

# **Review of the current status of research on ‘Smart Homes’ and other domestic assistive technologies in support of TAHI trials**

*Prepared for*

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## 1 **Executive Summary**

The study provides an overview of developments in smart home technology and its use in the assistive technology sector. It includes an extensive literature review and detailed descriptions of current smart home installations in the UK and Europe.

The report highlights the complexity of providing products and services in this area, and the relative immaturity of smart home technology in this sector. Many of the available products have emerged from office automation technologies developed for use in building control applications or from small niche markets in the assistive sector. Smart home developments have also concentrated on home control applications, but larger potential markets are also now being identified in other areas. Many of the trials described use technology to improve the safety and security of older and disabled people, concentrating more on the monitoring rather than home environment control.

The report also demonstrates the practical difficulties faced in developing services in this sector. For many organisations these have been exploratory first steps in the use of technology to support care, and this lack of experience is reflected in common difficulties in specification and installation of equipment especially when retrofitting installations into buildings.

Many developments have suffered from the lack of relevant experience of electrical and other contractors, so that it has proved difficult for organisations to identify both suppliers of equipment and people with the skills to install the technology. In the majority of cases there has been no formal evaluation of the developments, and it is therefore difficult to obtain evidence of the costs and benefits of using such technology to provide care and support independent living.

## 2 Introduction

Although there is no single acceptable definition of a ‘smart home’ and other terms have also been proposed, for clarity the term ‘smart home’ is used throughout.

Home automation is also not a new concept and many homes have components of home automation installed, some of which can also support those with disabilities by allowing simplified access to devices within the home, and social alarm systems that link the home to remote care centres.

Although smart home technology has failed to make a great impact, there are now a number of ongoing experiments investigating how such technology can provide assistive technologies and how it can be applied in the social housing sector and the cost/benefits of doing this.

### 2.1 Definitions

There is no single accepted definition of a ‘smart home’. It has been defined as:

- ‘a house or working environment, which includes the technology to allow for devices and systems to be controlled automatically ([www.smart-homes.nl](http://www.smart-homes.nl)); and
- ‘the integration of technologies and services, applied to homes, flats, apartments, houses and small buildings with the purpose of automating them and obtaining and increasing safety and security, comfort, communication, and technical management’; and
- ‘the term commonly used to define a residence that uses a home controller to integrate the residence’s various home automation systems. Integration of the home systems allows them to communicate with one another through the home controller, thereby enabling single button and voice control of the various home systems simultaneously, in pre-programmed scenarios or operating modes.’ <http://www.smartthinking.ukideas.com/IntellBuild.html>; and
- ‘one where smart technologies are installed and where those technologies facilitate automatic or user-initiated *communication*, involving a range of appliances, sensors, actuators and switches.’ Malcolm Fisk (in Peace, S. & Holland, C., 2001)

Furthermore, the term Smart Home is not without its critics, and a variety of alternative terms have also been used to refer to this field including Domotics, from a contraction of the Latin word "domus" (= home, house) and telematics.

It is apparent that the current generation of Smart Home Technology is anything but intelligent, being restricted to relatively simple monitoring and control systems.

However to avoid confusion the term Smart Home will be used throughout.

## **2.2 The Role of Smart Home Technology in Social Housing**

Home automation is not a new concept and many homes have components of home automation installed, including domestic central heating, washing machines, home security systems, and even the remote controls for television and video recorders.

Such technology can also support those with disabilities by allowing simplified access to devices within the home, and social alarm systems that link the home to remote care centres. Despite this potential, smart home technology has failed to make a significant market impact in both the mainstream and assistive technology sectors. This has been due to a lack of available products and of a clear focus on the applications that will sell this technology to a mass market.

There are now a number of ongoing experiments investigating how such technology can be applied in the social housing sector and the cost/benefits of doing this. For example care is needed to ensure that smart home technologies do not remove choice and control from the user through an over-reliance on automation, and also that proper consent is given when any personal information is transferred to third parties. (Peace, S. & Holland, C., 2001).

It is also important to make a clear link between disabled people's social exclusion and the lack of accessible homes that make the best use of available technologies. Disabled people, and not just the wealthy, have a right to the use of inclusive design, using smart technology, as standard, not as a 'special need' (Thomas, P. & Ormerod, M., 2001).



The European Commission has funded a number of initiatives to promote the independence of older and disabled people through the use of technology, and has also published a number of relevant reports, for example, *The Role of Technology in Prolonging Independence of the Elderly in the Community Care Context* (Cullen, K. & Moran, R., 1992).

Within the UK, a number of events and programmes are also driving initiatives in this area including the EPSRC's (Engineering and Physical Sciences Research Council) special initiative to enable engineers and scientists to collaborate, and to work directly with older and disabled people and their representatives on issues to improve the quality of life (see <http://www.fp.rdg.ac.uk/equal/>).

The key document 'NSF for Older People' has identified the potential of new technology to enable older people to remain independent and is driving health and social services for older people.

<http://www.doh.gov.uk/intermediatecare/icmovingforward.htm>.

Furthermore, a report by the Royal Commission on Long Term Care, 'With Respect to Old Age,' (1998), emphasises that the most care recipients want to live in their own homes, and equipment is as a key way of helping people to remain independent (available from the HMSO – Tel: 0171 873 0011).

The Department of the Environment, Transport and the Regions (DETR) (Great Britain, Department of the Environment, 2002) note that there are over a million users of community alarm systems in the UK. However, in most cases the user must initiate the call and there is a need and the potential for smart homes and telecare systems that can adopt a more proactive approach to care. Systems that anticipate emergencies by monitoring a variety of conditions in the home and responding accordingly are clearly preferable to those that respond to them. Such technological solutions will help older people to feel safe and secure at home.

<http://www.housing.dtlr.gov.uk/information/hsc/olderpeople/06.htm>

### 3 What residents need and want

Elderly and disabled residents will have very diverse needs and contrary to popular belief can be avid users of, and also readily adapt to, technologies, but that they do have special needs that must be met. To this end a number of studies have been carried out to ensure that this requirement is satisfied.

#### 3.1 Introduction

Whilst it is clear that the needs and wants of customers who are elderly and disabled will be extremely diverse, we do know that like all building occupants they want:

- Comfort - “this is a given, yet hard to deliver”;
- Reliability - “let me know when something goes wrong”;
- Minimal energy costs - “maintain comfort yet pay as little for energy as possible”;
- Minimal interaction - “it should just work”.

And they also want:

- Low cost - “minimal first cost”;
- Safety - “protect my family”;
- Simplicity - “don’t make me do anything!”

Contrary to popular belief older people can be avid users of, and also readily adapt to, technologies (Fisk in Peace, S. & Holland, C., 2001) , but they need to see clear benefits before acquiring them. A lower take-up of such technologies by older people is to be expected as many technologies are marketed specifically at the young and older people are often unaware of them or unable to recognise their wider applicability.

#### 3.2 Early research findings

Key research into the needs and wants of elderly and disabled people began with the EU TIDE project ASHoRED (Adaptable Smarter Homes for Residents who are Elderly and Disabled People), which ran from 1992-3. These user needs were then addressed in the ASHoRED project demonstrators located in Germany, Finland and Spain (Richardson, S.; Poulson, D.; Schmeling, A.; Horelli, L.Dolz, J., 1993).

Following on from ASHoRED, the CASA project (Concept of Automation and Services for people with Special Needs) started in 1994 and looked not just at standalone intelligent home technologies but also at how to integrate the hardware with outside support services. The emphasis was on using home systems to monitor the home, mainly for safety reasons, by linking them to a remote service centre. Major areas for development were home safety and monitoring, home security, alarm and monitoring services, advisory services, and to a lesser extent video-telephony and environmental control applications (Poulson, D.F., 1995b; Poulson, D.F., 1997; Poulson, D.F., 2001).

Other early work to ensure that user needs are met when choosing environmental control devices and other electronic aids, e.g. by the Danish Building Research Institute (Ambrose, I., 1993a; Ambrose, I., [1993b]) identified five steps to ensure optimal co-ordination from the first analysis of user needs to the fully functioning system:

- Analysis of needs;
- Choice and purchase of equipment;
- Installing, instruction, running-in;
- Use of device, maintenance;
- Feedback.

Dewsbury et al developed a set of high-level guidelines to inform future designs in the smart home area (Dewsbury, G.A., 2001; Dewsbury, G.A.; Taylor, B.; Edge, M., 2001a; Dewsbury, G.A.; Taylor, B.; Webster, R., 2001) which recommend, for example, that 'Undertaking a full user needs assessment is critical to determine if technology is appropriate to meet the needs of the person'. The guidelines demonstrate the conflicting requirements and emphasise there will never be a standardised smart home that will meet everyone's needs.

<http://www.smarthinking.ukideas.com/Articles.html>.

## 4 Smart Home Technologies and Services

Different communication protocols and technologies have limited the development of smart homes. Each has potential advantages and disadvantages and no single solution is ideal for all application areas so that a hybrid of different technologies is likely to be found in a smart home. Guidance is available from a number of studies.

### 4.1 Introduction

The development of smart home technologies and services has been somewhat limited by different communication protocols and technologies. See [www.smarthomeforum.com](http://www.smarthomeforum.com).

These differ in their sophistication and maturity with some protocols being specifically developed for a consumer market e.g. X10, EHS and CEBus, and others emerging from office automation and the control industry e.g. EIB and LonWorks. There are also a variety of technologies for linking smart home components together.

Dewsbury et al describe the 4 main types of smart home technology as:

- Mains borne, e.g. X10 and Powerline;
- Busline, e.g. Konnex Association (formerly EIB, BatiBus and EHS) or LonWorks;
- Radio Frequency, e.g. Bluetooth;
- Infrared, of various types.

(Dewsbury, G.; Sommerville, I.; Rouncefield, M.; Clarke, K., 2002 working paper).

<http://www.comp.lancs.ac.uk/computing/research/cseg/projects/dirc/documents.htm>,

Each has potential advantages and disadvantages and no single solution is ideal for all application areas so that a hybrid of different technologies is likely to be found in a smart home.

### 4.2 Mains borne communication systems

Easy to install, but can be prone to electrical interference from 'dirty' power lines. Where mains operated devices are needed, such as lights and actuators, it can make installation easy, but where significant numbers of sensors are required it can be limiting.

### 4.3 **Bus operated systems**

Require additional wiring in the home which can make retrofit installation more difficult, but likely to be more reliable, which can be important for safety critical information such as alarm states.

### 4.4 **Radio frequency transmission**

Becoming increasingly popular as it can make retrofit installation of sensors particularly easy. Sensors can be located anywhere without extensive rewiring, and modern battery technology means sensors can operate for years without battery replacement being needed. Increasingly these technologies are also being used in home security and social alarms systems.

### 4.5 **Infrared communication**

Well established as a communication medium for home systems, and ideally suited to controlling existing home devices such as televisions and video recorders. It can also be used to provide a user interface to a smart home system, allowing freedom of operation of any component. It also provides some flexibility for the connection of more specialist assistive devices for severely disabled people such as environmental control systems and communication devices. However it is limited to line of sight operation, and is also not particularly suitable for transmitting secure information.

### 4.6 **Advice and information**

A reference of currently available control and communication systems to assist elderly people in their own homes has been produced by the EPSRC EQUAL project, Integrated control and communication systems for distributed sheltered housing in the community. <http://www.qub.ac.uk/arc/research/projects/equal.html>

Another study of smart home technology and its potential environmental control application for people with disabilities can be downloaded from [www.stakes.fi/cost219/FIELDBUS.DOC](http://www.stakes.fi/cost219/FIELDBUS.DOC),

Porteous and Brownsell have also categorised the services that these technologies provide in the smart home environment under four main service groups:

- Building (monitoring the performance of the building);
- Security (safety and security of the residents);

- Home control (operated by the resident to facilitate independent living);
- Telecommunication (using information and communication services).

(Porteous, J. & Brownsell, S.J., 2000).

## 5 Controls and Displays for Smart Home Technologies

A number of studies have led to guidelines and principles for all types of controls and displays being published. The types of controls and displays and their associated systems that have been considered include:

- Electrical supply and control
- Personal Digital Assistants
- Alarm Systems
- Home automation
- Housing products and services

Adherence to the advice will ensure that controls and displays are more usable and acceptable for older and disabled people, who may be working to the limits of their abilities but whose needs for support may be greater than those of the general public.

### 5.1 Electrical supply and controls

Palfreyman considers both the location of switch and socket outlets and the design of controls so that users, including elderly and disabled people, are able to operate them safely (Palfreyman, T., 1990). The emphasis is not on smart home technologies but it demonstrates the need to avoid awkward, overly discreet controls that may be mounted in inaccessible places, although no guidance is given on the choice of appropriate technical components. <http://www.cae.org.uk>

### 5.2 Personal digital assistants

Orrell and Randell (Orrell, D.H. & Randell, R.E., 1995) propose a design concept for personal digital assistants (PDAs) so that they consider the needs of older users in ‘instrumental activities of daily living’ (e.g., writing letters), communicating (e.g., using the Internet), and controlling and monitoring the home (e.g., as a control device in an integrated smart home environment). Some of the design features include a larger display (e.g., 19.5cm by 28cm) that is easier to see, and a reduced need for scrolling for those with limited ability or experience in new technologies.

### 5.3 Alarm systems

Design guidelines are available for social alarm systems, community alarms, or dispersed alarm systems, which form an important part of many smart home installations. The FASDE project (Future Alarm and Awareness Services for Disabled and Elderly) looked at the problems of deaf people and elderly people being alerted to both personal and impersonal alarms and developed Tactum, a watch that indicates different events with vibration patterns and symbols. Various transmitters around the home send event signals such as the door, telephone, public alert, fire and baby alarm to the watch. ([www.tactum.com/tactum/en/info.htm](http://www.tactum.com/tactum/en/info.htm)). However, it may not be particularly useful for those who are deaf-blind to any degree and more research into their needs is required.

### 5.4 Home automation

Poulson draws on general guidelines for interface design, and also on specific work from the EU TIDE CASA project to document the range of home automation products and services currently available to support the needs of older and disabled users (Poulson, D.F., 2001). He stresses that there has been little integration of the different systems and the performance of the whole home automation system, made up of a large number of elements, requires careful integration.

### 5.5 Housing products and services

Gann, (Gann, D.; Burley, R.; Curry, R.; Phippen, P.; Porteus, J.; Wells, O.; Williams, M., 2000) suggests that four principles might guide the design of housing products and services:

- Non-intrusive;
- Simple user interfaces;
- Inclusive; and
- Providing social interaction.

Abascal et al also stress that user interfaces must be simple to use and intuitive, and adaptable to the individual needs of the person (Abascal, J.; Civit, A.; Fellbaum, K.; Hampicke, M.). [www.stakes.fi/cost219/procabascsmart3.doc](http://www.stakes.fi/cost219/procabascsmart3.doc)



## 6 Telecare and Smart Homes

Telecare is about the provision of care and medical services from professional providers and businesses to support people in their own homes, as opposed to telemedicine, which usually refers to the provision of information remotely between different professionals within medical and healthcare fields. There are first and second generation systems which monitor residents and generate alarms when certain conditions are detected and consequently ethical considerations have been identified as a major barrier to the delivery of telecare with clear guidelines being needed to maintain privacy, confidentiality and proper use of electronic medical data.

### 6.1 Definitions

Telecare has been defined as:

- ‘the use of communications networks to support care services in people’s own homes.’ (Fisk in Peace, S. & Holland, C., 2001); and
- ‘the remote provision of care and medical services to people in their homes using digital information and communication systems’ (Tang, P.; Gann, D.; Curry, R., 2000).

Telecare is about the provision of services from professional providers and businesses to end-users (known as business-to-consumer or *B2C*), as opposed to telemedicine, which usually refers to the provision of information remotely between different professionals within medical and healthcare fields (business-to-business, or *B2B*). (Gann, D., et al., 2000). Therefore, although Telecare is not focus of this work, the provision of social and healthcare technologies and the development of smart home technologies overlap considerably and share a common technological base in information technology and telecommunications, and the integration of the two is expected to produce more secure and autonomous living (Tang, P. & Venables, T., 2000). It may well be that telecare systems will supersede social alarm systems, with smart homes and telecare being ‘natural companions.’ (Fisk in Peace, S. & Holland, C., 2001)

## 6.2 Telecare Systems

Doughty and Williams discuss the difference between First and Second Generation Telecare monitoring systems.

- First Generation systems are based on community alarms, and use a range of smart sensors that are active in nature, i.e., the user must press a button to make contact with the warden or call centre or to issue an alarm. The Tunstall Lifeline 4000 is an example of an intelligent care phone that forms the hub of such a system. The alarms can be connected to a number of smart sensors that generate alarms when certain conditions are detected e.g. smoke and CO, activity, and water leaks. There are pilot trials in the UK and Europe looking at different sensors e.g. in County Durham, West Lothian, and Northern Ireland. Prototype products range from CLEO, which provides an alert if the cooker, is left on, to BERT, which reminds the client to take medication. The devices are able to send different types of alarm messages, which will flag a different alert at the call centre (using the TT92 protocol) so that the most appropriate response will be made (Doughty, K. & Burton, L., 2002; Doughty, K. & Williams, G., 2001).
- Second Generation Telecare monitoring systems that are capable of assessing more complex and changing needs are also being trialled. They have more sophisticated monitoring systems involving a combination of passive (or automatic) sensors to monitor activities, in addition to a local data collection and processing unit. Such is the MIDAS system (Modular Intelligent Domiciliary Alarm System) developed by Technology in Healthcare Ltd. A number of sensors monitor lifestyle activities such as bed and chair occupancy and use of the kettle. This system is being used in a number of current smart home developments, including those in West Lothian and County Durham (Doughty, K. & Williams, G., 2001).

Doughty and Williams believe that such smart technologies can transform an older person's home into a WISE Home (Well-Being, Information, Safety/Security, and Empowerment)—taking control of dangerous situations and providing warnings and reminders to both the clients and their carers. Such a system, HAMISH (Home

Automation – MIDAS In Smart Housing), is under development, which will include control applications, such as switching on lights automatically to avoid trips in the dark, switching off appliances when no longer in use, and recording failures to use assistive aids such as stair lifts. (See Doughty, K. & Burton, L., 2002)

Tang et al with Anchor Trust conducted a telecare study as part of the 'EQUAL in the Built Environment' programme (Tang, P., et al., 2000). The study identifies and discusses the users requirements for telecare services, the potential UK market, likely costs and savings, and inhibitors to the future development in the UK. Ethical considerations were identified as a major barrier to the delivery of telecare with clear guidelines being needed to maintain privacy, confidentiality and proper use of electronic medical data.

In the trials of the 'lifestyle monitoring system' (LMS) developed and evaluated by the Anchor Trust and British Telecom (Brownsell, G., 2000; Porteous, J. & Brownsell, S.J., 2000) the importance of developing a Personal Telecare Plan (PTP) for all users of telecare systems was highlighted. Data to form part of this PTP would include, for example, full customer profile and housing situation, carer details, and preference for particular technologies. There must be effective policies, practices and procedures on user confidentiality which should clearly state that the customer has the right to the information held and access to the records, that the information is fair and accurate, what can and cannot be given to other parties, and what rights the customer has for redress. The report also gives detailed advice on installing, assessing, managing and maintaining telecare systems to ensure that the individual's needs and property are respected at all times. For further information on telecare and telemedicine market see the National Database of Telemedicine at <http://www.tis.bl.uk> and the Journal of Telemedicine and Telecare at <http://www.rsm.ac.uk/pub/jtt.htm> .

## 7 Ethical Issues

Ethical considerations have been reported as being a major barrier to the delivery of telecare and guidelines have been developed to address these concerns. The intrusiveness of smart home technologies and services also raises ethical issues, as does the use of technology to monitor people with dementia. At the heart of these ethical issues is the principle of informed consent, requiring that information be provided to the person about each possible option and its consequences, that consent is voluntary, and that the person has the competence to understand the various options.

### 7.1 Telecare

Ethical considerations have been reported as being a major barrier to the delivery of telecare (Tang, P., et al., 2000) and ethical issues are often at the core of telecare systems. Some of these issues are discussed as part of an EPSRC EQUAL project called Integrated Control and Communication Systems for Distributed Sheltered Housing in the Community (Tweed, C. & Quigley, G., 1999). As there is no documented long-term experience of an elderly person living in a smart home, there is currently little advice or experience available on the ethical issues in deploying telecare installations. Guidelines generally tend to focus on how intrusiveness can be minimised, but there are also wider issues that need to be examined, for example:

- How will the independence of smart home lifestyles impact on existing social welfare and healthcare provision?
- Will it end up being a substitute rather than a supplement?
- Will telecare erode informal support networks and practices, with family and friends becoming complacent if they think the technology can deal with the situation. If so, this could lead to social isolation of the older person.
- To what extent does telecare act as a placebo, rather than a means of getting help in times of emergency?
- What effect will telecare have on the self-esteem of clients?

<http://www.qub.ac.uk/arc/research/projects/equal.html>

## 7.2 Smart homes

Fisk (in Peace, S. & Holland, C., 2001) also stresses that in order to maximise user acceptance, ‘the intrusiveness of the technologies and associated services should be minimised.’ This issue of intrusiveness raises a number of ethical issues about the functionality of the systems, the extent to which computers can be relied upon to make automated decisions, and that personal information belongs to that person alone unless they choose to share it with someone else. Control by the user is a key requirement, and any service user must be able to operate an on/off switch to any system that is considered intrusive.

## 7.3 People with dementia

The use of technology for security, safety, comfort and possible surveillance of people with dementia raises a further number of ethical issues. At the heart of these ethical issues is the principle of informed consent, requiring that information be provided to the person about each possible option and its consequences, that consent is voluntary, and that the person has the competence to understand the various options (M. Downs in Bjørneby, S. & van Berlo, A., 1997). The British Medical Association can also provide guidance in this area (BMA & RCN, 1995).

Professor Mary Marshall at the Dementia Services Development Centre, University of Stirling, posed six questions that need to be asked before introducing new technology in the care of people with dementia (Marshall, M., 1995)

- What is the problem the technology has been introduced to address?
- For who is it a problem?
- What interventions have been tried to address this problem?
- Who decided on technology as a solution?
- Whose needs does it serve?
- What are the benefits and drawbacks of the technology for the person with dementia?

## 8 Marketing and Funding

The smart home market is still immature with arguments still continuing as to whether the business and domestic markets are one or separate and it has been subjected to ‘technology push’ so that there is transference between these two applications. In the domestic market, consumers are still sceptical about potential benefits, technologies are difficult to integrate for interoperability, and it is difficult for the consumer to get good service and advice. Conflicting standards have contributed to this lack of progress and although smart home technology (or variants of it) could have a wide mass consumer market, those not interested in living in a smart home are most likely to be aged 55 and over, although these same people do want safety and security in their homes.

As well as the general consumer markets there is potential for using technology to support people with special needs by maintaining and supporting them in independent living. However, care professionals still do not know that the technology exists and we know that it is not sufficient to just provide information; infrastructure has to be in place to support its use. What is needed is a ‘whole system approach’ to ensure that the technology is integrated into a wider care package and that it is being used appropriately and ethically. Funding is also likely to be a problem as it involved multi-agencies and costs cover not only the equipment and its installation and maintenance but also the support infrastructures that underpin it.

### 8.1 Background

The market for smart home technologies have been discussed for years, but the market is still immature. For example, In 1990, the Yankee Group Consumer Communications Planning Service at <http://www.yankeegroup.com/> examined the current status of home automation in the United States and asked if there would be a home automation boom during the 1990s (Yankee Group, 1990). They described a product called HomeBrain, produced by Hypertek, Inc., which was an electronic device with a built-in computer used to monitor a wide range of sensors, switches, appliances and communication devices. At that time, the cost of a high-end, custom home installation system would average about 3% of the price of the house, and the retail price for the standard package of software and the HomeBrain system ranged

from \$5,000 to \$8,000. However, this did not include the cost of the sensors, climate control equipment, lighting/appliance control modules, wiring, installation, etc. The final cost was expected at that time to be between \$9,000-\$14,000 in a typical 3,000 sq. ft, 4-bedroomed house.

## 8.2 Business vs. consumer markets

In 1994 the European Intelligent Building Group in association with the British Automated Homes and Building Association (BAHBA) raised the question whether the intelligent home and intelligent building were two markets or one (European Intelligent Building Group, 1994). A speaker (David Fanshawe) made the salient point that even a manager who specifies an entire intelligent system for his own company is unlikely to have intelligent technologies in his own home. Although efficiency will dominate a decision to purchase these technologies while at work, at home the main requirements will be comfort and pleasure. However, value for money is a key criterion for both markets, the home consumer being critically price-sensitive.

To exploit the home market, Fanshawe also suggested that three business sectors needed to cooperate: Application Software (to supply the services), Modular Equipment (the hardware to present the services), and Network Installation (to interconnect the equipment and thus deliver the services to wherever they are needed). He described the ESPRIT Home Systems Project, which ran from 1989-1992, and designed a flexible Home Systems architecture, capable of supporting home automation as well as delivering value-added services. The project defined a simple yet powerful method of System Management, which supported automatic installation, so vital for consumers who cannot be expected to call in a professional installer whenever a new product is purchased.

The home automation market has been subjected to technology push, with technologies being developed for use in office automation and commercial control applications, subsequently being applied for use in a domestic setting so that there was an increasing overlap between domestic and non-domestic buildings due to the presence of the microprocessor. Intelligent controls have replaced conventional devices in almost all of the UK non-domestic controls market, thereby leading to

falling prices and increased potential for the domestic market. However this technology push may also work in both directions so that new technologies developed to meet consumers' needs are likely to migrate into building automation, which could end up being more cost-effective.

Schneider and Tränkler also discuss the efforts by industry and by research institutes to bring information and automation technologies into the private home. They claim that the market breakthrough could not be achieved in Germany, and the situation was likely to be similar that in Europe, the USA and Japan for both technological and market oriented reasons. (Schneider, F. & Tränkler, H.-R., 1999).

### **8.3 Technical issues**

Gann et al (Gann, D.; Barlow, J.; Venables, T., 1999) have also stressed that smart home markets, technologies and supply industries are still immature in Britain and that 'consumers are ignorant or sceptical about potential benefits; technologies are difficult to integrate for interoperability; the industry is fragmented and there are no one-stop-shop suppliers providing a full range of bundled products and services'. They feel that the technical issues will probably be the easiest to resolve and that the key determinants for success are likely to be robustness, reliability and ease of installation.

Doughty and Burton (Doughty, K. & Burton, L., 2002) also point out that 'progress towards achieving genuinely smart homes has been compromised by the existence of a number of conflicting standards'. Electrical wiring buses have been used most frequently to interconnect the devices, but require a large investment in wiring which is difficult or impossible to achieve quickly and without disturbing the fabric of the home. Alternatively, a wireless communications infrastructure, using the advances of low-power radio-frequency technologies, lends itself to wider possibilities for home automation in smart homes.

### **8.4 The mainstream consumer market**

The Joseph Rowntree Foundation commissioned the Consumers' Association to conduct a study on the potential mass market for smart home technology



(Pragnell, M.; Spence, L.; Moore, R., 2000). It consisted of background research, and a survey of over 1,000 households to examine consumers' attitudes towards smart homes, and interviews with experts to discuss the results of the survey. They suggested that smart home technology (or variants of it) could have a wide mass consumer market but that respondents not interested in living in a smart home (37%), were most likely to be aged 55 and over, without children, PCs, pay TV or home entertainment systems, and those who hold negative attitudes towards new technology. However, of the four key smart home features (remote access, safety and security, centralised control, and convenience) safety and security were the most popular (70%). This suggests that this feature may be the key driver to attract users who are less technology literate, i.e., older people with concerns for their safety and security inside and outside the home.

## 8.5 The special needs market

As well as the general consumer markets there is considerable potential for using technology to support people with special needs by maintaining and supporting them in independent living. There are at least two separate market segments for smart home technology:

- to provide control applications for people with severe physical disabilities,
- to monitor safety and security in the home

The market for environmental control systems is very small in the UK (1000s) and three companies have been particularly active in the UK market, namely Possum Control, Hugh Steeper Ltd (now RSL Steeper) and more recently Gewa UK Ltd (also part of the same group as Possum Control). They produce their own proprietary wireless and powerline based systems to control telephones, alarm system, lights, door entry, radio and television. They provide a complete environmental control package to clients, involving assessment, installation and maintenance but it is common for third party components to also be used in these installations, such as door, curtain and window openers, and multipoint locking systems for doors. For more information see: [http://www.possum.co.uk/PCL/possum\\_controls%20Info.htm](http://www.possum.co.uk/PCL/possum_controls%20Info.htm)  
<http://www.rslsteeper.com/>

A more recent player is SRS Technology Ltd. who have developed a new environmental control system called the SRS100, which allows all home appliances to be controlled from one device. It is a portable device using a totally wireless system (IR and radio) and can also be used to control a computer, allowing Internet and e-mail access by people unable to use a conventional keyboard. Accessories also include a unit for hands-free telephone usage, radio controlled power sockets, social alarm, window, door latches and openers. For more information see:

[www.srstechology.co.uk](http://www.srstechology.co.uk)

There is a much larger market for social alarm systems, with users in the UK alone being estimated at well over 1 million. Currently Tunstall Telecom as market leader dominates the UK market. <http://www.tunstallgroup.com/>. However, there are a number of other companies also operating in this sector such as Tynetec, Scantronic and BT. Traditionally they provide systems that link, via telephone based systems triggered by alarm cords or pendants located in the home, to a care centre to deal with emergencies. A report on Community Alarms is available from Ricability (Research and Information for Consumers with Disabilities). <http://www.ricability.org.uk/>

For telecare systems, Porteous and Brownsell (Porteous, J. & Brownsell, S.J., 2000) advised that agencies should produce a strategy to ensure awareness of, and access to, its services. They suggested that this strategy should include: how the service is provided; who it is for; the type of service to be provided; and how it will be customer orientated. It should also identify various target groups, e.g. older people, referral sources, and other agencies and professional groups.

Woolham and Frisby report that even though a number of innovative smart home projects have taken place, no local authority in England and Wales has developed mainstream services for people with dementia that include technology as part of the care package (Woolham, J. & Frisby, B., 2002). They believe that care professionals still do not know that the technology exists and stress that it is not enough just to provide information, infrastructure has to be in place to support its use. They advocate a 'whole system approach' to ensure that the technology is integrated into a wider care package and that it is being used appropriately and ethically. A suggested

framework for an ethical protocol is contained in the ASTRID Guide (Frisby, B. & Price, S., 2000). See also [www.astridguide.org/final.htm](http://www.astridguide.org/final.htm)

## 8.6 Funding

Funding for smart home initiatives is likely to be problematic in the short term, as traditionally medical and social aspects of care have been administered from separate funding agencies, making some preventative initiatives difficult to fund. The cost of implementation is therefore an important consideration and that the responsible local authorities will need to consider the source(s) of new funding very closely. (Tang, P., et al., 2000). It has been suggested (Doughty, K. & Burton, L., 2002) (Woolham, J. & Frisby, B., 2002) that it should be the responsibility of local authorities and NHS initiatives, including the Integrated Community Equipment Store, to make telecare systems and technological devices widely available at a local level and that possibly 'preferred supplier' relationships are arranged with particular manufacturers, suppliers and distributors. Awareness training in the potential to use 'Electronic Assistive Technologies' is therefore required for Occupational Therapists and other members of the Community Care Team (Doughty, K. & Burton, L., 2002).

The cost of smart home technology is a regular stumbling block in the introduction of the technology but the price of the devices is not all that is required as it is also important to consider whether the building is new or retrofitted, as there will be a number of different variables, e.g., ease of installation, the type of walls, whether the rooms are prefabricated, etc. Only when the technology becomes used regularly over a number of years within the social care sector will we have an idea of the true costs of the technology. One cost figure, based on the smart home installations from the CUSTODIAN project, is given as between £13,000 and £15,000. The project found that a baseline minimum for an installation could be perceived to be about £5,000 for the basic bus line installation with a minimum number of devices (Dewsbury, G.A., 2001). However the costs and benefits of the technology should not be assessed from the monetary standpoint alone, but should be considered in relation to the more important enhancements to the quality of life and quality of care being provided to older and disabled residents (Dewsbury, G.A., 2001; Quigley, G. & Tweed, C., 1999; Tweed, C. & Quigley, G., 1999).

Woolham and Frisby also elaborate on the various funding that is needed, including paying for the equipment, integrating the equipment, arranging any social response that is required, installing the equipment in the person's home, servicing and maintenance, along with de-commissioning.

The Department of Health's National Specialised Services Definitions Set states that "Developments in electronic technology make it possible for some users with complex needs to have communication aids, environmental control and wheelchair control functions provided by a single system. There are also those who do not require such sophistication but who can be expected to benefit from telecare or 'smart house' technology. Some assessments for environmental controls are likely to result in the provision of a telecare solution." The definition anticipates that much of emerging technologies 'will be of low cost/high volume and capable of provision through community equipment services'. Resources for more complex and specialist telecare provision should be developed within existing electronic assistive technology services and overseen by consultant clinical scientists/rehabilitation engineers or specialist therapist with responsibility for developing experience and knowledge in this area. To download the entire document, see:

<http://www.doh.gov.uk/specialisedservicesdefinitions/5disequip.htm>

## 9 Associations and Sponsors

Technology alone is not enough; a smart home and its environment must also be accessible and ‘barrier-free’ and associations that promote these concepts as well as those specifically targeting the smart homes area are presented.

### 9.1 American Association of Retired Persons

An AARP survey showed 83% of older Americans want to stay in their current homes for the rest of their lives. Their website promotes the concept of the universal design home and suggests that, as modifications or repairs are made universal design features should be included to make the home a home of the future.

[www.aarp.org/universalhome](http://www.aarp.org/universalhome)

### 9.2 The Centre for Accessible Environments

The UK Centre for Accessible Environments (CAE) provides information and a forum for dialogue between providers and users on how the built environment can best be made or modified to achieve inclusion by design (see <http://www.cae.org.uk>). They have recently published a new guide containing practical advice for older and disabled people including advice on new homes, improvements around the home, safety and security issues, and major adaptations for specific disabilities. Called *Planning your home for safety and convenience*, it can be obtained through the Centre (Tel: 020 7357 8183 or email [info@cae.org.uk](mailto:info@cae.org.uk)).

### 9.3 The Engineering and Physical Sciences Research Council EQUAL Programme

A website has been developed as part of the EPSRC EQUAL Programme. It is based on research carried out at University College, London, through talking with older people about their home life and has been designed as an awareness tool on how people use and think about their homes as they grow older. It shows the choice of homes that are available and ways to design the home environment so as to maintain people’s independence and dignity. See [www.3rdagehomes.org](http://www.3rdagehomes.org)

#### **9.4 The Foundation for Assistive Technology**

FAST (The Foundation for Assistive Technology) is a national charity that acts as an information resource and exchange platform for those interested in the development of assistive technology for older and disabled people. Key features on their website at <http://www.fastuk.org/> include, for example:

- A comprehensive database of assistive technology research and development projects; and
- A User Forum comprised of people with a range of disabilities who are interested in contributing to research and development.

#### **9.5 The Disabled Living Foundation**

The Disabled Living Foundation (DLF) is another national UK charity which aims to provide choice for people who use assistive equipment to live a more independent life. It provides advice and information booklets on a wide range of topics including what features to look for when choosing items, but contain no specific product or supplier information. There are links on their website to related UK disability organisations, charities and equipment suppliers who are able to provide information and advice on a wide range of disability issues. <http://www.dlf.org.uk/>.

#### **9.6 The Medical Devices Agency**

The Medical Devices Agency conducts formal assessments of assistive equipment (<http://www.medical-devices.gov.uk/>).

#### **9.7 The Anchor Trust**

In addition to its mainstream activities the Anchor Trust produces a wide range of reports, for example guidance on how to choose community alarms, including how alarm systems operate, how much they cost, how to get an alarm and a buying guide. This and a range of other publications can be ordered via their website at <http://www.anchor.org.uk/>

## 9.8 European and international agencies

The Smart Homes Foundation is an internationally oriented platform for promoting smart home technology, exchanging ideas, initiating projects and implementing technology and services into practice (<http://www.smart-homes.nl/engels/links.html>).

COST 219 (followed by COST 219bis) (Co-operation in the field of Scientific and Technical Research.) is a European research project that aims to ensure that the design of telecommunication services and equipment are as accessible as possible for older and disabled people. There are a number of publications relevant to the smart home area (many of which can be found on their website at <http://www.stakes.fi/cost219/>) COST219bis has also developed a series of specific guidelines, including Design Guidelines on Smart Homes (van Berlo, A.; Allen, B.; Ekberg, J.; Fellbaum, K.; Hampicke, M.; Willems, C.;G.; Roe, P.R.W., 1999). See [www.stakes.fi/cost219/cosb235.htm](http://www.stakes.fi/cost219/cosb235.htm)

There are a range of other associations which can provide guidance and support in the installation of advanced technologies in the home, although not specifically for older and disabled people:

- SmartHomeForum is an independent information site for Smart Homes and buildings and focuses on the technologies and applications used in this market by providing information, newsletters, discussion forums, and interviews, etc. <http://www.SmartHomeForum.com> and [www.intellicom.se](http://www.intellicom.se)
- The European Home Systems Association (EHSA) developed from, and was founded by, members of the European ESPRIT Home Systems Project 2431. EHSA is an open organisation, whose aim is to support and promote European industry in the field of Home Systems <http://www.domotics.com/homesys/Ehsa.htm>
- The European Intelligent Building Group (EIBG) is an independent grouping of parties involved in the design, production and management of advanced buildings, with participation from suppliers, researchers, managers, building users and professional advisers throughout Europe. More information can be obtained from <http://www.eibg.net/>

- The BT Home Network, in its vision for the Digital Home, enables the user to choose what appliances and devices to have around the home, how and where to use them, also ensuring the addition of future applications such as home security systems and controlling the home while at work. See [http://www.bt.com/digitalhome/dh\\_info.jsp](http://www.bt.com/digitalhome/dh_info.jsp)
- A gateway to leading European projects, technologies and market players in the field of Home Networks and Gateways, is funded by the European Commission and managed by Sigma Consultants. The focus is on ‘Extended Home Environments’, home networks and gateways, and broadband services to the home. The only project that specifically mentions elderly and disabled people, however, is [DOC@HOME](#).
- CABA (the Continental Automated Buildings Association) is the industry association that promotes advanced technologies for the automation of homes and buildings in North America (see [www.caba.org](http://www.caba.org))
- OSGi (Open Services Gateway initiative) is an international, non-profit organisation formed to develop and promote open specifications for the network delivery of managed services to devices in the home, car and other environments. See [www.osgi.org](http://www.osgi.org) and [www.smarter-homes.org](http://www.smarter-homes.org).
- There is a wide range of links to manufacturers and relevant associations, as well as a number of helpful articles that can be downloaded, via the CUSTODIAN project website: <http://www.smarthinking.ukideas.com/STIndex.html>



## 10 Conferences

A selection of relevant conferences and conference organisers, ordered by date, is presented to give an overview of current activity in the area and also where to look for further information. Their focus ranges from home networks and automation to smart homes to promote independent living for older and disabled people.

### 10.1 Major conferences

#### 10.1.1 Net@Home

13-15 November 2002, Cannes, France

Net@Home 2002 is the 5th edition of the event organised annually by Sigma Consultants and targeting companies and industry associations already active in the field of Home Networks and Gateways, Connected Appliances and Internet Services, or interested in penetrating European markets in this field. The 4th annual conference and exhibition on Home Networks & Gateways, Connected Appliances and Internet Services was held at the Meridien Hotel in Nice in November 2001.

For more information see <http://www.net-at-home.com/Event02/default.htm>

#### 10.1.2 Person-Centred Technology in Dementia Care

16 October 2002,

The Journal of Dementia Care held a conference on 'Person-Centred Technology in Dementia Care, 16 October 2002, at the Birmingham Botanical Gardens. Details are available on their website at <http://dementia.careinfo.org/cgi-bin/conferences.pl>

#### 10.1.3 Connections 2002

14-16 May 2002

Leaders in the home networking and residential gateway space met in Dallas for CONNECTIONS™ 2002: The International Home Networks and Gateways Showcase. This was co-hosted by [CABA](#) and [Parks Associates](#) and provided a networking and informational opportunity for the players providing home networking, gateways, and their corollary products and services for the home. CONNECTIONS™ will convene again in 2003 for the seventh consecutive year.

For more information, see [www.connectionsconference.com](http://www.connectionsconference.com)

#### **10.1.4 The world forum for building innovation.**

##### **Delivering the benefits of intelligent building design, systems and management.**

14-16 May 2002, Old Windsor, UK.

The first meeting of the World Forum for Building Innovation took place in May 2002. This meeting was the starting point for the development of an international network dedicated to developing and delivering the benefits of intelligent building design, systems and management around the world. The second meeting of the World Forum is scheduled to take place in Beijing, China in 2003.

See <http://www.iandi.ltd.uk/forum2002/index.html>

#### **10.1.5 2nd annual connected homes 2002.**

##### **Services, partnerships and business models.**

5-6 March 2002, Stockholm, Sweden, Sponsor: Marcus Evans

This was a forum to discuss the opportunities and business models in developing, building and deploying wired homes at a reasonable cost. Ranging from wireless and stand-alone networks to end-user consumer devices and usability, the conference reviewed requirements for successful deployment of services.

For similar events see [www.smarthomeforum.com/](http://www.smarthomeforum.com/)

#### **10.1.6 2nd IIR Residential Gateway European Forum.**

26-28 February 2002, Rome.

This forum examined business models, technical choices and marketing and sales channel development for the residential gateway.

See [www.iir-conferences.com](http://www.iir-conferences.com)

#### **10.1.7 The connected consumer summit 2.**

##### **Delivering the networked home.**

11-12 February 2002, San Francisco, USA, Sponsor: Yankee Group

#### **10.1.8 ALIVE**

26 October 2001

ALIVE is an initiative in which European regions cooperate in the challenge of the ageing of the population throughout Europe. ALIVE invests in contacts with other European regions to compare the policy of the regions in areas such as care, welfare,

employment, housing and recreation. During their recent conference E. Liikanen, Member of the European Commission responsible for Enterprise and the Information Society, stressed the contribution that the smart house concept could make to these areas. He emphasised, however, that technology alone cannot provide the complete solution and accessibility of doorways, thresholds, bathroom and kitchen facilities, etc., are all important. In addition, there needs to be a respect for autonomy and privacy, that the users' real priorities and expectations need to be respected, and that functionalities have to be chosen based on those user needs.

See <http://www.alive-eu.org/>

#### **10.1.9 Smart homes - ITCOM 2001**

20 - 24 August 2001, Denver, Colorado, USA, Sponsored by SPIE, the International Society for Optical Engineering

See [www.spie.org/conferences/calls/01/itcom/confs/IT604.html](http://www.spie.org/conferences/calls/01/itcom/confs/IT604.html)

#### **10.1.10 Dependability in healthcare informatics.**

22-23 March 2001, Edinburgh

Proceedings of the 1st dependability IRC workshop, Proctor, R.

Rouncefield, M., Editors, Published by Lancaster University. ISBN: 1 86220 109 9

#### **10.1.11 Proceedings of TeleMed 2001**

**From research to service delivery - 8th international conference on telemedicine and telecare.**

15-16 Jan 2001, London

#### **10.1.12 Proceedings of TeleMed 99**

**From research to service delivery - 7th international conference on telemedicine and telecare.**

28 November-1 December 1999, London

#### **10.1.13 International conference on smart homes & telematics.**

22 -23 February 1999, Evoluon, Eindhoven, The Netherlands.

Organised by the Smart Homes Foundation, the main goals were to give an overview of the state of the art of various aspects of smart homes, give an overview of EU

funded telematics projects in this area, come up with directions for concrete guidelines and future actions in the further development and realisation of smart home applications, and create a forum for exchange of new ideas for project proposals in the EU's Fifth Framework Programme. See [www.smart-homes.nl](http://www.smart-homes.nl)

**10.1.14 Proceedings of TeleMed 97**

26-27 November 1997, Medicine on the Superhighway - An International Conference on Telemedicine and Telecare, London, UK

**10.1.15 The living home '96.**

**Europe's first home automation and interactive home services event.**

19-21 March 1996, London, Sponsor: RMDP Ltd.

This Conference included sessions on enabling technologies, network providers, value added services and home management, along with an exhibition of products and services.

**10.1.16 The intelligent home and intelligent building.**

**Two markets or one?**

9 November 1994, London

European Intelligent Building Group/ British Automated Homes and Building Association (BAHBA)

**10.1.17 BESTA international conference.**

**Technology for Independent Living in Life Cycle Homes**

8-9 June 1994, Lillehammer, Norway

**10.1.18 Intelligent Buildings.**

18 Jan 1990, London, Institution of Electrical Engineers (IEE), IEE Digest, no. 1990/013

## **10.2 Local conferences and seminars**

As well as the international events listed above, a number of more local courses and seminars have taken place recently that provide an excellent overview of current projects and relevant issues. Readers are advised to explore local events in their own areas.

### **10.2.1 Seminar, Newcastle County Council**

#### **Exploring Smart Technology**

17 April 2002

Speakers were Tim Venables from SPRU (co-author of Digital Futures; Roger Orpwood (Bath Institute of Medical Engineering, Gloucester Smart Home Project); and John Woolham (Northamptonshire Social Care and Health Directorate and formerly from ASTRID project)

### **10.2.2 Seminar, Leicester County Council**

9 May 2002

Informal group/discussion with speakers including Kevin Doughty (Technology in Health Care) and Brian Frisby (Northampton Safe at Home scheme).

### **10.2.3 Turned onto Technology, a modern vision for person-centred care**

London, 11 July 2002

Sponsored by College of Occupational Therapists, BT and EPSRC, including speakers from West Lothian, Durham and Northampton projects.

## 11 Smart Home Sites

This section provides a short summary of relevant smart home sites divided into:

- Those sites focusing on elderly and disabled people; and
- Those sites not specifically focusing on elderly and disabled people, but which could provide benefits for these target groups if the technologies were designed and evaluated with their needs in mind.

Where the authors have personally visited the site, there is a link to a comprehensive site visit report.

### 11.1 Sites Focusing on Elderly and Disabled People

#### 11.1.1 United Kingdom

##### 11.1.1.1 Anchor Telecare Project

**Driving Force: Social Care**  
**Development Phase: Pilot**  
**Not live.**

Started in April 1997 and completed March 1999.

Partners included Anchor Housing, British Telecom PLC, and the University of Liverpool. Information provided by Dr. Andrew Sixsmith, Department of Primary Care at the University of Liverpool on 10<sup>th</sup> May 2002, who was responsible for the evaluation of the project.

There is a major concern about frail and disabled older people at home who are at risk of such things as falling and illness. In such an event a conventional social alarm system allows the victim to raise an alarm in a control centre by pressing a button on their telephone or on a pendant worn on their person, but these systems are useless if the person is incapacitated (e.g., if they are unconscious). This research involved a 3-month field evaluation of an intelligent Lifestyle Monitoring System (LMS) that monitored both activity and biomedical measures, using sensors in the home to identify 'alert' situations, or deviations from 'normal' activity patterns, which could indicate that the occupant is experiencing some kind of problem.

Twenty-two elderly people aged from the early 60s to over 85, with two-thirds in the age range 75-84 years, in four different localities took part. A total of 61 alerts were

recorded, at a mean frequency about one alert per month per client. Of the 61 alerts, 46 were classified as false alerts and the other 15 as genuine, although no real emergencies occurred during the study. Many people in the field trial reported enhanced feelings of safety and security, which could help to stimulate independence and help them to remain living in their own homes, (Sixsmith, A. & Sixsmith, J., 2000; Sixsmith, A.J., 1998; Sixsmith, A.J., 2000).

The users did not feel that the system was intrusive, but their expectations exceeded the abilities of the system, with some people thinking the sensors were cameras, and that a real person was monitoring them in real time. The system pooled data on a half hourly basis and this proved to be too vague to be useful in itself, and other sensing systems were required. (Porteous, J. & Brownsell, S.J., 2000; Sixsmith, A.J., 2000).

Problems with the study included:

- Practical complications in recruiting people to trial the equipment as for many the commitment was too great;
- Technical problems with the control box which had too little capacity and required a separate phone line, with developing an algorithm of ‘normal’ behaviour for individuals and with positioning PIRs

### 11.1.1.2 Angus Community Care Charitable Trust

Site Visited 30 August 2002- **See site report for more detail**

**Driving Force: Social Housing**

**Development Phase: Roll Out**

**Live**

Operational since June 2002.



The Community Care Trust in the Angus region of Scotland, as part of a Real Life Option Initiative, funded the development of a new care home complex for people with learning disabilities and behavioural problems. Edinvar Housing Association has acted as contractor to the project, with Steve Bonner acting as the installation engineer.

There are three dwellings; one provides for four residents to have individual bedrooms but shared facilities for other activities; the other two units provide 10 self-contained flats and flats for staff.

The residential home has the most technology installed, but the other developments also include the necessary infrastructure. IHC systems are installed with an emphasis on alarms and monitoring rather than control applications.



- **Entrance:** all main doors and windows are monitored. Entrance to the complex and individual flats is also via an electronic lock system with door lock release.
- **Detectors and Sensors:** Fire, gas and CO detectors are provided, along with PIR sensors in the bathroom. Bed sensors can also be connected and some bathrooms have flood detection and automatic switching off of the water supply.
- **Power:** The power sockets in the individual flats can be switched off remotely by carers if necessary.
- **Alarms:** All alarms are linked to a paging system allowing carers to identify the source and cause of alarm at a number of stations in the home, using the same key fob system used for the door entry system.

The two flat complexes have alarms fitted to the doors and windows and a common intercom system. However the technology infrastructure is available for additional services to be added as needed.

Further information can be obtained from:

Steve Bonner,

Edinvar Housing Association,

Telephone 0131 243 2051

Email [stevebonner@edinvar.co.uk](mailto:stevebonner@edinvar.co.uk) or [stevebonn@ic24.net](mailto:stevebonn@ic24.net)

### 11.1.1.3 Assistive Technology Denham Garden Village.

#### **Driving Force: Housing for the Elderly**

#### **Development Phase: Specification**

#### **Expected to go live from 2004 onwards.**

A £50 million project being developed by the Anchor Trust to include 320 dwellings on a new build site. It will provide a model for integrating housing and care services in a community setting without conventional nursing or residential home to provide support for dementia care and those with a high need for physical care. The first phase is due for completion in 2004 but development will continue until 2008.

The project will include broadband telecommunication, and in addition to cable and Internet services there will be CCTV systems for security, videophones and a range of alarms systems. Flood and carbon monoxide detection will be linked to electrovalves to switch off the supply in the homes and in addition to conventional social alarms with pendants and alarm cords, there will be other specific sensors related to client need e.g. fall detection, detecting bath fill, and whether the cooker has been left on or not. The homes will also have intruder alarms and movement detection, and a remote door entry system with video link. Other possible functionality will include control of lights, curtains, heating and entertainment systems using remote controls.

The project will provide these monitoring and control systems in each home based on need, with an expectation that £6-8K will be spent on technology in each dwelling.

Further information can be obtained from:

Peter Shipley  
Director of Special Projects  
Anchor Trust  
Fountain Court  
Oxford Spires Business Court  
Kidlington  
Oxfordshire  
OX5 1NZ

#### 11.1.1.4 Bolton, Methodist Housing Association

Site visited 5 July 2002—**See site report for more detail**

**Driving Force: Social Housing**

**Development Phase: Pilot**

**Live.**

The first project, consisting of 12 smart units (8 flats and 4 bungalows) in Lever Edge Lane, Bolton, has just been completed (July 2002) and a second at Hope Mill is expected to be completed in the near future.



This is a collaboration between Manchester Methodist Housing Association and Bolton Council with funding from The Housing Corporation. The first project targeted the general public over 50 and those with physical disability, whilst the second project (18 flats and bungalows at Hope Mill) will target elderly people, with some properties specifically designed for wheelchair users whilst others are for more general use.

The bungalows have the most technology and an IHC bus is used to control the application. Emphasis is on security and safety with a range of sensors being installed including PIRs for security and smoke detection, water leak detection, water usage monitoring (inactivity alarm), night activity detection (use of lights in the home), and night wandering (use of external door). There is integration with social alarms,

activating heating and lighting and simplified access to the house in response to an alarm. There is an optional flashing external lighting to indicate distress and the system can be set to dial different telephone numbers according to the type of alarm raised. Separate social alarms are installed by residents as needed, and are not integrated into the development.

There is also a video door entry system with the image displayed on the television, enabling the door to be operated from any room, and an 'all-off' switch for lighting when the house is empty. There is also occupancy simulation when the house is empty during the hours of darkness until 11 pm and an automatic reduction of heating levels when doors and windows are left open.

Further information can be obtained from:

Peter Bojar  
Manchester Methodist Housing Association  
Hopeleigh  
1-3 Fairhope Ave  
Salford  
M6 8AR  
Tel 0161 768 1812  
[p.bojar@mmhg.org.uk](mailto:p.bojar@mmhg.org.uk)

### 11.1.1.5 Edinvar AID (Assisted Interactive Dwelling) House.

**Driving Force: Social Housing**  
**Development Phase: Completed**  
**Live.**

The AID flat has been occupied by two tenants since October 2001. They have physical disabilities and one also has some hearing and visual impairment. Prior to this the end-users and their carers could use the facilities through day visits, weekend stop-overs and longer term stays.

The flat uses an EIB 'Instabus', but on the surface the home looks little different from any other dwelling but has numerous actuators that operate windows, curtains and doors, and a video entry-phone system at the heart of the dwelling. Safety monitoring is also a feature, and sensors are installed to help track an occupant's movements and identifying potential emergency situations, in a number of activities. These include:

- Toilet flush;
- Activation of a bedside pressure pad;
- Opening/closing curtains;
- Activation of Passive Infra-Red detectors;
- Activation of a smoke/heat detector;
- Activation of emergency pullcord or similar device.

It is understood that Edinvar is planning further installations in some of its 1,500 other tenancies, using a modular approach by installing 1 or 2 pieces of equipment in one dwelling and perhaps different equipment in another. Edinvar has also produced a Procedures Manual that outlines problems and possible solutions, such as rewiring a mains supply circuit, modification to doors and windows, and system integration.

Now that the flat is occupied there is a standard social alarm installed, but the monitoring features of the home are switched off. The applications still operating are primarily those for control of doors, windows, lighting and door lock release and opener. However, the door intercom has no inductive coupling for a hearing aid and is of a design that does not allow add-on units to be connected.

On-call maintenance is required to operate the service and Edinvar have engaged maintenance contractors, and providing them with easy guides for faultfinding.

The AID demonstration also led to a similar EIB-based development for Glasgow City Council as part of the 'Just Another Disability Initiative' in 1999. This is a two-bedroom retrofit flat, designed to support a person with dementia and their carer. An infrastructure was developed to allow the flat to be used by people with physical disability by including a motorised door opener with electronic key, and motorised windows. The home is fitted with a range of sensors including door contacts, PIR sensors, and an optional bed sensor. Kitchen appliances can be controlled and isolated independently, and for fire safety the carer can also switch off the cooker remotely. The home also has a display panel in the carers' room allowing the carer to monitor alarms. This show-flat is now being lived in, but is not specifically being used to support tenants with dementia.

Edinvar have also been involved in a new build development in Forfar near Dundee, and this is a three-building complex consisting of blocks of individual flats and a residential home. The homes have been constructed for the Angus Community Care Charitable Trust, and will support people with learning difficulties by monitoring home safety and security. See Angus Community Care Charitable Trust 11.1.1.2)

Further information can be obtained from:

Steve Bonner,  
Edinvar Housing Association,  
Telephone 0131 243 2051  
Email [stevebonner@edinvar.co.uk](mailto:stevebonner@edinvar.co.uk) or [stevebonn@ic24.net](mailto:stevebonn@ic24.net)

### 11.1.1.6 Gloucester Smart House

Site visited 19 June 2002—**See site report for more detail**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**



The Bath Institute of Medical Engineering (BIME) is collaborating with Dementia Voice and Housing 21 to develop technology to support people with dementia and their carers in their own homes. The Gloucester Smart House was launched on 21 June 2000 as a show home, open to visitors, and to allow people with dementia, with their carers, to stay for a few days to assess the facilities and devices. See the following websites for additional information:

<http://www.bath.ac.uk/Centres/BIME/projects/smart/>  
[www.dementia-voice.org.uk](http://www.dementia-voice.org.uk) and [www.housing21.org](http://www.housing21.org)

Further information can be obtained from:

Dr Roger Orpwood  
Bath Institute of Medical Engineering  
University of Bath  
c/o The Wolfson Centre  
Royal United Hospital  
Bath BA1 3NG  
UK  
Email: [R.D.Orpwood@bath.ac.uk](mailto:R.D.Orpwood@bath.ac.uk)  
Tel: 01225 824103  
Fax: 01225 824111

### 11.1.1.7 Going Home Staying Home Project

**A partnership between Northern Ireland Housing Executive, Foyle Health and Social Services Trust and Fold Housing Association.**

**Driving Force: Social Care**

**Development Phase: Under Development**

**Live.**

This project has three components namely:

- **Reablement:** an intermediate care scheme for older people, which aims to facilitate early discharge from hospital and prevent readmission by providing a comprehensive assessment and rehabilitation programme for up to six weeks.
- **Assistive technology:** to offer support to older people in both city and rural areas by supplying a range of technology offering monitoring and security links. A core package will be provided based around Tunstall's Lifeline 4000 Telephone unit with additional add-ons tailored to individual requirements. These include: smoke detectors; flood sensors; alarm pull cord; passive infrared sensors etc. There are also additional devices – fall detector; video door entry; big button telephone that will be connected as required. All of these sensors are wireless and therefore require minimal disruption to the property or the occupant; they can also be removed and reused when no longer required. There will also be a demonstration house at 17 Rosstown Drive, Waterside, to demonstrate this equipment to clients and care professionals.
- **Community telemedicine** scheme in partnership with Altnagelvin Hospital, to facilitate the early discharge of people over 65 who have suffered an acute exacerbation of Chronic Obstructive Pulmonary Disease. They will be monitored at home using a telemedicine monitor which records; blood pressure, ECG, Temperature, Pulse, Breathing Rate, SAO<sub>2</sub>, and spirometry. The project will begin September 2002.

Further information can be obtained from:

The Foyle Health Project co-ordinator, Angela Elliott

or the project nurse, Ann Box

On: 028 71266111 ext. 2291.



### 11.1.1.8 INTEGER Westminster Tower Refurbishment Project

#### **Driving Force: Social Housing**

#### **Development Phase: Pilot**

This project started in 2001 and is now in a pilot phase, which involves setting up demonstration flats for Westminster City Council and the major refurbishment of a tower block in the Westminster area (Glastonbury House). The objective is to apply intelligent and green principles to the refurbishment in the three main areas of:

- Environmental Control
- Well-being and care needs
- Electronic service delivery and e-government.

The systems will operate both at the overall building and individual apartment levels, and will include management of the thermal environment and lighting. The technology will also provide telecare and telemedicine applications that will probably include activity monitoring and an integration of home automation with existing social alarm systems so that, for example, lights and heating could be activated automatically if the resident raised an alarm. The systems could also provide some support for forgetful residents by making the home safer, for example, water flow and leak detection could be used to notify authorities of problems within the home, and also to automatically switch off the water supply. Telemedicine applications will also be explored, allowing remote monitoring of routine procedures such as blood pressure and heart activity.

The project will also provide a platform for piloting electronic service delivery and e-government, and broadband internet and digital television will probably be an essential part of the development, allowing residents access to the on-line services being developed by Westminster City Council in its customer service initiative.

Further information on the INTEGER Westminster Tower refurbishment project can be obtained from:

Andy Haines  
Business Analyst  
I&I Limited  
Watford

Tel +44 (0) 1923 665963

<mailto:andy.haynes@iandi.ltd.uk>

See also: [www.iandi.ltd.uk](http://www.iandi.ltd.uk) and [www.integerproject.co.uk](http://www.integerproject.co.uk)

### 11.1.1.9 Joseph Rowntree Foundation (JRF): Hartrigg Oaks and New Earswick

#### **Driving Force: Social Housing**

#### **Development Phase: Pilot**

Two smart demonstration homes have been developed through the retrofitting and conversion of an existing bungalow at Hartrigg Oaks and a new house at New Earswick near York. The house is adapted for an elderly woman in her 70's with a profound physical disability. Echelon technology was installed using mains wiring rather than dedicated bus technology and the main focus is on control applications, i.e., lighting, heating, door locks, rather than safety/security monitoring systems.

Based on the JRF demonstration sites in York, A User's Guide has been produced, which describes what a smart house does, why it does it, and suggests ways in which the features of the smart home can provide most benefit (Venables, T. & Taylor, C., 2001b). See also [www.jrf.org.uk/housingandcare/smarthomes/default.asp](http://www.jrf.org.uk/housingandcare/smarthomes/default.asp)

A Specification Guide (Venables, T. & Taylor, C., 2001a) has also been published by JRF and is intended to assist potential specifiers and installers in developing their own smart homes. See

<http://www.jrf.org.uk/housingandcare/smarthomes/specification.asp>

The report presents evaluations of some of the products used in their demonstration houses and examines the affordability, reliability and ease of repair of the products, and also makes recommendations for future development of the products. For example, a Multi-Sensor developed by Zytron Ltd, was used as a single ceiling-fitted device with a variety of sensors and emitters to send and receive information to and from the network. Its features include:

- Smoke detection;
- Passive infrared movement detection;
- Temperature sensor (for fire detection and heating control);
- Infrared signal receiver;
- Emergency LED light;
- Gas detection (CO) available as an option;
- Light level detection;
- Siren;

- Optional 360 degree digital video camera.

A number of these Multi-Sensors have been tested over the last three years without any difficulty and are still being used regularly. The wide variety of sensing equipment included makes it cost effective to install and very unobtrusive.

There is similar detail for:

- Light and plug controls,
- Security alarm controllers,
- Internal/external swing door, sliding door, window, curtain and vertical blind motors,
- Sink and cupboard lifters,
- Programmable remote controls.

A video is also available from the JRF describing these developments. (Digital Futures: Making Homes Smarter).

Further information can be obtained from the JRF, see [www.jrf.org.uk/home.asp](http://www.jrf.org.uk/home.asp) or contact Richard Best, Director, Tel: 01904 629241

### 11.1.1.10 Kendal, Safe Homes Project

#### **Driving Force: Social Housing and Social Care**

#### **Development Phase: Pilot**

#### **Live.**

This is a new project to establish a passive alarm service to older adults with dementia living alone in their own homes in Kendal, as identified in Standard 7 of the 'NSF for Older Adults,' a key policy document from the Department of Health that is driving health and social services for older people.

(See <http://www.doh.gov.uk/intermediatecare/icmovingforward.htm>)

The project involves the following partners: Carlisle City Council; Carlisle Careline; Alzheimer's Society, Kendal; South Lakes District Council; South Lakeland Community Alarm Service; Cumbria Supporting People Team; and Tunstall Communications. For the purpose of the project, Cumbria County Council, Social Services Department are providing all capital costs associated with the purchase of the equipment from the Building Capacity Grant. £27,000 for the financial year 2001/02 will fund all the devices necessary for 20 dwellings. (See also the Marketing and Funding section 8 of this report for a discussion as to how this project is being funded and could be funded in the future.) It is understood that this project is in a specification phase of development. (See also the Wigton Smarthome 11.1.1.17 development for other work in this area being conducted by Cumbria Social services.)

Further information can be obtained from:

Paul Latimer  
Cumbria Social Services  
Tel 01228 607137  
[Paul.latimer@cumbriacc.gov.uk](mailto:Paul.latimer@cumbriacc.gov.uk)

### 11.1.1.11 Millennium Homes Project

Site visited 15 May 2002—**See site report for more detail**

**Driving Force: Social Care**

**Development Phase: Pilot**

**Live.**



This is a £1.2 million project over a 30-month period funded under the DTI Foresight programme - Shaping of Society, administered by the EPSRC, and due to finish at the end of 2002. Only partial funding has been provided, with no opportunity for evaluation and training activities. By the end of May 2002 there were 10 homes operating with equipment installed, but these are operating in ‘silent mode,’ gathering data but not raising alarms with residents. The Millennium London Borough of Greenwich has been selected for the first pilot scheme.

A Millennium Home will provide a ‘caring’ home rather than a ‘smart’ house and so the system is a relatively simple monitoring system based on an existing BT security

alarm system. The philosophy has been to develop simple radio sensors that can be installed easily at strategic points to monitor, for example, activity, water leak, doors, cookers and lock activation, with an emphasis is on safety monitoring rather than control applications.

Leading the team are Heinz Wolff and Maggie Ellis, Brunel Institute for BioEngineering. Collaborating partners are BT, Huntleigh Technology, and Plextec.

Further information can be obtained from:

Professor Heinz Wolff  
[heinz.wolff@brunel.ac.uk](mailto:heinz.wolff@brunel.ac.uk)

### 11.1.1.12 Northamptonshire Safe at home Scheme

(also see the ASTRID project 12.2.2 )

Site visited 21 June 2002—**See site report for more detail**

**Driving Force: Rehabilitation / Assessment and Social Care**

**Development Phase: Demonstration / Proof of Concept**

**Live.**



The objective of the ASTRID project (CEC Telematics Applications Programme) was to determine whether assistive technology assists in maintaining someone, who has a diagnosis of dementia, within their own home, and might otherwise need to enter residential care. The project ran from March 1999 to August 2000. Partners included: Northamptonshire County Council, Dementia Services Development Centre, and Edinvar Housing Association, UK; Human Factors Solutions, NO; Work Research Centre, IE; and Glaukopis, NL. (See 12.2.2 The ASTRID project for details of a Guide to technology that could be used for people with dementia).

Following the ASTRID project, Northamptonshire County Council began its Safe at Home Scheme with a demonstration house focussing on dementia. The scheme aims to support 50 homes in Northampton in 2002, and will be extended to 50 further homes in Corby and Kettering later in the year, with numbers set to double for 2003.



The equipment installed on site covers four areas:

- Problems around cookers;
- Orientation in time;
- Alerting devices/alarms;
- The need to raise an alarm outside the home.

(An evaluation of the site is due to be published soon by Hawker Publications, 13 Park House, 140 Battersea Park Road, London SW11 4NB, Tel: +44 (0) 20 7720 2108.)

Further information can be obtained from:

Brian Frisby,  
Northamptonshire County Council,  
Social Care & Health Directorate, County Hall,  
Northampton  
Tel: 01604 237491  
Email: [bfrisby@northamptonshire.gov.uk](mailto:bfrisby@northamptonshire.gov.uk)

Also see <http://www.northamptonshire.gov.uk/council/documents/Dementia/safe.asp>  
and

<http://www.astridguide.org/final.htm>



### 11.1.1.13 Portsmouth Smart Homes Project

Site visited 24 May 2002—**See site report for more detail**

**Driving Force: Social Housing**

**Development Phase: Pilot**

**Live.**



The Portsmouth Smart Homes are the result of a research programme, started in 1997, funded by an Innovation and Good Practice Grant from the Housing Corporation, with a total budget of £150,000. Inspired by earlier projects in Scandinavia such as BESTA (See 11.1.2.3) in Norway, the initiative is driven from Portsmouth City Council Housing, Portsmouth University, and John Grooms Housing Association as landlords.

This is a new build installation of six flats with the three downstairs flats designed to be wheelchair accessible. The focus is on people with severe physical disability and so there is emphasis on control applications. The system was expected to go live in mid June 2002 with a subsequent 1-year evaluation. The flats all have infrastructure for home automation, using Echelon smart home technology. Each room has a multisensor mounted in the ceiling allowing remote control of devices in the home and also acting as a temperature, light, smoke and movement detector. Other sensors

in the home are used to detect if the building is secure i.e., that doors and windows are closed and locked when the home is left. Internal temperature and light levels and outside temperature and wind speed are monitored and the system can also detect rain, so that if it is windy and wet the system can shut doors and windows. The front door has a video camera linked to the TV or monitor so that callers can be seen and the door opened remotely. A number of internal and external doors are also electrically actuated.

The home is energy efficient with underfloor heating providing background heating, boosted by local fan heaters controlled by the system. An efficient high temperature pressure system provides hot water and the whole system can also be controlled and monitored externally via the telephone line.

Further information can be obtained from:

Bob Souster  
Director of Development  
John Grooms HA  
Tel 020 7452 2040  
[Bsouster@johngrooms.org.uk](mailto:Bsouster@johngrooms.org.uk)

#### 11.1.1.14 Teesdale (County Durham), People at Home and In Touch Project

##### **Driving Force: Social Care**

##### **Development Phase: Pilot, moving towards Roll-out Live.**

The company Technology in Healthcare have developed a second-generation alarm system with intelligent monitoring, called MIDAS, which is capable of assessing complex and changing needs of elderly and disabled people in their homes. It uses their own wireless communication standard and is being trialled by local authorities in Scotland (West Lothian), Cheshire, Lincolnshire and Teesdale. See (Doughty, K. & Williams, G., 2001; Doughty, K.; Williams, G.; King, P.J.; Woods, R., 1998).

See <http://www.tech-healthcare.demon.co.uk>

The 'People at Home and In Touch Project' in Teesdale is in response to the Government's 'Best Value initiative'. The technologies researched included:

- Smart social and environmental sensors,
- Intelligent monitoring systems,
- Social alarms,
- Smart assistive technologies,
- Telemedicine,
- Video links to carers,
- Teleshopping and other on-line services.

Durham is now using different technologies with older people, younger physically disabled/ sensory impaired people and carers in pilot trials. Using a computer recycling scheme, one pilot involves the use of ICTs (Information and Communication Technologies) to investigate how technologies can overcome social isolation and exclusion through the use of computers and the Internet. Other pilots are testing how technologies can flag up emergency situations, and how technologies can be used as part of a preventative strategy. A project video has been produced providing an overview of the initiative.

Further information can be obtained from:

Pam Mills,  
Social Services Department,  
County Hall, Durham  
Telephone: 0191 383 4518  
Email: [pam.mills@durham.gov.uk](mailto:pam.mills@durham.gov.uk),

### 11.1.1.15 West London, New Technology in Elderly Care Project

**Driving Force: Social Care**

**Development Phase: Pilot**

**Live.**

This is a large study investigating the benefits of electronic aids and devices in elderly care, both in institutions and in the community. It includes the use of:

- Audio-visual communication systems,
- Tagging systems to detect wandering,
- Fall detectors,
- Hip protectors,
- Bed and chair monitors,
- Health monitors.

Plans are to include more subjects, extend the range of environments, and conduct Phase 3 (frail elderly, secure environment) or Phase 4 (frail elderly in the community) studies.

(This information is taken from a presentation by Frank Miskelly, Consultant Physician and Senior Lecturer in Medicine for the Elderly, Charing Cross Hospital, at 'Turned onto Technology, a modern vision for person-centred care,' 1-day course, London, 11 July 2002 10.2.3)

### 11.1.1.16 West Lothian Council Opening Doors for Older People Project

#### **Driving Force: Social Care**

#### **Development Phase: Pilot, moving towards Roll-out Live.**

This project was made possible by a £5.6m Challenge Funding grant<sup>1</sup> submitted in December 1998. West Lothian Council and its partners, (Lothian Health Board, The Trust, Bield Housing Association, Hanover (Scotland) Housing Association and Communities Scotland (formerly Scottish Homes)) who contributed to the project in money and land, received the money in February 1999. £750,000 of this money was earmarked for Smart Technology and in addition to smart home systems it was initially intended to use close circuit television and medical monitoring of people in their own homes as part of this initiative.

The project aimed to demolish three of the existing older residential homes for older people in West Lothian that required massive refurbishment to bring them up to current standards, and replace them with new housing with on-site care complexes. The new development would house older people as tenants with 24 hour, year round support from on-site staff who would also offer housing and support services to the tenants as well as delivering personal care

The first complex of 24 flats, (with the Bield Housing Association as landlords), is Almondvale Gardens in Blackburn and this complex will open to tenants in August 2002. As well as on-site staff, the tenants will benefit from the use of smart technology that will have been through extensive trials prior to installation and will continue to be monitored and evaluated both for Almondvale Gardens, and for use in the other projects. All the properties are for 2 people and consist of a bathroom, lounge, kitchen and bedroom (there are no bedsits).

The homes will have a core package of equipment comprising:

- Lifeline 4000 phone;
- Smoke detectors;
- PIRx2. (Passive infra red detectors);
- Video door entry system;

- Flood detectors;
- Hettie. (A temperature evaluator developed by Technology in Healthcare, which can provide warnings of hypo/hyperthermia).

The tenant wears a pendant (neck or belt) that can be pressed to summon help. If the tenant collapses the pendant also raises an alarm and activates a call to a handset carried by staff who will respond to the situation.

Within the wider community, older people who have a Lifeline 4000 will use their pendant to request help. This call will go to a designated call centre that will respond immediately to the person raising the alarm. If no response is received from the caller, staff within the Health and Care Team are alerted and attend immediately.

Monitoring and support are the main objectives, but control applications have not been discounted and although not explicitly included in this phase of the work, will be considered if a particular client has a need for such technology. For example, a tenant with bronchitis may be able to carry on with daily living activities but they may have a monitoring system installed to check their breathing pattern. If anything untoward occurred this would be detected and an alarm raised to alert staff, who can take appropriate action. However, there is some concern that control applications may not be appropriate for clients with dementia. The systems installed include the Technology in Healthcare MIDAS alarm system linked to a Tunstall Telecom Lifeline 4000. The MIDAS (or Modular Intelligent Domiciliary Alarm System) is a telecare system that can be tailored to the needs of the individual.

The two other similar developments in this initiative, for completion in March 2003, are 30 bedsit flats at Colinshiel Court, Armadale (Landlords Hanover (Scotland) Housing Association), and 30 units at Holmes Road, Broxburn. (Landlords Bield Housing Association)

Currently smart technology is also being delivered to more than 75 homes in West Lothian. In tandem with care packages and support from West Lothian Council's

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<sup>1</sup> All Scottish Councils can submit bids for money to fund an innovative project that will benefit people

Health and Care Team, they are enabling older people to remain in their own home longer whilst ensuring their families have peace of mind as the monitors will raise alarms should an emergency arise. The smart technology within the community has been in situ for just over 12 months, and continues to be evaluated and monitored.

MIDAS is also being trialled by other local authorities as well in Cheshire, Lincolnshire and Teesdale. See (Doughty, K. & Williams, G., 2001; Doughty, K., et al., 1998). See [www.tech-healthcare.demon.co.uk](http://www.tech-healthcare.demon.co.uk)

A project video has also been produced providing an overview of the home care initiative.

Further information can be obtained from:

Marion Reid at 01506 777348

[marion.reid@westlothian.gov.uk](mailto:marion.reid@westlothian.gov.uk)

Also see [www.scot-homes.gov.uk/news/press612.html](http://www.scot-homes.gov.uk/news/press612.html)

### 11.1.1.17 Wigton Smarthome Project, Cumbria

Site visited 2 July 2002—**See site report for more detail**

**Driving Force: Social Housing and Social Care**

**Development Phase: Demonstration / Proof of Concept, moving to pilot Live.**



This is a retrofit installation into 2 social housing bungalows in Wigton, Cumbria to support older adults, but it is planned that other clients with disability would also benefit from such systems. The project, which was completed in July 2002, is a collaboration between Cumbria Social Services and The Home Housing Association and an evaluation phase will follow.

There is some emphasis on control applications using the IHC bus system, including electrically operated windows and curtains, remote switching of a kettle, and a motorised front door lock and opener. In addition to a conventional key, the door can be opened with a radio key and visitors can be monitored using a video intercom system connected to the television, and given access remotely. They can also leave voice messages at the front door. There are local controls mounted on walls for room light, windows, curtains, room temperature and television, but the system can also be



operated via a remote unit. Wireless sensors, linked directly to a Tunstall social alarm system, are also used to detect carbon monoxide and water leaks.

See [www.cumbria.gov.uk/news/2002/1401b.asp](http://www.cumbria.gov.uk/news/2002/1401b.asp)

Further information can be obtained from:

Paul Latimer  
Cumbria Social Services  
Tel 01228 607137  
[Paul.latimer@cumbriacc.gov.uk](mailto:Paul.latimer@cumbriacc.gov.uk)

## 11.1.2 Europe

### 11.1.2.1 Belgium, Zwijndrecht

**Driving Force: Social Housing**

**Development Phase: Mature Development Live.**

This programme began in 1995 and aimed to build 5000 apartments with smart home technology in service flats within a 10 year period (van Berlo, A., et al., 1999).

Before the building started, older people themselves identified the following priorities and technical requirements:

- Maximal safety and security
- Maximal comfort
- Simple interfaces
- Minimal cost of energy

The first 500 apartments were being built with the IHC-system developed by the PEHA company.

### 11.1.2.2 Netherlands, Province of North Brabant

Sites visited 27-28 June 2002—**See site reports for more detail**

**Driving Force: Social Housing**

**Helpt Elkander Housing Association – Development Phase: Mature Development**

**Residentie Boerhaave – Development Phase: Mature Development**

**HHVL Housing Scheme – Development Phase: Mature Development**

**Werkendam – Development Phase: Mature Development**

**Vredeshof – Development Phase: Mature Development**

**Hoge Akkers – Development Phase: Roll-out**

**Live.**

The Province of North-Brabant in the Netherlands started a programme to build demonstration projects with smart home technology to learn more about:

- Real needs of older residents,
- The various technologies available
- How to install the different solutions in practice.

In mid 1999, 3 projects were in the finishing stages with 50 apartments available for evaluation. See also <http://www.stakes.fi/cost219/procVanBerlo.doc>

In the various demonstration projects, different smart home systems from different companies are being installed, including:

- Intruder alarms
- Activity monitoring
- Caller monitoring and displayed via CCTV;
- Automatic lighting when it gets dark
- An over-riding night switch over the bed to control the home

Further information can be obtained from:

Ad van Berlo

[info@smart-homes.nl](mailto:info@smart-homes.nl) or [vanberlo@smart-homes.nl](mailto:vanberlo@smart-homes.nl)

A short summary is provided below for each of the individual sites, and more detail can be found in the site reports.

**Helpt Elkander Housing Association—See site report for more detail**

A complex of 18 new build apartments in Neunen, Netherlands designed to support elderly people with a high degree of care need. This is one of the earliest Dutch projects that started in 1998 and became live in 2000. It is owned by ‘Helpt Elkander’ a small local Dutch housing association. Using the Teletask Bus System, applications include access control to the apartment block (electronic lock and door release), intruder alarm, inactivity measurement, and some automatic lighting. An ‘all off’ switch is also implemented that switches off lights and power to the electric cooker.

**Residentie Boerhaave—See site report for more detail**

A total of 17 new build apartments (out of 81) in Roosendaal, Netherlands, have been designed to support clients with a high care need. This site became live in 2000, and is owned by the Soomland Housing Association. The development uses the PEHA home bus system. Applications include access control to the apartment block (electronic lock and door release), intruder alarm, inactivity measurement, and some automatic lighting. A 'night time' switch is also implemented that switches off lights and power to the electric cooker. In addition the cooker has an isolating switch that needs to be operated before the cooker can be used. The curtains in the living room and bedroom are also electrically operated and can be opened and closed by using a remote control and switch on the wall near the curtains.



**HHVL Housing Scheme—See site report for more detail**

This is a new build apartment block property in Eindhoven, Netherlands. A total of 6 out of the 18 properties have smart technology installed to support elderly clients. This site became live in 2001 and is owned by the HHVL Housing Association. The development uses the EIB home bus system. Applications include access control to the main building (electronic lock and door release), intruder alarm, and inactivity measurement (using water flow). A ‘night time’ switch is also implemented that switches off lights and power to the electric cooker and in addition there is some automatic lighting e.g. night light. In addition the cooker has an isolating switch that needs to be operated before the cooker can be used.

**Werkendam—See site report for more detail**

This is a new build apartment block in Woudrichem, Netherlands. The development is intended to support local residents with a higher care need aged 55+. The site was opened in September 2001 and is owned by the SGB-Housing Association. The flats are constructed around a central enclosed atrium with shared facilities for both eating and more personal care provision. The development uses the Teletask home bus system. Applications include regulation of temperature in the atrium and individual flats, as well as access control and security. Inactivity measurement is also implemented (using PIR activity). A ‘night time’ switch is also implemented that switches off lights and power to the electric cooker and in addition there is some automatic lighting, e.g. night light and additional sockets controlled by a remote unit.

**Vredeshof—See site report for more detail**

This is a new build apartment block property in Best, Netherlands. A total of 6 out of the 18 flats have full smart technology applications to support those with a general high care need, i.e. elderly or disabled. The site was opened in early 2000 and is owned by the Domein Housing Association. The development uses the NICO Home Bus System Applications, which include access control to the main building (electronic lock and door release), intruder alarm, and inactivity measurement. A ‘night time’ switch is also implemented that switches off lights and power to the electric cooker and in addition there is some automatic lighting, e.g. night light.



**Hoge Akkers—See site report for more detail**

This is a retrofit apartment block property in Best, Netherlands. A total of 44 flats have smart technology applications to support elderly people. The site was opened in mid 2002 and is owned by the Domein Housing Association. The development uses the EIB Home Bus System. Applications include access control to the main building, intruder alarm, smoke detection and inactivity measurement. A ‘night time’ switch is also implemented that switches off lights and power to the electric cooker and in addition there is some automatic lighting, e.g. night light.

### 11.1.2.3 Norway, BESTA

**(Also see BESTA Project 12.2.3)**

**Driving Force: Social Housing**

**Development Phase: Demonstration / Proof of Concept**

**Not Live.**

The BESTA project started in January 1993 and ended July 1994. Partly funded by the Norwegian Research Council, the project included 10-20 companies (mainly Norwegian, but also other European companies), 2 county councils, Norwegian Telecom, 2 ministries and 1 rehabilitation hospital. The main aim of the project was to develop and evaluate integrated smart homes, which were designed according to user requirements and life cycle standards. User requirements formed the basis for the development of models for three different demonstration homes. Demonstrations were based at Sunnaas Hospital and in Lillehammer, Norway. Whilst the BESTA project was primarily a demonstration of smart home technology rather than fully operational systems, it has proved to be a basis for many other developments. The Edinvar work has been influenced by BESTA and a number of developments are taking place in the Larvik and Tønsberg regions of Norway directly based on the BESTA project. [See Larvik and Tønsberg site reports 11.1.2.4.](#)

#### 11.1.2.4 Norway, Larvik and Tønsberg

**Larvik: Heleroa Senior Flats. Larvik: Rekkevik Nursing Home and Senior flats.**

**Tønsberg: Tjeldveien Omsorgsboliger**

**Sites visited 5-6 June 2002—See site reports for more detail**

**Driving Force: Social Housing and Social Care**

**Development Phase: Roll-out and Mature Development**

**Live.**

A number of developments are taking place based on the BESTA project work, which finished in 1994. These are complexes of flats and care homes for elderly people, as well as more specialist developments for those with dementia. See Bjørneby, S. (2002) for an overview of developments in Norway including the Tønsberg development.

**Larvik: Helgeroa Senior Flats—[See site report for more detail](#)**

This is a new build complex of 12 flats for elderly people outside Oslo that was opened in 1999 by the municipality. The development uses the EIB bus system and is primarily designed to increase safety in the home. A range of unobtrusive sensors are located in the home to detect water leaks, bed activity, cooker being on, and windows and door being open. In addition there are alarm cords and pendants installed where they are needed. Control applications include a single on/off switch for the home and a timer unit for the cooker so that it cannot be left on indefinitely.

**Larvik: Rekkevik Nursing Home and Senior Flats—[See site report for more detail](#)**



This is a new complex integrating a care home with shared facilities for 16 residents and a block of 30 flats in the Larvik region of Norway, south of Oslo. This is designed to support frail elderly people and people with mild dementia (in the care home). This development has been operational since early 2002 and is owned by the local authority. The development uses EIB technology and local software integration, also linked to a mobile telephone based alarm system (DECT). Safety and security are the primary applications, but also wandering can be monitored within the care home. The thermal environment is also controlled by the system.

External doors and windows are alarmed in the flats and also the doors in the nursing home. In the nursing home the system is also used to monitor those with dementia, ensuring that people do not wander. Smoke detectors are also installed and in the flats there is also a cooker sensor that detects heat. Other specialist sensors, e.g. bed activity, can also be connected to the system.



**Tønsberg: Tjeldveien Omsorgsboliger—See site report for more detail**

This is a new build care home specifically designed for people with dementia in Tønsberg, Norway. The home is essentially split into two units of four flats with shared facilities for washing and cooking. Each flat also has its own basic cooking facilities. The unit has been operational since 1995 and is owned by the local authority. The home uses EIB technology with some local software integration, also linked to a mobile telephone based alarm system providing text messages of alarm conditions.

Safety and security are the central themes, with a range of sensors being included in the home. These include door and windows, cooker and bed sensors. The bed sensor is also used to switch on the ceiling light (at a dimmed level). All external doors and windows to the care home have sensors along with the main doors to the individual flats. Flats also include individual door lock releases. Under-floor heating is also provided, also controlled by the EIB system.

### 11.1.2.5 Sweden, The PDH at Danderyd Hospital

**Driving Force: Rehabilitation / Assessment**  
**Development Phase: Mature Development**  
**Live.**

The PDH is the Pre-Discharge Home unit (PDH) in Stockholm, Sweden. The unit, built in 1999, acts as an intermediate station in the Danderyd Hospital, allowing the patient to make the transition between the institutional life inside hospital and life outside as easy and smooth as possible. The unit is intended to support people who, after a medical event or trauma, and consequent long period spent in hospital, face returning home, that may have been modified, but that is not designed for the needs of their new condition. It supports them as they rediscover the domestic environment and helps them to regain, increase and improve autonomy in their domestic life in terms of safety, security and comfort.

The unit is an apartment of 100 square metres and consists of a living room and kitchen, a bedroom and bathroom, separate toilet, hall and terrace. It is fitted with adjustable furniture such as toilet seat, moveable bed, tables, cupboards, clothes hanging bars, etc. Doors generally slide open by button press, to facilitate wheelchair access and the TV provides Internet access to online purchasing and communication, and provides control functions for the curtains.

The main domotic components include:

- *In the building:* fire and smoke alarm, sprinkler, intruder alarm, intercom, entry phone, computer, telephone, communication with the computer, telephone answering machine, fax, remote and/or automatic controls of blinds, doors, lighting, heating and ventilation. This is based upon a bus system.
- *In the dwelling:* security alarm in the bathroom and bedroom, 24 hour monitoring through flush WC, alarm when falling, alarm for cooker overheating, memory help to take medicine.

Further information can be obtained from:

Chief Occupational Therapist (Marianne Söderström)  
Pre-discharge Home Unit,  
Danderyds Sjukhus,  
Rehab Med.,  
Stockholm,  
Sweden.

### 11.1.2.6 Sweden, SmartLab

**(also see SmartBo Project 12.2.14)**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

SmartBo (Elger, G. & Furugren, B., 1998) was a 3-year project run by and located at the Swedish Handicap Institute, which demonstrated how information and communication technologies and computer-based solutions can give elderly and disabled people a more independent lifestyle in the home. The project, documented in a video (with English sub-titles) shows how severely mobility impaired, deaf/blind people and people with cognitive impairment can benefit. The equipment from SmartBo was moved and is now used in a new permanent activity called SmartLab, situated within the Swedish Handicap Institute. Technologies within SmartLab include products for environmental control, safety and care in the home, as well as communication with the outside world. It is interesting to note that SmartLab can be made available to other R&D projects as a testing environment in home-like surroundings, with possibilities to supplement the lab with further equipment or new system solutions. A website is available, but only in Swedish: [www.hi.se/smartlab](http://www.hi.se/smartlab)



### 11.1.3 United States

Developments in the home automation area in the USA have not tended to concentrate on the elderly and disabled sector, and have been traditionally dominated by the luxury housing sector or the DIY market. However some information about US research and developments for the support of older and disabled people is presented.

#### **Honeywell**

It is understood that Honeywell are actively working in this sector, and are developing a product called the Independent Life Style Assistant. The basic concept is to monitor safety in the home and to notify the resident of potentially hazardous events such as an overheating cooker. If residents fail to respond to the alarm condition then external parties such as neighbours could be notified of problems in the home or the system could even switch off the cooker automatically. Other applications could include reminding the owner to take medications and detecting whether they have been taken.

See [http://content.honeywell.com/yourhome/convenience/elderly\\_PR.htm](http://content.honeywell.com/yourhome/convenience/elderly_PR.htm)

#### **University research**

It is understood that Intel are also sponsoring research in this area, and that there is research taking place in American Universities. At Georgia Tech in Atlanta they are developing radio based tagging systems for elderly people and have a smart home test bed called the Aware-Home. This is a 'living laboratory' on the University campus funded by a \$700,000 grant from the Georgia Research Alliance. The home appears to be primarily a test bed for innovative design ideas such as a Digital Family Portrait that monitors the activity of the elderly person and displays how the person is feeling to others, a Gesture Pendant that allows control of devices in the home through gestures, and a kitchen product called "What am I Cooking?" This system is essentially a memory aid acting as a reminder to the cook what they were making after they have been interrupted in their cooking activities. For more details see:

<http://cooltown.hp.com/mpulse/0901-smarhome.asp>

The University of Rochester is also known to be working in the home automation and ageing sector and have also developed a living laboratory looking at health care

applications. The emphasis is on monitoring the individual through sensors and cameras in the home. Applications being explored include tracking the location of common household items such as keys and glasses, gait monitoring and automatic analysis of skin condition (to detect early signs of skin cancer etc). In addition a medical advisory system is being developed, to give the home's resident information about medical conditions and personal health. See:

<http://www.rochester.edu/pr/Review/V64N3/feature2.html>

#### 11.1.4 Japan

In February 2000 a group of experts from UK housing, health, care and technology visited Japan to assess the use of Information and Communication technologies (ICTs) in the delivery of services for people in need of care and social support in the home. The projects in this section have been selected from this report. (Gann, D., et al., 2000). The authors found that:

- There appears to be a stronger focus on technological solutions in Japan than is the case in the UK.
- The concept of 'design for all' has been widely developed and integrated within Japanese functional and technical design activities, with the term for universal design (*Kyoyohin*) being widely used in Japan.
- The main demonstration sites are in the high-priced private sector,
- The main focus is on people with physical impairments.
- Large suppliers tend to invest heavily in research and development, whereas the UK's small, low-volume suppliers tend to operate in niche markets, frequently making it difficult to raise the capital or develop the competencies to develop new technologies successfully.

At the time of writing Gann et al claimed that Japan was ahead of the UK in two areas:

- Implementing trials to assess the possibility of providing distributed services; and
- Providing health and care demonstration homes and facilities.

Individual site reports follow.

#### 11.1.4.1 Daiwa Prototype Houses

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

Daiwa is one of Japan's largest industrialised housing producers for the private sector. Their 1995 Prototype House demonstrated barrier free features. It included a home automation system and was intended to be used for assessments of retrofit work.

The 1999 Prototype House included a home automation system with voice recognition and cellular telephone, infra-red or computer mouse control for a range of lighting, security and entertainment features. Gann et al found that Daiwa considered technology as being important to make things easier for older and disabled people, and that in the long term technologies needed to be integrated with social service provision.

#### 11.1.4.2 Owada NAIS Care Home

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

NAIS is Matsushita's brand name for products aimed at the care market. The Owada NAIS Care Home is the first development for Matsushita Electronic Works Company in the residential care market, and is one of only 20 privately run residential care homes in Japan. The building is a showcase to allow NAIS to learn more about older people's needs and the needs of their carers. Older people permanently live in certain parts of the building (under a long-term residential scheme, a tenant scheme, or a short-stay scheme), and other parts are open to visitors. The building is organised into nine group homes, with each group living as a 'family'. Since staff recognise that technology can play a part in assisting people with dementia, as well as aural and visual impairments, Gann et al consider this home as having potential to help develop a better understanding of automation for these user groups.

### 11.1.4.3 Panasonic HII House

**(also see the eHII House and Panasonic Center 11.2.4.1)**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

The HII House (Home Information Infrastructure) is a technology showcase designed by an interior designer to demonstrate future Panasonic products and services and to obtain feedback from visitors. Their aim is to integrate three domains in order to identify new markets for products and services: digital and network technologies, healthcare and welfare, and environment and ecology. For completeness from Gann et al, this project is listed in this section focusing on elderly and disabled people, but see the most recent enhancement of the HII under ‘Sites not specifically focusing on elderly and disabled people’ —the eHII House and Panasonic Center 11.2.4.1.

#### 11.1.4.4 Welfare Techno House

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

This includes fifteen demonstration and research houses that aim to promote the concept of universal design and the idea of independence for older and disabled people by creating accessible environments and maximising the use of assistive technologies. Users and carers are able to explore issues over a period of several days by trying out the technologies and seeing if they meet their specific requirements.

The project was launched in 1995 as a collaborative effort between the Japanese Agency of Industrial Science and Technology, under the auspices of the Ministry of International Trade and Industry, and the new Energy and Technology Development Organisations. A number of private sector companies have donated equipment to this scheme, including Panasonic, Sharp, Toshiba and Mitsubishi, Woodtec, Saita and Toto. Gann et al suggest that the UK could benefit from further government interest and sponsorship in this way.

## 11.2 Sites Not Focusing on Elderly and Disabled People

There have been various initiatives demonstrating smart home technologies e.g., the House of the Future, outside Brussels, which opened in March 1995, involving as many as 158 companies; the Intellihome, built in California and Edinburgh by Taylor Woodrow, the British developers; and the House of the Future in Limoges, France. The following projects do not focus specifically on smart home initiatives that facilitate independent living for older and disabled people. However, they are included as current examples of initiatives that could provide benefits for these target groups if the technologies were designed and evaluated with their needs in mind. At the present time, and unless otherwise stated, there is no clear evidence that these projects have any particular plans to include older and disabled people in their development work.



## 11.2.1 United Kingdom

### 11.2.1.1 Hewlett-Packard's CoolTown

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

The aim of this project is to make heads of industry aware of emerging technologies and involve them in turning long-term visions into real-life products and services.

The first CoolTown Centre was set up in California 2001, and smaller versions are planned for throughout the world. The £7m centre in Wokingham, Berkshire, is designed to be a showcase for a digital lifestyle, with appliances that fulfil people's wants and needs. Technology uses standard barcodes, radio receivers, infrared and Bluetooth wireless technology to transmit information to handhelds and mobile telephones, using the Web as the hub. (BBC News item 29 Jan 2002, at [http://news.bbc.co.uk/1/hi/english/sci/tech/newsid\\_1782000/1782820.stm](http://news.bbc.co.uk/1/hi/english/sci/tech/newsid_1782000/1782820.stm)).

### 11.2.1.2 INTEGER

**(site visited -Watford)**

**Site visited 30 May 2002**

**Driving Force: Social Housing**

**Development Phase: Demonstration / Proof of Concept**

**Live.**

The INTEGER programme is a holistic approach to innovation in housing. It was the brainchild of architect Nicholas Thompson of Cole Thompson Associates and information technologist Alan Kell of i&i who are respectively Project Director and Research Director of INTEGER. The project started in May 1996 with a small group of research and design consultants, and now has the support of some 150 organisations from all parts of the world, including the UK. Together they have built the INTEGER Millennium House to demonstrate some of their ideas. Whilst the INTEGER development is primarily about ecological and renewable housing, there are some features that are of interest from the perspective of the project.

For more details contact:

INTEGER Intelligent & Green Ltd,  
Building 9,  
Bucknalls Lane,  
Garston,  
Watford,  
WD25 9XX  
See [www.integerproject.co.uk](http://www.integerproject.co.uk)

### 11.2.1.3 Orange at home

**Site visited 28 May 2002**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

Orange at home is a consumer-focused research centre designed to evaluate next generation wirefree™ connected devices, appliances and services in the home.

Launched in 2000, four families have lived in the home for short periods since Easter 2001, the longest time being 2 weeks, although they are aiming at 6 weeks periods for future evaluations. While the families were living in the home, Orange worked with the Digital World Research Centre at the University of Surrey, to undertake the necessary video-based ethnographic research. Orange has also worked with the Royal College of Art and the London Business School on this project.

Orange summarises its insight and learning from the project into eight key categories, which include:

- At home, but away (e.g., voice control of remotely accessed services);
- wirefree™ home living (e.g., webtablets to access entertainment and information services);
- Personalisation: ‘That’s mine’ (e.g., personalising access to the web);
- Connected community (e.g., virtual communities of shares interests);
- Touch and control (e.g., touch and tangible control of specific systems and devices, but always with manual override facility);
- Convergence and divergence (e.g., multiple terminals around the home);
- Islands of intelligence (e.g., connecting individual kitchen appliances with other systems); and
- Wellness and wellbeing (e.g., a health suite, monitoring heart rate, etc.).

Its philosophy is that just because a particular technology is especially innovative, does not mean that consumers will buy it. Therefore, it is important to monitor consumers’ behaviour and interaction with new technologies in the home environment, in order to establish how future wirefree home services could be deployed and marketed.

Even though the project is not specifically focusing on older and disabled people, Orange has observed that the wirefree™ home as the central hub has extended people's social and work network. We can therefore see the benefits for older and disabled people, although the authors of this report recommend that the interfaces to such technologies will need to be evaluated with these user groups to ensure accessibility, usability and acceptability.

See [www.orange.com/orangeathome](http://www.orange.com/orangeathome).

For more information, contact

Sue McGill, Orange at home, at [sue.mcgill@orange.co.uk](mailto:sue.mcgill@orange.co.uk)

## 11.2.2 Europe

### 11.2.2.1 Belgium, Living Tomorrow, the House of the Future (LivTom)

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

This vision is realised by the interaction of the ideas of leading edge companies, prominent institutions and organisations and the interconnection of their state-of-the-art technologies. Various facilities can use the complex for educational and introductory purposes. The LivTom complex consists of three entities:

- A house of the future with home office;
- An office of the future;
- Functional areas (auditorium, event hall, meeting rooms and restaurant for visitors and events).

For more information, contact

Indringingsweg 1  
B-1800 VILVOORDE  
Tel.: 0032-2-263.01.33  
see [www.livtom.com](http://www.livtom.com)

### 11.2.2.2 Finland, Place Labs

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

Place Labs (see the details on MIT Media Laboratory 11.2.3.1 below) are currently being developed, with MIT serving as focal point and clearing house. The Finnish Government (TEKES) has funded a feasibility study to develop a facility in Helsinki connected to MIT in order to consider issues and technologies in Scandinavia. Discussions are also underway to develop networked Place Labs in Korea and Portugal.

### 11.2.2.3 Netherlands, Philips HomeLab and Easy Access

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

This is a permanent, fully functional home laboratory, which opened on 24 April 2002, in Eindhoven, the Netherlands. It is designed as a two-level, 2-bedroom home, linked through hidden cameras, microphones and 2-way mirrors to a state of the art observation centre adjacent to the facility on the Philips High Tech Campus. It was built to study how people interact with prototypes of intelligent technology in a real-world environment. Through HomeLab, Philips researchers can better understand their needs and motivations to use technology, and bring better products to market in the quickest possible timeframe. Sponsors are Royal Philips Electronics, and the EU IST Programme.

For media inquiries, contact:

Hans Scholten, Philips Corporate Communications

Tel: +31 20 5977425

[hans.scholten@philips.com](mailto:hans.scholten@philips.com)

See <http://www.philips.com/>

#### 11.2.2.4 Smartest Home of the Netherlands

**Site visited 26<sup>th</sup> October 2001**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

This is a show home of 160 sq m, with smart technology and home networks, which can be reassembled in different locations – the target is to move the house every six months. The first location was the city of Tilburg, followed by Kenniswijk in October 2001. The house can now be visited (as of website in June 2002) in Almere. See [www.smart-homes.nl/engels/content.html](http://www.smart-homes.nl/engels/content.html)



### 11.2.3 United States

#### 11.2.3.1 Cambridge, MIT House\_n and Changing Places

**Site visited 13 May 2002**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept**

**Live.**

The House\_n: MIT Home of the Future at MIT (Massachusetts Institute of Technology), started in 1999 for companies to explore the home of the future and look at new ways of designing, building and integrating new technologies. This is now a joint MIT Media Lab/ Department of Architecture initiative, which has developed into the follow-on project called Changing Places. This project, amongst other objectives, is exploring how the development of sensing technologies can enable new applications in the home, the workplace and the city (from proactive health care to energy conservation).

(See [http://architecture.mit.edu/house\\_n/](http://architecture.mit.edu/house_n/) and <http://cp.media.mit.edu/research/>

PlaceLabs (including, amongst others, a house lab for a single family and an apartment lab) are being used for testing technologies, materials and infrastructure, as well as testing these technologies with people in relation to their environment. These are shared research labs that can be used by both sponsors and the academic community. A “Living Laboratory” shared research facility (essentially the same thing as the PlaceLabs) will be located near MIT in Cambridge, Massachusetts. The Living Laboratory will be a full-scale and fully functional single family home constructed using a new component-based building methodology developed by House\_n researchers. It is intended to be a highly flexible and multi-disciplinary research lab designed explicitly for the scientific study of people and their interaction patterns with new technologies and home environments. In fact, the researchers are currently requesting proposals from academic and corporate researchers for studies that can only be accomplished via the use of this facility.

More information can also be obtained from

Kent Larson,  
Architect and Director at MIT School of Architecture,  
[kll@mit.edu](mailto:kll@mit.edu)

### 11.2.3.2 Houston, Eagle Broadband Home

**Site visited 14 May 2002**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

Eagle Broadband is positioning itself as a Service Provider delivering bundled digital services (Internet services, local and long-distance telephone services, cable-style television over fiber, video-on-demand (VOD) and networked security systems) to the home networks. A model home, equipped with systems enabling these services, is part of a community called Canyon Gate, in the Houston residential area, with around 200 homes under construction. Eagle Broadband has signed a partnership agreement with the developer and is in direct contact with the end customer (a single bill of 100 USD per month in average depending on the importance of the set of services). There are no specific plans to support elderly or disabled people.

More information can be obtained from <http://www.eaglebroadband.com/>  
Or from John Nagel, Vice President Engineering, Eagle Broadband, at [jnagel@eaglebroadband.com](mailto:jnagel@eaglebroadband.com)

### 11.2.3.3 Redmond, Microsoft eHome

**Site visited 17 May 2002**

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept Live.**

The Microsoft home is about providing a concrete example of people's imagination based on existing technologies. The objective is not to showcase and recommend solutions but to provide professionals with an attractive and motivating concrete vision of the home of the near future in order to make Microsoft's positioning in home of the future more visible and to act as a support for the identification of possible developments in partnership. There are a number of advanced digital devices (large flat TV screens in most rooms, PADs) and functionalities (iris screening to open the front door, voice control of many devices, remote control of white goods). They are also partnering with grocery manufacturers to embed intelligence in groceries so the systems can read and recognise them.

The Microsoft demo home can be compared to the Cisco Internet Home in San Jose or to the 'Living Tomorrow' project in Brussels.

See [www.microsoft.com/windows/ehome](http://www.microsoft.com/windows/ehome) (although there is little of relevance to this particular study) or email Aaron Woodman at Microsoft, Lead Product Manager, Consumer Prototyping and Strategy, [aaronw@microsoft.com](mailto:aaronw@microsoft.com)

#### 11.2.3.4 Seattle, Premise Home

**Site visited 17 May 2002**

**Driving Force: Technical R & D**

**Development Phase: Pilot**

**Live.**

The SYS automation software is an overall management system with a wide range of functionalities (distributed media, lighting, climate control, energy management systems, security camera surveillance, home theatre, etc.). This software is being demonstrated in a real home environment (Premise System VP of Business Development's House).

The company's expertise is with the software. The company does not intend to sell its SYS automation software directly to the end-consumer (Premise System's direct customers are System Integrators and Device Manufacturers). The software platform is being tested by being installed in the homes of the developers, and end users might get involved in the future as more rollouts occur.

More information can be obtained from

[www.premisesystems.com/about\\_us/pressroom/pressreleases/](http://www.premisesystems.com/about_us/pressroom/pressreleases/)

Or from Irene Kruppa, Director of Marketing, Premise Systems, Email:

[Irene.kruppa@lantronix.com](mailto:Irene.kruppa@lantronix.com) or [ikruppa@premiseystems.com](mailto:ikruppa@premiseystems.com)

## 11.2.4 Japan

### 11.2.4.1 EHIII House and Panasonic Center

(also see the Panasonic HII House 11.1.4.3)

**Driving Force: Technical R & D**

**Development Phase: Demonstration / Proof of Concept**

**Live.**

The eHIII House is the most recent enhancement of the HII (Home Information Infrastructure) house developed and implemented by Japan's Matsushita Electric Industrial Co., Ltd (a member of the ECHONET Consortium – information only available in Japanese but see <http://www.echonet.gr.jp/>). The eHIII House, which closed in March 2002, incorporated the latest advanced in networking technologies and products, interconnecting not only inside but also outside the home. Encouraging the concepts of 'e-living' and 'e-business,' some of the advanced network devices and services include the Video Door Phone; an Echonet terminal, for managing and monitoring home power usage; an Electronic Health Monitoring System; and the latest mobile communication devices such as those using W-CDMA.

The Panasonic Center is now in the planning stage. Currently under construction at Ariake, the new Tokyo Waterfront Subcenter, it will hold its planned inaugural in September 2002. Information only available in Japanese but See eHII House at <http://www.matsushita.co.jp/corp/news/official.data/data.dir/en010111-1/en010111-1.html>

Information only available in Japanese but See Panasonic Centre at

<http://www.matsushita.co.jp/corp/news/official.data/data.dir/en020110-13/en020110-13-2.html>

## 12 Projects (including Tools and Techniques)

A selection of relevant projects is presented to give an overview of current activity in the area and also where to look for further information. The selection included projects that have taken place in the UK, Europe, the USA and Japan.

### 12.1 United Kingdom

#### 12.1.1 Advanced Sensors for Supportive Environments for the Elderly

An EPSRC EQUAL Project, which runs from 1<sup>st</sup> October 2001 until 30 September 2003. It is investigating supportive environments for monitoring elderly and disabled people living alone. The objectives of the project are:

- To develop a prototype demonstrator to monitor a person in their home environment,
- To decide the appropriate level of monitoring and resulting relevant actions,
- To track the occupant automatically, identifying significant events in their home context, e.g. inactivity or falls.

The Consortium consists of Department of Applied Computing, University of Dundee, Dundee Repertory Theatre Co., Servite Housing Association, and Foxtrot Theatre Co. See [www.computing.dundee.ac.uk/projects/supportiveenvironments/](http://www.computing.dundee.ac.uk/projects/supportiveenvironments/) or go to <http://www.fp.rdg.ac.uk/equal/> and click on workshop Bioengineering & Mobility for a slide show about the project up to June 2002.

### 12.1.2 **Integrated Control and Communication Systems for Distributed Sheltered Housing in the Community**

This EPSRC EQUAL Project started in October 1998 and ended in December 1999. It examined three main aspects of the feasibility of control and communication technologies used to enhance quality of life for elderly people in their own homes and to assist care management by providers:

- Technical aspects – to investigate what is possible at the systems level and how the technology can be retrofitted in existing dwellings;
- Socio-technical – to investigate the primary needs and perceptions of occupants and service providers and to develop guidelines for effective user interfaces; and
- Economic – to establish the different options graded by cost to occupants and provider. (Tweed, C. & Quigley, G., 1999; Tweed, C. & Quigley, G., 2000)

Their reports can be downloaded from <http://www.qub.ac.uk/arc/research/projects/equal.html>

### 12.1.3 **Introducing Assistive Technology into Older People's Homes**

This EPSRC research project commenced in October 2000 and will be completed in December 2002. It is exploring, selecting, providing and maintaining Assistive Technology in older mainstream properties in which the majority of older people live. Fieldwork is taking place in 10 areas with housing associations and local authorities. It will involve:

- Discussions with providers;
- Focus groups with residents;
- Surveys of actual homes and key housing types;
- Assessment of existing provision and the potential for further provision;
- Estimates of costs of installation and maintenance.

Partners in the project include the Age Concern Institute of Gerontology, King's College London; Centre of Rehabilitation Engineering, King's College London; Research Group for Inclusive Environments, University of Reading; with one of the consultants to the project being the Director of the Smart Homes Foundation in the Netherlands, Ad van Berlo. See <http://www.fp.rdg.ac.uk/equal/AT/>



#### 12.1.4 **SIMBAD 1 and 2 (Smart Inactivity Monitor Using Array-based detectors)**

SIMBAD is funded by the DoH/DTI Medlink Programme, and SIMBAD 1 ran from July 1999-April 2001. Project partners included: Irisys Ltd; British Telecom PLC; University of Liverpool; University of Manchester.

SIMBAD 2 is running from July 2001-July 2003. Project partners for this phase include: Irisys Ltd; Huntleigh Technology PLC; University of Liverpool.

The SIMBAD project is developing an intelligent inactivity monitoring and fall detection sensor using array-based passive infrared technology developed by InfraRed Integrated Systems (IRISYS) Ltd. This novel, low-cost, technology is capable of reliably locating and tracking a thermal target within the sensor's field of view, providing size, location and velocity information. This provides a much richer source of data than current home monitoring systems and will detect if a person has fallen and will raise an alarm in a call centre, even if the person is incapacitated and unable to raise the alarm himself or herself. .

Phase 1 of the project involved the development of basic hardware and software components, lab testing, simulations and limited field-testing. The system worked well in the field trials, and the main 'defects' were that it was designed to work with only one person and in one room. This is being addressed in the project extension, SIMBAD 2, which is to develop better algorithms and a detector sub-system.

More information can be obtained from the project co-ordinator, Lindsey Galloway.

[jl@irisys.co.uk](mailto:jl@irisys.co.uk)

### 12.1.5 TCPI Project

TCPI (Telecare planning and implementation) is funded by the EPSRC's Integrated Healthcare Technologies Programme and the project's industrial and care authority partners. Partner include: Science and Technology Policy Research Unit (SPRU), University of Sussex; Bournemouth Community and Mental Health NHS Trust; Surrey Social Services and 7 other partners, and the project will be completed in July 2003. The objective is to identify options for delivering telecare by simulating alternative care and business models and conducting live trials. More information can be obtained from Dr. James Barlow at SPRU, [j.g.barlow@sussex.ac.uk](mailto:j.g.barlow@sussex.ac.uk), and from <http://www.sussex.ac.uk/spru/imichair>

## **12.2 Europe**

### **12.2.1 ASHoRED Project**

The ASHoRED (Adaptable Smarter Homes for Residents who are Elderly and Disabled People) project (EU TIDE project 101) ran for 14 months from 1992. The project (Bjørneby, S. et al, 1992) defined the problems of daily living and user need requirements of elderly people and visually impaired people who live in their own home. These user needs were then addressed in the ASHoRED project demonstrators located in Germany, Finland and Spain (Richardson, S., et al., 1993). The user requirements were also a starting point in developing a conceptual framework for the CUSTODIAN project. ASHoRED identified six functional areas in the home (Entrance, hallway, elevator, stairs, garden, drive; Kitchen; Living room; Bedroom; Bathroom; and General), and CUSTODIAN allocated systems to each of these functional areas (Dewsbury, G.A.; Taylor, B.; Edge, H.M., 2001b)

### 12.2.2 ASTRID Project

**(also see Northamptonshire Safe at Home Scheme 11.1.1.12)**

The project (CEC Telematics Applications Programme) aimed to determine whether assistive technology helps to maintain someone, who has a diagnosis of dementia, within their own home rather than in residential care. The project ran from March 1999 to August 2000. Partners included: Northamptonshire County Council, Dementia Services Development Centre, and Edinvar Housing Association, UK; Human Factors Solutions, NO; Work Research Centre, IE; Glaukopis, NL.

The ASTRID project developed a Guide to technology that could be used for people with dementia. It is aimed at elderly people with dementia, and their families and informal carers, and professional social and health care staff who need to select technological options to meet assessed needs. A summary of the guide and information about ordering can be obtained from <http://www.astridguide.org/> (Frisby, B. & Price, S., 2000; Woolham, J. & Frisby, B., 2002; Woolham, J., et al., 2002).

Following the ASTRID project, Northamptonshire County Council began its Safe at Home Scheme with a demonstration house specifically with a focus on dementia.

For more information contact

Brian Frisby,  
Northamptonshire County Council,  
Social Care & Health Directorate,  
County Hall,  
Northampton  
Tel: 01604 237491  
Email: [bfrisby@northamptonshire.gov.uk](mailto:bfrisby@northamptonshire.gov.uk)

Also see [www.northamptonshire.gov.uk/council/documents/Dementia/safe.asp](http://www.northamptonshire.gov.uk/council/documents/Dementia/safe.asp) and [www.astridguide.org/final.htm](http://www.astridguide.org/final.htm)

### 12.2.3 BESTA

#### (Also see Site Reports for Larvik and Tønsberg 11.1.2.4)

The BESTA project started in January 1993 and ended in July 1994. Partly funded by the Norwegian Research Council, the project included 10-20 companies (mainly Norwegian, but also other European companies), 2 county councils, Norwegian Telecom, 2 ministries and 1 rehabilitation hospital. The main aim of the project was to develop and evaluate integrated smart homes designed according to user requirements and life cycle standards (Clatworthy, S. & Bjørneby, S., 1994). User requirements formed the basis for the development of models for three different demonstration homes:

- A flat to support younger disabled people,
- A house for elderly people with mobility problems,
- A flat for elderly people with disorientation and memory problems.

Demonstrations were located at the Sunnaas hospital and in Lillehammer, Norway.

The flat to support younger disabled users used X10 technology and an IGEL home controller as a central monitoring system. The applications included remote control over lights, curtains, window and door (using a remote control key), and there was a social alarm and telephone connected to the unit. Sensors connected to the system included PIR, light sensor, cooker monitor, magnetic switches and smoke detector. Automatic night-lights were installed and movement detection was also used to switch room lights on and control room heating. There was a door intercom with video camera and the IGEL system provided a voice reminder to users about daily activities they should perform.

The house was a new build property with one room set up as a demonstration of an alarm call centre connected to the home via an ISDN link. The home used the Siemens Instabus home system connected to an IGEL home controller. Applications included remote control over lights, curtains, window and door (using an Abloy remote control key), and there was a social alarm and telephone connected to the unit. A modified cordless telephone was also used as a remote control unit. Automatic night-lights were installed, and movement detection was also used to switch room and

outside lights and control room heating. A door intercom with video camera was also installed.

The third flat was also a new build property and was part of a group home for six elderly people with a high care need. This flat had an ELKOMATIC Home Bus installed produced by a Norwegian company called ELKO. There was greater emphasis placed on monitoring home safety rather than control applications. Automatic lighting was installed, and the cooker was monitored and would switch itself off if left unattended. The system also provided verbal messages to help prevent wandering at night so that if the occupant went near the exit door at night they would be told to go back to bed, and if they then went outside an alarm would be raised with a service centre linked to the home system via telephone. The phone had large push buttons with pictures instead of numbers (also produced by Falck).

Other aspects of the development included an 'in bed' sensor produced by Falck that raised an alarm if the person had not gone to bed, and a pendant-based social alarm unit. The project also evaluated a fall detector connected to the same system.

This development also demonstrated solutions for carers including a portable fax to allow carers to order shopping for the client, and a portable PC allowing nurses access to medical information from the home along with email facilities.

#### 12.2.4 CASA Project

Following on from ASHoRED, CASA (Concept of Automation and Services for people with Special Needs) was a two year project that started in 1994 as part of the EC's TIDE Bridge phase (Poulson, D.F., 1995a; Poulson, D.F., 1995b; Poulson, D.F., 1997). It looked not just at standalone intelligent home technologies but also at how to integrate the hardware with outside support services. The emphasis of the project was on using home systems to monitor the home, mainly for safety reasons, by linking them to a remote service centre. The project built demonstration systems in Spain and Portugal, and installed working systems in three apartments in Zaragoza, Spain. The actual functionality in each flat varied, but commonly included:

- Intruder alarm;
- Detection of water leaks and switching off of water supply;
- Gas, smoke and CO detection;
- Activity monitoring;
- Monitoring of domestic appliances (cooker left on and fridge door open);
- Monitoring of door bell ringing and response;
- Monitoring clients leaving their bed.

In addition to raising local alarms, the system was also linked to a remote service centre that was notified of certain alarm conditions. To limit the number of false alarms, many alarm events were first brought to the attention of the resident who, in most cases could cancel them if they were false alarms. The system also had an integrated social alarm system and a messaging service allowing a remote care centre to send text messages to the home TV. The TV was used to provide an interface to the system and also utilised an adapted remote control unit. In addition there were some limited control applications provided including remote door release, control of lighting, and an automatic night light. The project developed a number of prototype products based on the European Home Systems (HS) standard using the home power line as communication medium.

There were some problems with the reliability of the prototype equipment but the project concluded that there was a significant role for home automation in the care and support of elderly people in their own homes, and that in the majority of cases monitoring safety and security would be more appropriate than control applications.

### 12.2.5 COST 219 and 219bis

The Commission of the European Union recognised the need for co-ordination in this area by establishing [COST 219](#) (Future telecommunications and teleinformatics facilities for disabled and elderly people). Of particular interest to this survey are the Design Guidelines on Smart Homes, a COST 219bis Guidebook (van Berlo, A., et al., 1999). This can be downloaded from the Internet at <http://www.stakes.fi/cost219/smarthousing.htm>

The focus is very much on older and disabled people, with the handbook identifying several user groups with special needs (normal ageing, visually impaired, hearing impaired, mobility impaired and cognitively impaired) as capable of obtaining specific benefits from this kind of technology, provided that knowledge on their specific requirements can be incorporated into the development strategy.



### 12.2.6 CUSTODIAN

The CUSTODIAN software tool was developed during this EU project to not only test scenarios and set-up configurations, but also to demonstrate the design of smart home installation to client groups and other stakeholders (Dewsbury, G.; Taylor, B.; Edge, M., 2001/2002; Dewsbury, G.A. & Edge, H.M., 2000). The tool is based on the idea that there is little point in specifying and designing an EIB system from scratch every time, and that the design can start with either a basic model, to which devices can be added, or can start with a more comprehensive model, from which devices can be removed. Project participants included: Robert Gordon University (UK), University of Reading (UK), University of Porto (PT), Edinvar Housing Association (UK), and the European Installation Bus Association (BE). Smart Thinking is a consultancy that has developed a specialism in designing appropriate technology for people with disabilities that meet their specific needs. They developed their expertise through the CUSTODIAN project where they designed two smart homes in Dundee, Scotland. The CUSTODIAN software can be downloaded from <http://www2.rgu.ac.uk/subj/search/Research/SustainableHousing/Custodian/download.html>

### 12.2.7 **DEFIE and Mosaic-HS**

The DEFIE project, which ran from December 1993 and ended formally in February 1996, was part of the TIDE programme (Technology Initiative for Disabled and Elderly people). The project's goal was to develop a multimedia, integrated system that allows elderly people, and those with motor and/or sensory impairments, to command and control domestic and working environments with a high degree of self-sufficiency and safety. CNUCE-CNR, one of its partners, then participated in another TIDE project (Mosaic-HS) which aimed to consolidate the know-how acquired from previous projects on smart homes and applied the EHS Home Bus to the design of a new prototype.

See [http://www.ercim.org/publication/Ercim\\_News/enw28/bandinelli.html](http://www.ercim.org/publication/Ercim_News/enw28/bandinelli.html)

### 12.2.8 **DOC@HOME**

The goal of the DOC@HOME project is to enhance the effectiveness and efficiency of management of home care patients with chronic disease and facilitate overall control over the disease by introducing newly developed concepts and technology.

This type of low cost interactive monitoring will enable patients to regulate themselves, will give the patient a sense of control and allow medical personnel to stay ahead of acute heart failure or other critical conditions. For more information, see [www.smarter-homes.org](http://www.smarter-homes.org) below, and also

<http://www.curonia.com/eur/Project%20Web%20Site.htm>

### 12.2.9 ENABLE

The project is funded under the EC Programme, Quality of Life and Living Resources, and will last for three years, starting in March 2001. The project aims to facilitate independent living for people with early dementia and to promote their well-being through access to enabling systems and products. The objectives of ENABLE are to:

- Develop prototypes and provide test series of enabling technological products;
- Develop methodology for assessing the effects of using the products, including cost/benefit analysis;
- Examine whether the products can enable people with dementia living in their own home;
- Raise awareness about the potentials of such technology.

The selected products fall into three categories. Devices to:

- Support memory (time orientation, taking medicines etc.);
- Provide pleasure and comfort (multimedia programmes);
- Facilitate communication (pre-programmable telephone);

People with dementia will test the products in practice for up to one year, and the effects of using them will be studied through interviews with the users and their carers. Partners are situated in England (Dementia Voice and Bath Institute of Medical Engineering), Ireland (Work Research Centre and Dementia Services Information & Development Centre), Finland (STAKES – National Research and Development Centre for Welfare and Health), and Norway (Forget-me-not, Norwegian Centre for Dementia Research, and Sidsel Bjørneby, human factors consultant).

For more information see the project website <http://www.enableproject.org/index.html> or contact the project co-ordinator, Norwegian Centre for Dementia Research, at [knut.engedal@nordemens.no](mailto:knut.engedal@nordemens.no)

### 12.2.10 HS-ADEPT

HS-ADEPT was an EU funded Telematics project than ran from 1994 to 1996, addressing the challenge of developing interfaces for users of smart house technologies with severe physical disabilities who might be able to, for example, operate only a single switch (Cooper, M., 1999). The project's work was driven by two important criteria:

- Separating the interface design from the system (to allow for a variety of interface options); and
- Offering ease of control over a potentially complex system.

The system was based on bi-directional infra-red communications from the portable controller to a 'gateway' to the EHS-Bus located in each room in the house. This 'gateway' was called the User Interface Feature Controller (UIFC), and it held a 'dynamic model' of all the home system devices that it needed to control in that room, as well as any others that could possibly be controlled from that room. Cooper also describes some key points that emerged from potential users of the technology over the course of the project, for example:

- That users do not want to live in an automated home – they want control over their environment; and
- That automation can be used to reduce the overall effort required in control.

The paper can be downloaded from:

<http://kmi.open.ac.uk/people/martyn/smart%20homes%2099%20-%20paper.html>

### 12.2.11 INCLUDE project

The EU INCLUDE project was a 4-year cooperation between the main European experts on the issues of telematics applications and elderly/disabled people. Its goal was to ensure that issues of importance for these user groups are optimally addressed at programme, sector and project level within the Telematics programme. The INCLUDE project website gives a good overview of the concept of a smart house, emphasizing that good design for disabled and elderly people is good design for all. See [www.stakes.fi/include/ince550.html#Smart%20Houses](http://www.stakes.fi/include/ince550.html#Smart%20Houses)

### 12.2.12 Njord-Tide

This EU Telematics Application Programme project (See also Sweden, The PDH at Danderyd Hospital 11.1.2.5) developed a handbook providing information about evaluation methods that can be used in domotic environments to ensure that the user gains the maximum benefit from the technologies applied in housing environments for elderly and disabled people (Mekibes, B., 2001; Mekibes, B.; Mekibes, B.; Gleiss, N., 2001). The EAS (Evaluation Approach System) Handbook is published on CD-ROM, with internal links to databases containing context analyses, domotic sites and eight evaluation methods, based on surveys made in the countries of the NJORD-TIDE project partners. For example, one method that can be used is called a ‘Go-through evaluation’, whereby experts and users go through the building and examine specific features of the domotic environment, noting particular problems on the way. The results are then collected, summarised and discussed in a final group discussion. It is interesting to note that a more common name for this method is ‘walk-through evaluation’, but it has been renamed in the context of this project because people can participate without being able to actually walk, better meeting the characteristics of some older and disabled people. A summary of the Handbook in PDF format can be downloaded from <http://njord-tide.arch.kth.se>

### 12.2.13 SIRLAN project

The SIRLAN project aims to create a Tool Kit Platform for the installation of applications for home and building equipment (e.g., washing machine, computers, TVs, meters, surveillance cameras, alarms, switchboards), which would communicate within or outside of the building through any type of communication network. The platform will be based on a modular architecture capable of supporting all categories of home and building products from a simple push-button to a home computer with secured servers for remote configuration and security. The platform will be used to develop new products and services, in several markets: home and building infrastructure, utilities applications and services, home appliances, personal goods, small business and home services. The toolkit will support the 'Convergence' standard (EIBA, Batibus and EHSA) for home and building LANs.

(This information has come from [www.smarter-homes.org](http://www.smarter-homes.org), which is a gateway to leading European projects). See <http://www.sirlan.org/>



#### 12.2.14 Sweden, SmartBo

(also see SmartLab site 11.1.2.6)

SmartBo (Elger, G. & Furugren, B., 1998) was a 3 year project run by and located at the Swedish Handicap Institute, which demonstrated how information and communication technologies and computer-based solutions can give elderly and disabled people a more independent lifestyle in the home. The project, documented in a video (with English sub-titles) shows how severely mobility impaired, deaf-blind people and people with cognitive impairment can benefit. The equipment from SmartBo was moved and is now used in a new permanent activity called SmartLab, situated within the Swedish Handicap Institute. Technologies within SmartLab include products for environmental control, safety and care in the home, as well as communication with the outside world. SmartLab can be made available to other R&D projects as a testing environment in home-like surroundings, with possibilities to supplement the lab with further equipment or new system solutions. A website is available, but only in Swedish: [www.hi.se/smartlab](http://www.hi.se/smartlab)

### 12.3 United States

According to a Harris Poll conducted in May 2002, more than half of Americans are familiar with the concept of a 'smart home' and  $\frac{2}{3}$  cited quality of life as the most important reason to have one (cited from [http://biz.yahoo.com/prnews/020618/datu036\\_1.html](http://biz.yahoo.com/prnews/020618/datu036_1.html))

Consumers were still, however, concerned about the cost, the time it would take to set up a smart home, and difficulties in getting support when the technology breaks down. 51% of the survey said that they would be willing to pay 10% more for smart appliances with a self-repair facility built into the device. In addition, 31% said that they would be willing to pay for a customer service that was 'always on' in order to obtain timely ongoing support.

Tang et al point out that, compared to Europe, the U.S. has a wider range of available telemedicine services. In addition, it is acknowledged that telecare can mean cost savings and improved quality in home care. In 1994 California conducted a review of its requirements for a coordinated strategy for the effective implementation of telecare. This was expected to result in a state-wide telecare service network, which would include delivery to the home (Tang, P., et al., 2000).

## 12.4 Japan

### 12.4.1 Daily Life Support System for Elderly

This project is developing a system to support the daily life of elderly people, whose motion and memory abilities are declining, to carry out daily activities with ease and make full use of their abilities in domestic life. The system will combine the following three components:

- A power assistant that is easy to use, multi-purpose and compact;
- A memory assistant to support record and memory recall;
- An easy and friendly human interface for elderly people.

More information can also be obtained by emailing Dr. Watsuji at [watsuji.toru@sharp.co.jp](mailto:watsuji.toru@sharp.co.jp)

### 12.4.2 Real Time Sensing System

The goal of this project is to develop a system to evaluate and monitor the state of daily life of elderly people by using a digital appliance network. The systems consist of the home network system of appliance products, technology of power line cable networking, and the software to evaluate the health and living conditions of the target elderly population.

More information can also be obtained by emailing Dr. Watsuji at

[watsuji.toru@sharp.co.jp](mailto:watsuji.toru@sharp.co.jp)

### 12.4.3 Summary of other research in Japan

A range of research projects which support the introduction and use of new technologies to deliver health and care services into people's homes are described by Gann, D., et al., 2000, and this section is drawn from that publication. For example, the Ministry of International Trade & Industry (MITI) sponsors three programmes to support the development of assistive and welfare technologies. These address:

- Future technologies (similar to the UK NEAT and MedLINK programmes);
- Demonstration projects (such as the Techno House), a type of project that does not exist in the UK; and
- Commercialisation projects, which might be considered like the EPSRC's IntHeTech IMI programme.

The Industrial Science and Technology Frontier Program has also funded 62 projects in the area of medicine and welfare, which includes movement within, and support around, the home. Project collaborators represent Japanese technologies, the majority of which are large companies. In addition a programme of commercialisation of new welfare equipment has been running since 1993, during which period 91 grants have been awarded. As described under the Smart Homes Sites section, the Techno House (11.1.4.4) projects also conduct research by allowing users to interact with new technologies and provide industry with effective feedback.

Gann et al found some interesting and important differences between the UK and Japan in conducting research into new technologies for health and care. In Japan:

- There is a clear separation between the needs and policies for provision and the provision of an effective industrial response;
- There is limited emphasis on academic involvement when developing new technologies;
- There is a more use of demonstrators (valuable in promoting consensus between e.g. healthcare providers, policy makers, industry and residents).

There is a lack of empirical evidence on the way older people use new technologies to meet their needs and activities across the wider social networks and more UK demonstration projects are needed if we are to understand the potential benefits and risks of introducing such new technologies.

## 13 **Some Lessons Learnt**

The lessons learnt in this review have been divided into:

- Lessons learnt from the literature;
- Lessons learnt from site visits and interviews;

These are presented below.

### 13.1 From the Literature

Porteous and Brownsell (Porteous, J. & Brownsell, S.J., 2000) describe various practical complications that needed to be resolved over the course of the Anchor Telecare Project. There were practical complications in recruiting people to trial the equipment, due to a number of reasons:

- Many people found it difficult to visualise the Lifestyle Monitoring System;
- The project sought to develop and test the system with the same people, many of whom did not want to be used as ‘guinea pigs’;
- The length of time that people needed to be involved often proved too much;
- Some informal carers were unable to commit themselves..

Technical complications were concerned with the:

- Control box – developers needed enough capacity for additional sensors to generate a realistic picture of the participant’s lifestyle. BT therefore developed their own prototype control box, with a similar function to a dispersed alarm but with greater capacity, but as the data were retrieved every 30 minutes, an additional telephone line had to be installed and some telephones also had to be replaced by ‘tone’ telephones.;
- User profile – developing appropriate algorithms to analyse the data proved difficult, since identifying ‘normal’ patterns of behaviour was often difficult. For example, staying up especially late to watch television would not require assistance;
- Positioning of the PIR sensors – since movements could be detected simultaneously by several PIRs, the reliability of the system could be compromised.

Gann et al describes the experiences and the lessons learnt from two smart home installations in York and Edinburgh. (Gann, D., et al., 1999). They found that most of the problems arose at the interface between one technology, or specialist skill, and others. They suggest three critical factors for success:

- How the process is organised;
- Single point management responsibility for the entire process; and
- Availability of appropriate skills, particularly for systems integration.

Related to these three factors, they highlighted some lessons that could be learnt: It is necessary to have significant, in house technical expertise, and therefore an organisation wishing to develop smart homes needs to invest heavily in training and internal technical capabilities;

- Even though they are supposedly compatible, it is necessary to ensure interoperability between different smart home components, by testing them on a mock-up demonstration board;
- When constructing new build smart homes, build in flexibility for future changes, e.g. leaving cableways behind skirting boards in anticipation of the need to install future smart home cabling, of which the cost would be negligible. However, consider issues such as spread of fire and smoke through cableways and the implication of building regulations;
- Demonstration projects can take much longer than anticipated, due to a variety of factors: finding appropriate suppliers, the need to recruit and train in-house staff, and delays in delivery of equipment by the suppliers.
- The costs of equipment installed in demonstration projects can be high, but should reduce when economies of scale come into play, and when technologies for commercial use are examined for use in the domestic arena.

Full details can be found in Gann et al, 1999 (Gann, D., et al., 1999):

Woolham and Frisby have identified a number of issues when implementing a care plan and getting equipment installed and working. They point out that social care or health professionals need to know where the equipment can be obtained, who can install it, how quickly, who will service it and who will remove it when it is no longer needed (Woolham, J. & Frisby, B., 2002).

Woolham et al suggest three kinds of difficulties in the use of technology after its installation (Woolham, J., et al., 2002).

- **Specification issues** - the equipment did not perform to specified standards. This could be because of a fault, or it has not been installed correctly, or it is being used inappropriately, or possibly because the communication protocols



are different so that equipment cannot communicate. Technicians or engineers need to be competent, and installer must have an understanding of the needs of people with disabilities to improve the quality of the installation (Woolham, J. & Frisby, B., 2002).

- **Technology** - not appropriate to the needs of the user, or the relative or informal carer.
- **Incorrect use of the technology by formal or paid carers** – sometimes they did not understand how the equipment worked and would sometimes trigger the equipment by accident. Training should alleviate such problems but high staff turnover or working patterns meant that this was not always the case (Woolham, J., et al., 2002).

The majority of carers interviewed during the evaluation of the Northampton Safe at Home Scheme (Woolham, J., et al., 2002) felt strongly that seeing the technology in action had changed their views on whether it could be used in the care of someone with dementia. There was also evidence that although technology was not felt to *increase* the service user's independence, it was felt to have helped to *maintain* existing levels of independence. By comparing the costs of residential and hospital provision among the comparator group over the evaluation period, it was also found that the costs of purchasing, installing and fitting the technology were less than the potential savings made.

A very useful summary of various issues and solutions when developing quality assured and person-centred technology specifically within dementia care is provided in Woolham, J. & Frisby, B., (2002), along with a recommendation of which issues can be addressed locally and which ones need to be addressed at a national level.

## 13.2 From Site Visits and Interviews

In documenting the experiences in developing smart home applications, both in the UK and in Europe, a variety of themes emerge as lessons learnt by the developers concerned. Whilst generalisations are difficult to make there is sufficient similarity in findings from different sites in order to allow some observations to be made. These are divided into:

- The inherent complexity on the housing sector and service provision;
- The complexity of market forces in this sector;
- Relevant applications
- Specific lessons learnt from the trials;

### 13.2.1 The inherent complexity of the housing sector and service provision

Providing services to the home of an elderly person represents a particular challenge as in many countries the responsibility for service delivery is devolved to a number of agencies, each of which have responsibilities for care. In the UK, medical and social care has been the responsibility of different agencies, leading to the situation where there has been a lack of integration and sub-optimal use of resources. For example, historically there has been little incentive for social services to invest heavily in technology that might reduce the need for an individual to go into hospital care, as the cost of hospital care is dealt with from different budgets from social care. In the case of many elderly and disabled people, a complication is also introduced by their reliance on rented accommodation, either through local authorities or housing associations. Within this context it can be difficult to determine who should be responsible for providing a safe home environment and in supplying the technology and associated services that might support more independent living.

The developments that have been included in this survey have been primarily collaborations between Universities, Housing Associations and Social Service Organisations. Whilst this is a reflection of the emphasis of this survey on home automation and telecare rather than telemedicine, it may also be a reflection of the current lack of integration in this area. Recent changes in social and medical care policy are likely to lead to much more integrated service delivery mechanisms, and it can be anticipated that future smart home development projects will also reflect this.

Many of the alarm and monitoring systems being developed in this sector also have medical application, particularly in providing preventative medical support.

An additional layer of complexity is also introduced by a shift in policy from providing care in institutional settings to providing care in the person's own home or community. Developing technology and service infrastructures that will work in the community is a particular challenge, particularly where there is old and sub standard housing stock to contend with. Retrofitting technology into existing housing stock can be problematic, particularly where control applications are needed.

### **13.2.2 The Complexity of Market Forces in this Sector**

An investigation of the driving forces behind smart home developments in the UK reveals that this sector is being influenced by a number of different market forces.

These can be summarized as being primarily:

- Housing Associations and Charities;
- Mainstream Office Automation;
- Social alarm providers;
- Specialist Environmental Control Manufacturers;
- Service providers.

#### **13.2.2.1 Housing Associations and Charities**

These have been instrumental in exploring the potential for smart home technology in the UK, with a number of trial buildings being constructed in recent years. A number of new build developments are now being evaluated, and are described in detail elsewhere in this report.

#### **13.2.2.2 Mainstream Office Automation**

Many of the products currently available for use in the domestic assistive technology sector have emerged from mainstream office automation technologies developed for use in building control applications. The domestic consumer market, and to a lesser extent the assistive sector, is therefore seen as an additional market place for these companies, but not their main areas of business. Products developed have often been relatively expensive, e.g. Lonworks and EIB, and possibly over engineered for a domestic market. In recent years however a number of smaller companies have emerged, developing proprietary smart home products for consumer usage. Examples include Teletask and the IHC system, both of which are currently being applied in small-scale developments in the UK and other parts of Europe.

#### **13.2.2.3 Social alarm providers**

There is also some evidence that social alarm providers are starting to identify the potential of smart home technology in producing more sophisticated passive alarm systems and sensors. The dominant player in the UK market is Tunstall Telecom, who have taken over Technology in Healthcare, a company developing specialist

sensors in this area. More sophisticated alarm and monitoring systems are under development, with extensive trials of equipment taking place in the UK and Ireland

#### **13.2.2.4 Specialist Environmental Control Manufacturers**

Specialist environmental control manufacturers have been operating in this sector for many years, with Possum Controls Ltd, Hugh Steeper, and more recently Gewa and SRS being key players in the UK market. Traditionally they have provided systems that allow severely physically disabled people the ability to control domestic lights, doors, televisions, and other home devices, as well as alarm and telephone facilities. In the past these products have been supplied under the auspices of medical rather than social funding, and have primarily been supplied to younger rather than older people. These companies are likely to remain players in this sector, and may well move towards providing home monitoring as well as control systems.

#### **13.2.2.5 Service providers**

Service providers have also been instrumental in exploring the potential of technology to support their operations, and a number of UK social services are now actively exploring how smart home technology might be used to provide more efficient and effective support. Many of the UK initiatives have been needs-driven, based on social services and/or housing associations wishing to explore the value of technology in supporting their operations.

### 13.2.3 Relevant Applications

The developments taking place in the UK in the smart home area can be characterised in terms of their primary focus, and the kinds users they are designed to support.

Very broadly they can be divided into those that are:

- Specifically intended to support the physically impaired of all ages. These types of developments tend to place a much greater emphasis on basic wheelchair accessibility issues, and include significantly more control applications within the home. Automatic door and window opening systems are examples, as are automatic taps and toilet flushing systems.
- Mainly designed to support independent living for the frail elderly. They tend to have a primary focus on supporting the safety and security of residents, and include applications such as activity monitoring, fire alarms and water and gas leak detection.

#### 13.2.3.1 Sites specifically intended to support the physically impaired of all ages

Developments reported in this survey with a key focus on control applications include:

- Edinvar AID (Assisted Interactive Dwelling) House;
- Portsmouth Smart Homes Project;
- Wigton Smarhome, Cumbria;

#### 13.2.3.2 Sites mainly designed to support independent living for the frail elderly

Whilst it is dangerous to report trends on such a small sample, it seems as if there has been a shift in emphasis from control to monitoring applications, with more, larger scale trials being planned in these areas. Those sites identified with a primary focus on monitoring applications include;

- Anchor Telecare Project;
- Angus Community Care Charitable Trust;
- Bolton, Methodist Housing Association;
- Derry, FOLD Housing Association;
- Kendal, Safe Homes Project;
- Millennium Homes Project;
- Northamptonshire Safe at home Scheme;

- Teesdale (County Durham), People at Home and In Touch Project;
- West London, New Technology in Elderly Care Project;
- West Lothian Council Opening Doors for Older People Project.

All of the sites visited in the Netherlands and Norway were also characterised by a primary focus on monitoring rather than control applications, though as with the UK sites there was often a mixture of monitoring and simple control systems. Control was often limited to the remote control of lights and power sockets, and door release systems rather than more sophisticated control applications requiring specialised actuators such as door, window and curtain opening.

Cost is clearly a significant element in this shift in emphasis from control to monitoring, with motorised control applications being expensive to install, and likely to have significantly higher operational costs. Mechanical systems are also inherently less reliable than electronics, and so it can be anticipated that actuators will need more servicing and will wear out significantly faster than most sensors.

Another factor in this change of emphasis is market driven, with the realisation that the markets for monitoring applications are likely to be much larger than for home control. Control applications may provide additional convenience, but it is only in the cases of extreme physical disability that they are likely to be actually needed, and it is therefore difficult to justify their use for supporting independent living with the more general elderly population. There are some concerns that an overuse of control technology will encourage inactivity, and limitations in cognitive ability and established life habits may also limit the degree to which the frail elderly can learn (or wish to learn) new ways of performing familiar tasks. For these reasons automatic monitoring systems are likely to be of a more general application rather than sophisticated home control systems.

### 13.2.4 Specific Lessons Learnt from the Trials

An investigation of the trials currently taking place in the UK and elsewhere reveals some interesting issues and trends. Many of these reflect the relative immaturity of this market sector, and the degree to which most trials are experiments in providing services using home automation technology. These have been divided into:

- Difficulties in Specification
- Poor Installation of Smart House Elements
- Poor Labelling of Controls
- The Need for Flexible Installation
- The Need for Failsafe Operation
- The Need to Review Installations
- Structural Difficulties in Installing Smart Home Technology
- Current Lack of Installation Engineers
- Lack of Equipment
- Reliance on User Actions
- Maturity of Technology
- The Influence of Other Stakeholders

#### 13.2.4.1 Difficulties in Specification

A common theme emerging in the trials is the difficulty of providing a detailed specification of how a smart home should operate and in adequately defining operating procedures for such homes. Lack of experience in developing smart applications often meant that specification and installation was of a trial and error nature, with evidence of poor communication between service provider and installers. Often installers did not understand the needs of their target users and consequently made sub-optimal local installation decisions. Communication between installers and service provider was often difficult, and suggested a need for a third party to assist in this process. There was also some suggestion that specifications emerged over time, and that it was unrealistic to expect to be able to produce a 'right first time' solution. This meant that some resources needed to be provided to review developments and make changes if necessary.



#### **13.2.4.2 Poor Installation of Smart House Elements.**

The sub-optimal decision led to sub-optimal installations so that in some cases there were basic accessibility problems such as door thresholds and access ramps that had not been adequately resolved, whilst in others it was the smart home elements that were poorly located. The positioning of controls and sensors sometimes caused problems, with PIR sensors being either in the wrong place to detect the relevant activity, or being obscured by other furnishings in the rooms, as was also the case with some local controls. In some cases there were too few or inappropriately sited power sockets in some homes.

#### **13.2.4.3 Poor Labelling of Controls.**

In a number of cases homes were provided with complex switches that were not labelled. For example, standard four way switches were used to control different aspects of lighting and alarm systems, but because of the customised nature of the homes these needed to be labelled and this was not done. It would have been useful for the installer to have included professional labelling of such switches. Similarly, some remote controls were overly complex and suffered from a lack of labelling.

#### **13.2.4.4 The Need for Flexible Installation**

In a number of cases the trials revealed the difficulties encountered by having a fixed installation and position of sensors and controls, such bell pulls and PIR's, which often constrained where other equipment in the home could be positioned. In some cases poor location also resulted in systems not operating properly, and this was difficult to anticipate in many cases. For this reason wireless sensors were clearly an advantage compared to hard-wired sensors as they are easier to move and can be fitted once the location of furniture is known.

#### **13.2.4.5 The Need for Failsafe Operation**

The trials clearly demonstrated the need to ensure that systems would operate in a failsafe mode. However, the sites differed in the degree to which failsafe operation was ensured, with some sites providing full battery backup for home functions in the event of a power failure, whilst in others only limited functionality was provided. At two of the sites some initial difficulties with the quality and reliability of the mains

power supply were reported and in one case this had also led to some mains filtering being installed.

The need to provide manual overrides to electronic devices was appreciated, particularly in safety critical applications such as main door locks. However, ease of access conflicted to some extent with security, and this conflict was resolved in different ways between installations. For example at one site it was explicitly decided not to include a strike release mechanism on the front door lock as it was less secure than a conventional lock. At another site this issue was dealt with by installing an expensive motorised door lock. At most of the sites strike release mechanisms were deemed as being sufficiently secure for them to be used on access doors, but these were usually designed to be secure on power failure. Conversely internal doors with a lower need for security could be fitted with lock release on power failure.

#### **13.2.4.6 The Need to Review Installations**

The need to continually review the match of requirement to products and services has also been highlighted, but in a number of cases formal evaluation had not been built into the development process and so mismatches between specification and system operation could remain undetected for a long period of time. In one example a system was found to be operating incorrectly more than six months after installation, as the installation engineers did not detect the mismatch. In some other cases equipment was sub-optimally sited or had had to be repositioned to make it work properly.

#### **13.2.4.7 Structural Difficulties in Installing Smart Home Technology**

The ECA (Electrical Contractors Association) have funded research into this area on behalf of their members, and concluded that inexperience of this technology on the part of the electrical contractor industry is likely to limit take up. Others have confirmed this. As the UK building industry is organised on the basis of property builders subcontracting specialist services to others, this can also make communication difficult where new technology is being installed. For example an electrician will have a contract with the builder rather than the building commissioner, and this can lead to another layer of communication. This can create difficulties when non-standard installation such as smart homes are required.

#### **13.2.4.8 Current Lack of Installation Engineers**

At the time of writing this report there are very few installation engineers working in this sector, and subsequently there is not a well-established body of expertise in this area. There is no national network of installation engineers that can provide support for smart home applications, and few electrical contractors trained in the use of these kinds of systems. This meant that in many cases the installation process needed to be carefully monitored to ensure that it took place properly. Some basic installation problems were observed such as poorly fitting doors, and equipment being sited in less than optimal places.

#### **13.2.4.9 Lack of Equipment**

Until recently it was also almost impossible to find sources of suitable smart home equipment. Whilst this situation has improved, there have still been reported cases of not being able to find suppliers for equipment, of not being able to find suitable products to match need, and also suppliers going out of business before delivery.

Specialist sensors proved to be a difficult area, with some products not working well or prototypes having to be used rather than fully commercialised products. Specific areas where further development was clearly needed were in the areas of bed activity sensors and fall detection, as there was some dissatisfaction with the products currently on the market. In some cases it had proved difficult to source sensors and actuators that were needed in order to construct a smart home. For example at one site there had been problems in obtaining an electric patio door that had a level threshold, and also in other cases components were imported from other countries as they were not available in the UK.

#### **13.2.4.10 Reliance on User Actions**

In a number of cases there were difficulties due to a reliance on users to operate new technology. Whilst appropriate user training could reduce these operational difficulties, reducing reliance on users and creating more automatic systems would be preferred in many cases. For example some of the homes required the elderly user to actively switch the homes status from one mode to another, such as setting an alarm system. This created some false alarms due to user confusion, and also highlighted

the need for careful assessment of individual capacity to deal with technology. Likewise it was observed that in a number of cases users did not wear their social alarm systems pendants, leading to the potential for failure of the alarm systems in an emergency.

#### **13.2.4.11 Maturity of Technology**

Whilst smart homes are a relatively immature application area, the technology used to support such initiatives is, in many cases, relatively mature, building on existing office automation, telecommunication and social alarm systems. This was reflected in the reported reliability of the installations visited, with operational difficulties being related more to specialist components rather than core systems. However, some difficulties were also observed due to the need to customise monitoring software to specific applications, as this depended very much on the skills of the individual installer to create an easy to use interface.

Although some of the technology used is relatively mature in the business sector, many of the trials demonstrated a 'state of the art' situation in applying this technology in a domestic setting. Some technologies e.g. EIB have clearly been developed for larger scale office automation projects, and for this reason some of the available smart components are sub-optimal for the home. The high cost of many business-based smart home technologies has also led to cheaper alternatives being developed for the consumer market. The IHC system has been used in a number of the cases reported, and rather than being a sophisticated bus operated system, consist of hard wired sensors and actuators connected to a central control unit programmed via a PC. Whilst experience in using this technology is limited, there is the suggestion that the IHC system is better suited to small scale applications, owing to limitation in the number of elements that can be connected to a single controller and some lack of flexibility in programming. As experience develops in using these technologies, these limitations will become more apparent. It is clear however that the cost of a particular technology should not be the overriding factor in the procurement process, and that flexibility of application and possible future need should also be taken into account.

#### **13.2.4.12 The Influence of Other Stakeholders.**

The developments also revealed the impact of other stakeholders (e.g., family members and care workers) in the success or failure of smart home initiatives in this sector. A lack of enthusiasm by formal carers could impact significantly on the take up of technology, as in some cases users were reliant on formal carers for support in using new technology. The implication is that it is important to engage those providing care in such developments to engender positive attitudes towards using technology, and to accept that the needs of these secondary users should also be considered in any development activities. This can include an early involvement of all interested parties, as well as ensuring that appropriate levels of training and support are provided for care providers. Procedures for dealing with the technology also need to be established to minimise inappropriate use and false alarms with monitoring systems.

Consideration also needs to be given to the impact of technology on other family members and visitors to the home, and the degree to which technology is matching their needs as well as those of the primary user.

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