and from the home" The demonstration house, which featured in the BBC TV series "DreamHouse" utilised a variety of devices to improve control, comfort, safety and security as well as to assist in energy conservation. The consortium is currently working on plans for the construction of around 100 social housing units at sites throughout the UK.

## 7 TYPES OF TECHNOLOGY, AVAILABILITY AND RELIABILITY

There are an almost infinite number of technologies available for older and disabled people. They range from individual one-off bits of kit to solve a specific problem through to whole house smart home/telecare systems. In order to address the question of the differing technologies, it is best to consider them within the format previously used, namely, Smart home, Telehealth and Assistive Technology.

### 7.1 Smart Home Technology

Smart home technology is available in three main areas: Powerline (X10, EIB Powerline etc); Busline: EIB, Cebus, Lonwork, Batibus EHS etc) and Radio Frequency (RF) (eg Bluetooth, and most major smart home manufacturers).

Powerline systems are made of devices that can be connected directly into the main power supply (240 a/c current in the UK). These devices use the normal wiring to send data to the devices to activate or deactivate them. Powerline technology is enthusiastically used by amateur smart home enthusiast as the devices are simple to configure and a system can be up and running quickly and cheaply. Should the system fail then the installer should be able to repair it on the spot or by locally sourced devices. Often, Powerline systems require a computer to be attached to the system to monitor the devices, change their status, although many newer systems use the X10 coding in proprietary systems, and have bypassed the need for computers by placing the chipsets into the system itself. Many Powerline systems are in use today and some are used to support older and disabled people. Often the major problem with this system is related to interference and power cuts, which can throw the system into chaos, as default reset values can be unsuitable for the client group. X10 and many other Powerline systems are easily available. This product is used frequently as it can be made from off the shelf items that are cheap, but Powerline systems have not been found to be reliable.

Busline smart homes use a separate 12-volt cable (twisted pair) to transmit data to devices (the busline), which runs in parallel to the traditional mains cable. The use of this cable means that devices are independent of conventional mains borne power supplies. The busline devices can be configured to adhere to stricter operational parameters and therefore systems that are more complex can be envisaged. Busline has, to date been proven to be the most effect and reliable form of smart home (Berlo, 1999), as it can be configured to prevent devices malfunctioning during power cuts. The two-way protocols also allow the systems themselves to monitor devices without recourse to external computerised systems. Figure 14 shows how busline technology operates alongside the standard wiring of a home and devices can use both cables to achieve their intelligence.

Figure 14: An illustration of the EIB Busline

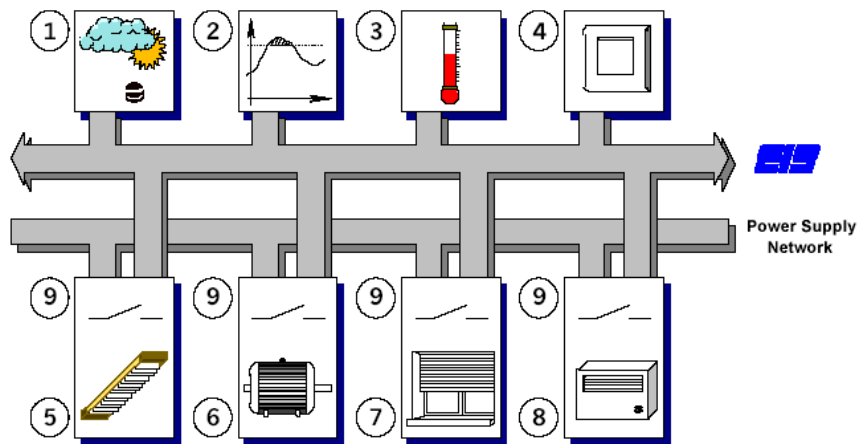


Fig. 1/2-1: Bus and mains networks

- |                     |                       |                  |
|---------------------|-----------------------|------------------|
| ① brightness sensor | ② threshold detection | ③ sensor         |
| ④ monitoring        | ⑤ lighting            | ⑥ motor control  |
| ⑦ window blinds     | ⑧ heating             | ⑨ 230V switching |

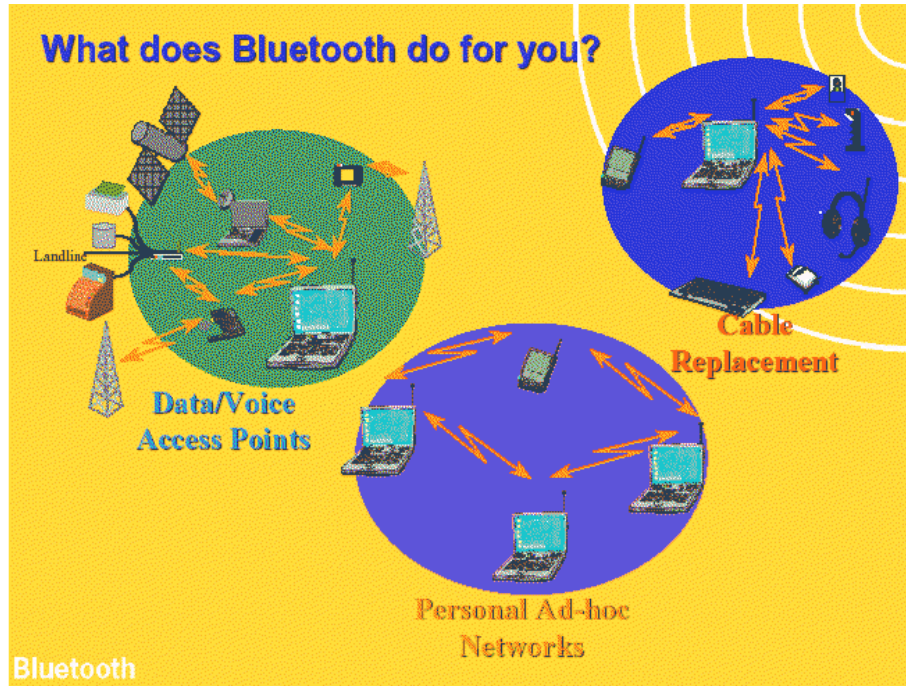
Source: www.eib.com

Busline technology was developed for large buildings such as offices and factories and therefore uses high quality components that have been tested rigorously which is ideal for use in high dependency systems. This high specification for products is also reflected in the price of items that are expensive and not always easy to obtain, due to the small number of providers of the technology (ordering can be unreliable and there can be large waiting times for equipment). Konnex (a consortium of European busline manufacturers) have decided on a standardised protocol for all systems that was achieved in 2001, making interoperability between European busline products easier. LonWorks who manufacture the Lon Chipset (the fastest chipset) have no standardisation agreement and therefore their systems are proprietary and the protocols are likewise proprietary. This can mean that integrating busline technology between competing systems (if Lon based) can be fraught with difficulty. Other issues concerning busline systems originate from the use of add-ons to the system. Many busline smart homes require the use of additional devices such as door or window openers which can be sourced from busline compatible companies, but prove to be too expensive for most users, so cheaper non two-way protocol devices are used instead. This means the system can become weak when these devices are added to it. The busline can usually tell what devices are connected to it and the status of each of these devices. Once non-busline (non two way protocol) devices are added the system can no longer determine the status of these devices and has to assume they are working appropriately.

Radio frequency (RF) and Infrared (IR) systems are becoming increasingly more popular. Most manufacturers of smart home technology have a RF product range. These products have tended to be perceived as less reliable due to problems with interference and short-range identification issues, although recently there has been a shift towards more robust whole systems. Many social care alarm systems are using RF components as standard although they may configure these into a busline or Powerline system. RF systems have been criticised as they could be broken into by an intruder with the correct IR code who could possibly gain access to the home or modifying the settings of devices.

The newest network protocol is called Bluetooth which is an open source protocol allowing bi-directional networking between close proximity RF devices. Figure 15 illustrates some of the potential uses of this system.

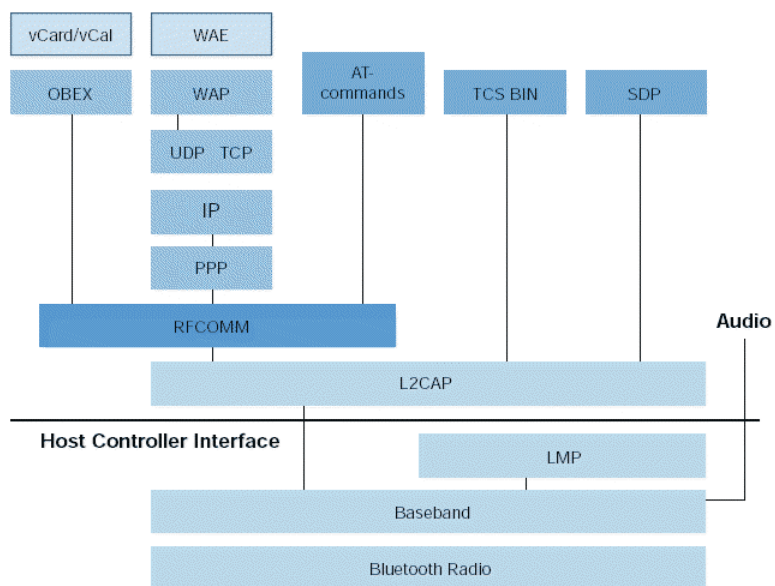
Figure 15: An Illustration of what Bluetooth can do



Source: Kardach (1998)

The interesting part of Bluetooth is that it enables a wide variety of interoperable devices such as WAP telephones through to standard home networking and smart home devices as expressed in Figure 16, which illuminates the protocol stack for the system. Bluetooth is modifying consistently and consequently is becoming more robust and reliable. Although there are few Bluetooth networks available at present, this is one of the strongest new systems for the future telecare and smart home market.

Figure 16: The Bluetooth Protocol stack



*The Bluetooth protocol stack*

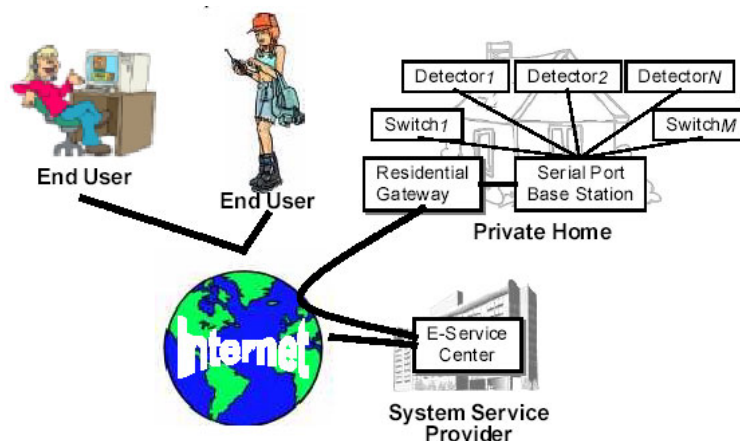
Source: Kardach (1998)

## 7.2 Telecare, Telehealth Technology and Residential Gateways

Telecare systems are still in their infancy and there are no proprietary systems available on the market at this time. Systems are designed using one off AT devices such as blood pressure monitors and configured into a standard systems such as a smart house system of a call system. Both telehealth and telecare systems rely on the use of the Internet or telephone lines as a means transferring information from the source (the house) to the receiver (the doctor/nurse etc). This relies on a Residential Gateway (RG) and a number of security issues surround the use of this form of data transference.

RGs allow the home to be connected to the outside world through a dialup connection that sends signals to a remote location. RGs can be used within smart homes to allow installers to modify settings within the home without being required to visit the property. This is highly cost effective but is open to security issues should someone break into the code by dialling the numbers. It has been suggested that it could be possible for a whole house to be reconfigured whilst the occupant is away or for thieves to gain access to a property that might appear to be well secured by breaking into the RG. RGs also rely on fast telecommunication protocols such that users should have ADSL or DSL lines in their homes. This requires that the home is constantly connected to the external world and hence the security problems are increased. Herzog and Shahmehri (2001) demonstrate that within the e-service *Monitor and Control* the residential gateway on the home net are accessible by e service clients via the internet only after authorisation at the system service provider. The RGs are configured to reject all other service traffic than that from the system service provider, yet they allow ftp download and web browsing from the home net without system service provider interference (See Figure 17).

**Figure 17: The Network Architecture of the *Monitor and Control* service**



Source Herzog and Shahmehri (2001)

There are also a number of ethical problems associated with RGs. These concern the appropriate data transmission, what is ethically acceptable to be transferred to external sources. There is little control over the data that leaves the home. There is little control over who has access to this data and what is done with the transferred data. The Data Protection Act does not cover this form of data transference as it is still in its infancy.

Davies and Raverdy (2000) contend that the future home networks will consist of multiple networking and platform technologies integrated through a series of gateways and shared devices. They go on to suggest that it is for developers to build heterogeneous middleware platforms which are irrespective of the operating system used. This does bode the question that the more heterogeneous middleware platforms there are which are working irrespective of operating systems there are, the more potential security threats and more holes that will be required to be filled leading to a possible unstable whole system. Wang et al (2000a) contend that there is a need to monitor device configurations to detect abnormal patterns. Wang et al (2000b) suggest that the home networking environment is more heterogeneous and dynamic than traditional network environments as consumer devices are likely to be connected to different networks, running different protocols and madder by different manufacturers.

### 7.3 Assistive Technology

As would be expected, the availability of AT devices depends on the device required and its price. The more expensive the device the more difficult it is to obtain it is often the rule. AT devices are often made by small companies who have limited turnovers. Abledata ([http://www.abledata.com/Site\\_2/Default.htm](http://www.abledata.com/Site_2/Default.htm)) lists approximately 19,000 devices available in 2000 different countries and the Disability Living Foundation (<http://www.dlf.org.uk/centre/inventory/index.htm>) contains 1489 pages on devices and distributors in the UK making AT a varied and widely accessible series of products. Often AT is designed on a one-off basis to answer a specific problem that is determined to need a solution. Other forms of AT are more widely available such as walking sticks, zimmer frames, communication assistance, wheelchairs etc. High-end AT such as devices that interact with high-end technology (smart homes, telecare etc) is more difficult to obtain and in many cases are not commercially available. In the UK Electronic Assistive Technology Services (EATS) would be contacted to provide this form of technology. Often simple high-end devices can be difficult to obtain or have problems in terms of configuration with the other technologies used in the house. Often the user of high-end technologies will have a number of different systems running simultaneously (HVAC, door openers, window openers, telecare remote monitoring, internal monitoring systems etc) and these are not always easy to configure together or to run from one source. Control panels are required to be usable by the occupant and ideally one control panel should suffice for the whole house. Control panels as with all technology put into the home need to be free of conflicts, interference, reliable, have battery back-ups, be usable, and not so bulky that they become a burden to the user.

## **8 Conclusion**

This paper has attempted to draw together the main people and companies working in the field of smart homes, telecare, telemedicine and assistive technology. It has undertaken the summation with a critical view considering aspects of dependability and applications relating to ubiquitous computing. The paper has tried to show that the area of technology within the home although full of problems does have real and practical solutions that can enhance the quality of life for people who rely on the technology for empowerment and operational activities.

The paper has also tried to demonstrate that technology is not a panacea and cannot replace human contact or undertake all things for all people. It is most useful when correctly and appropriately designed to meet the needs of a specific user (Dewsbury 2001, Dewsbury G, Taylor B & Edge M (2001), Peterson et al 2001).

Throughout the paper, an attempt has been made to show that there is considerable hope for technological interventions within the home. Moreover, technology is only beginning to realise its true potential within the domestic arena.

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