Chapter 15

Smart Housing

Contents

Introduction

A smart house is a system that consists of a data network that connects and integrates key electrical appliances and allows them to be controlled from a central source, or to interact with each other. Electrical appliances and functions include, but are not limited to items such as: heaters, lighting, alarm systems, ”white” and ”brown” household appliances, remote controls and communication devices.

Smart houses allow interaction between those elements controlled, and this is what makes the systems different from ordinary environmental control systems. The smart systems use electric power, twisted pair cables, coaxial cables, telecommunication systems, infrared, Internet or radio frequency or a combination of several as communication and control media. A basic smart house installation is easily programmed to fit each individual user’s needs, and therefore very well adapted to the principles of design for all.

Smart house systems include control by user, automatic control functions through interaction between components and connection and interaction with different communications media.

Because the smarthouse is a system, integrating products and devices, the user requirements must apply to all the separate components, as well as the system and how the components are integrated and interact within the system. Therefore the user requirements must relate to functions, as well as separate products.

Standards

In the process of defining user requirements, **ISO/DIS 13407**: *Human centred design of processes for interactive systems* must be followed. In this document the active participation of users is described

The rapid development of the technology and its potentials and work to converge technology and standards makes it difficult to keep abreast of developments and provide standards that take into consideration the needs of consumers, especially elderly and disabled consumers. Recent developments show that smart house systems will be closely co-ordinated with other technological developments through convergence and new industrial partnerships. The combinations may create problems for consumers. The PC companies think they know, the TV companies think they know and the smart house systems suppliers think they know what is best. Who will benefit most, the industry or the consumers or both?

It is therefore important that the standards for smart housing are seen in conjunction with standards for digital broadcasting, mobile communications, Internet, PCs, PDSs voice services. Consumers have as a rule not been included in the standards work in the smart housing area, but the more developed consumer issues that have been dealt with in the telecommunications area may be of benefit for smart housing consumers as well.

There are many different communication media for smart houses, for example:
twisted pair cables, coaxial cables, power line, radiofrequency, infrared, Internet. This is the reason why the standards relating to smarthouses may be found within CEN, CENELEC or ETSI, or as combinations of standards within these areas. ICTSB has considered these issues, and has started co-ordinated effort by organising two ICTSB Ad Hoc meetings on Smart Housing in 1999. The two meetings are building on the ANEC Consumer Report, but have gone deeper into the issues.

This overview of State of the Art in smart house standardisation shows the most important areas for standards work, and some related activities which need to be considered in this project.

CENELEC

CLC/TC 205 - Home and Building Electronics Systems (HBES)

Scope
This technical committee defines the general technical requirements of a Home and Building Electronic System. It concerns cabling and technology, electrical and functional safety, environmental conditions and behaviour in case of failures as well as specific HBES installation rules.

The HBES also includes the interfaces of devices and equipment providing connection to the HBES. Parts of devices and equipment not providing HBES functionality are not included. For such parts the relevant product standards apply.

Scope of the TC
To prepare standards for all aspects of home and building electronic systems in relation to the Information Society.
In more detail: To prepare standards to ensure integration of a wide spectrum of control applications and the control and management aspects of other applications in and around homes and buildings, including the gateways to different transmission media and public networks taking into account all matters of EMC and electrical and functional safety.
TC 205 will not prepare device standards but the necessary performance requirements and necessary hardware and software interfaces. The standards should specify conformity tests.

TC 205 will perform the work in close co-operation with relevant CENELEC TCs and those in CEN and ETSI.

Sub committee 205A Mains communications systems
To prepare harmonized standards for communication systems using low voltage electricity supply lines or the wiring of buildings as a transmission medium and using frequencies up to 30 MHz which will allow all type of telecommunication systems and services to be provided on power lines.

Working groups under CLC TC 205
Some working groups are more relevant than others, and it seems that WG 3, WG 5, WG 8, WG 9, WG 12, WG 14 and WG 15 are of interest, and this needs to be defined in co-operation with responsible persons within TC 205.

WG 3 HBES-Part 2-2 prA1
Systems Overview – General Technical Requirements, First Ammendment

WG 5 HBES – Part 6-4.1 to 6-4.5
Gateway between HBES and Telecommunication Networks

WG 8 HBES – 9.1
Installation Requirements – Generic Cabling for HBES class 1, Twisted Pair

WG 9 HBES – Part 5-4
Use of Infrared

WG 12 HBES – Part 9-2
Installation – Inspection and testing of HBES Installation

WG 14 HBES – Part 8:
Conformity Assessment (Guidelines for electrical contractors, installers or inspectors on checking and approving of an installed HBES

WG 15 ,HBES – Part 5-5:
Network based on Radio Waves (RF medium)

Expert appraisal
The working groups under this CENELEC TC 205 are the most relevant to take up the issues in relation to smart housing issues. This is particularly true, as the smart housing developments are merging into the combination of different media for transmitting and communication the integrated products and services, and because digital services gradually will be combined with smart house installations. (Developments like Bluetooth and Jini).

CENELEC Technical Report R105-002 concerns cabling.

Expert appraisal
The standard does not include user or consumer aspects of smart houses. It relates to technical aspects of installation buses, particularly where cabling is used. It is therefore important for the smart house systems that are most commonly in use, but will probably not apply to the same degree for the new developments where the communications media will consist of wire- and cableless communications systems. However, there exist working groups that relate to these issues.

TC13

Which relates to control and metering of gas, water and electricity supply.

TC 79 - Alarm systems

Social alarm systems.
To prepare harmonized standards for detection, alarm and monitoring systems for protection of persons and property, and for elements used in these systems. The scope includes in particular intruder and hold-up alarm systems, access control systems, periphery protection systems, combined alarm – fire alarm systems, CCTV-systems, other monitoring and surveillance systems related to security applications, as well as associated and dedicated transmission and communication systems. The standards shall specify conformity tests.

These standards must be integrated with smart house standards in order to give standard infrastructure for alarms from smart houses to the care services and other service providers. Advantages can be achieved if this work results in easier and safer installations and communications. This is of utmost importance if smart houses are going to be a supplement to the efficient care of the growing number of persons in need of care.

IEC/TC79:
Alarm systems- Social alarm systems – Part 1: System requirements.
Alarm systems-Social alarm systems – Part 3: Local unit and controller
Alarm systems – Social alarm systems, Part 7: Application guidelines, EN 50133-1:1996 (PR2489).
PrEN 50134-3 (PR=4967) This standard defines requirements for service centres and requirements.

CENELEC standard prEN 50134-1-2: 1993E

Cenelec standard no. prEN 50134-1-2: 1993E defines requirements to alarm centres, but does not include interface with smart house receptors and alarms.

CENELEC mandate 273: ICT and disabled and elderly people

This work has been considered by TC 79, who did not think this was of relevance to their working area, but they are awaiting a response from other committees.

Expert appraisal

CENELEC Mandate 273 is recommended to be co-ordinated with TC 79. There may be other relevant areas within TC79, especially because integrated alarms and transmission of these into other alarm systems is one of the main aspects that relate to smart house technology for universal design purposes. In addition, assistive technology needs to be integrated into the requirements in order to allow disabled persons to send alarms.

The requirements spelled out in these standards are good and relevant, but they do not treat the interfaces that are necessary between a smart home installation and the social service centre or home care service.

TC 100X

Which works with audio-video systems and equipment.

TC 206

Which works with Consumer requirements for entertainment equipment.

TC 215

Which works with the electrotechnical aspects of telecommunication equipment. This is particularly used within industry and commercial buildings. The TC concentrates on the cabling and passive components such as plugs and sockets, but does not cover active components and protocols.

Expert appraisal
TC 100X and TC 206 are related to digital services and combinations with smart housing.

CENELEC Standard EN-50065-1

This standard regulates smart house installations that do not use special cables, but the mains cables. In Europe the biggest systems are EIB Powernet, LonWorks (US) and CEBus (US). The last one is not approved by CENELEC.

CEN

CEN TC 225

This committee works with data-capture, automatic identification. Examples of this are service logs with bar code registration, identified presence and arrivals, etc. It can be seen in conjunction with smart house entry systems.

ISO/IEC JTC 1, subcommittee 31

This parallel action is carried out in a committee between CEN and ISO works with biometric methods, for example for admission to buildings or other controls. This could be advantages for disabled people, but also represent challenges of understanding.

CEN TC 247

This committee standardises control devices for mechanical building services. These EN standards will include performance criteria to optimise the energy consumption in smart houses.

EN12098-1 Symbols for user interfaces to improve the operation of HVAC plants. The committee works in close co-operation with TC 205.
The committee has prepared prENV 13154-1 “Data Communication for HVAC Application Field Net; Part 1: Application Objects” and ENV 13154-2 “Data Communication for HVAC Application Field Net: Part 2: Protocols” to support the connection and application of open products and systems in a common communication network for smart house.

CEN TC 293

This TC is about environmental control systems. It does not relate to smart house systems until now.

Expert appraisal
There are many similarities and overlaps between environmental control systems and smart house systems, and the standards of the two must be seen in connection. It is not recommended to install different systems with different interfaces and control units into smart houses with universal design of installations, because several installations and several interfaces makes the house complicated to use and expensive.

CEN TC 294

This TC works with remote control and metering of gas, water and electricity supply. The work started in 1991 and is still at the pre-standardisation stage.

Expert appraisal
As managing energy resources is one of the most important consumer aspects of smart houses, the standards work going on in this area needs to be adapted to be integrated with the smart house applications.
In order to make energy savings a potential benefit of smart houses for property managers as well as for individual home owners, standards must be revised to recommend flexibility of use through availability of a variety of different user interfaces and control options.

ETSI / IETF etc. W3C

Current developments show that within a decade, Internet will be integrated with smart house systems. Internet standards must therefore be adapted to be related also to standards that take into account smarthouse user aspects.
See Chapter 14.

Expert appraisal
Standards work in the Internet area is very technical and the development happens so fast that it is possible that user requirements must be introduced at a running basis into other organisations than the standards organisations. However, it is of utmost importance that universal design consumer issues are taken into account in the Internet developments.

COST 219 Bis

COST 219 has worked with universal design issues in telecommunications for many years. This European action has made guidelines for ICT products and systems, including smart houses, with regards to the requirements of elderly and disabled consumers. *(See www.stakes.fi/cost219/smarthousing.htm).*

Expert appraisal
The web site is very extensive and contains many useful links and useful information about Smart House issues, and it is recommended to read the guidelines in conjunction with this chapter. In addition it is recommended to make simpler Guidelines for planners and purchasers throughout a planning and implementation process. The Nordic project NORD**ICT** also recommends this.

Other Activities and Developments

Convergence

This initiative is a European combined effort of European Installation Bus (EIB), European Home Systems (EHS) and BATIBus to reach an agreement for a common standard. The work was finished in 1999, and is now a fact.

EIB has the leading De Facto standard for bus systems in Europe, and has influenced this new standard to a great extent.

Bluetooth Technology

This technology converges computing and communications. It allows for the replacement of proprietary cables that connect one digital device to another with a short-range radio link. The first products with Bluetooth radios in them will be available in year 2000, and companies such as Ericsson, IBM, Intel, Nokia, Toshiba and about 200 others have signed up in a Bluetooth Special Interest Group. This may indicate that smart house systems could be one of the applications, and that standards for the inclusion of consumer interests will be considered.

Sun Microsystems` Jini

Many of the world´s leading producers of technology are developing products with Jini codes. Functionally this means that we will have a mixture of broad-band information «pipes» and wireless high-speed data transfers that connect items in the house and office with each other and with the Internet. A radiofrequency net will broadcast throughout the house, independent of wires.

These developments may indicate easier and safer use of smart houses in the future, but we do not know how user aspects are being considered in the development, and which standards are able to keep abreast of the developments.

Expert appraisal
There is an urgent need for including user and design for all issues into these new and still inadequately converging developments.

IEEE Standard for High Performance Serial Bus

Which brings together IT and tele-communications, as well as the regions with their leading technologies.

Output from Projects

User requirements identified in other projects
User requirements which have been identified in several EC and national projects focus on the following issues:

- safety
- security, easy access to personal help in emergencies
- comfort
- convenience
- independence
- social contact and communication
- energy savings

The TIDE project **Home**Brain (TIDE Project number DE 3209) has analysed user requirements in relation to smart houses in the following projects:
ASHoRED
DEFIE
HS-ADEPT
BESTA
CASA

HOME SYSTEMS (1998, **Home**Brain D2.3 Report on methodology for user needs research).
The conclusion in the project is that even though the projects used very different methods, all projects found that user requirements mainly relate to the fact that everyone desires to stay in their own home for as long as possible. The surveys also showed that the user requirements were very similar no matter what the actual purpose of the project and regardless of nationality.

Another interesting finding is that the user requirements do not seem to vary during the eight years that the above projects span. Society and attitudes to technology may have changed during that period, but basic needs seem to remain the same.

A good user interface seems to be the single, most important user requirement. “Ease of use” of the actual product and system is another crucial point. The product must provide support to the user, i.e. the product must be operated intuitively and provide feedback to the users of various kinds (BESTA). Information is another important element.

This chapter does not refer specifically what each project has concluded. For additional information, Include web site COST BIS 219, Guidelines for smarthouses. *(See www.stakes.fi/cost219/smarthousing.htm).*

User Requirements

General universal design issues

Smart house systems can be useful for many user groups. Installed in an ordinary house, it gives potential to adapt the house to changes in the resident's needs and functional capacity. There is a clear consumer tendency to start looking at the potentials smart house installations can offer in ordinary dwellings. But up till now, most smart house installations in Northern Europe are in commercial buildings, as well as in groups of houses built or adapted for elderly people or people with disabilities.

Smart houses offer potential cost benefits for society by making residents in need of care more safe and independent, and by optimising the personal care. New convergence developments can also enable them to manage many activities in connection with household appliances and entertainment.

Elderly people who move from their present home into a house with smart installations represent one of the biggest challenges of modern society. Usually they experience progressing age related changes in vision, hearing, sense of touch, mobility, reaction time and memory. Because of these changes, there is a fear of accidents and other problems that may arise when they live alone. Smart houses can also be of use and support in residential care units through helping the care personnel to know about accidents or other undesired situations.

Cognitively impaired people

Cognitively impaired persons may include psychologically handicapped persons, persons with a brain injury (for example after a head injury) or persons with dementia or psychiatric conditions. In this report we have not specified requirements for one user group that could benefit from smart houses, but where little or no experience is present: mentally handicapped persons that are moving out of psychiatric care into a more independent living situation. There is a need to define user requirements for this group, because they may benefit from smart houses.

The user requirements related to smart houses are mostly general, and apply to all users. The functions can easily be reprogrammed or other components or functions added. Therefore it is most important that the user requirements are defined in accordance with Design for All /Universal Design principles.

Locating and Physical Access

Home Environment

- The smart house represents entirely new ways of operating controls and appliances in the home. Confusing elements and unfamiliar components must be avoided in the home, for example “smart” light switches that look like something else.
- Provide a clear line of sight to the necessary elements.
- The control components must be placed in accessible positions for all users, preferably not in corners and at a certain height over the floor, but with esthetical considerations taken into account.
- The controls must be accessible for all the activities that are controlled by users of smart house systems.
- Lighting outside the house must be good and not give glare. High contrast.

Public Environment

- CEN TC 225, JTC1, subcomittee 31 sets standards for admission to buildings. Quite frequently public office buildings and other public buildings have smart house installations, but it is rarely up to the public to control them.
- In order to make them accessible for the work of all types of persons the same requirements as for a home apply in these environments.

Mobile Environment

- The smart house can be controlled from the outside via telecom or other media, and then the same requirements apply as for these, *See Chapters 6 and 9*.

Requirements	Standardisation
Physical	
- Free and unimpeded access requires that all control units are located and designed in such a way as to be operable by wheelchair, walker or cane user (e.g. level floor surface) or by persons with reduced physical strength and reduced endurance.	Requirements - Requirements are the same as for access to houses (life cycle standard) - CENELEC TC 205 and CENELEC TC 105 and and ISO/IEC JTC1 SC31 must relate to smart house entries

Requirements	Standardisation
 **Auditory**	
- Acoustic signals must be audible by persons with reduced hearing, and visual or tactile alerts to be alternatives for deaf persons.	Requirements - Standards within CEN TC 225 CEN and ISO/IEC JTC1 SC31 must be adapted to accommodate the needs of persons with auditory disabilities.
 **Visual**	
- Signs must have high contrast (e.g. white or yellow characters on a dark background) and illuminated]. For blind people it is required that other media is used for status information, for example a loudspeaker . - Provide visually clear access to functionality (on / off). - All interaction elements (e.g. keys) must be easily detectable and recognisable.	Requirements - Standards within CEN TC 225 and ISO/IEC JTC1 SC31 must be adapted to accommodate the needs of blind and visually impaired people.
 **Cognitive**	
- Perceivable information is an important requirement, especially as smart houses are unfamiliar to most people.	Requirements - Standardised and user tested symbols and terminology which is understandable to others than engineers must be requirements to be standardised for suppliers of smart house systems.
 **Dexterity**	
- If the smart house system requires manipulating controls to get access to the house, all this requires adapted and various different ways of handling the control.	Requirements - CEN TC 293 environmental control systems must be revised to make interfaces integrated with smart house systems.
 **Combination**	
- None identified	

Physical Handling of Smart House Devices and Controls

Home Environment

- The components must be placed within easy access for people with all physical varieties and mobility modes, as well as auditory, visual and cognitive needs.
- Provide failsafe features.

Public Environment

- Only applicable in public buildings where persons work, because smart house installations are normally not handled by the public.

Mobile Environment

- Mobile devices can be used to manipulate and control environmental components in the home, so the same requirements apply here as for mobile telephones and other mobile equipment
- *See Chapter 6*.

	Requirements	Standardisation
 **Physical**	- Normally a smart house can substitute the need for handling controls in the home, but user requirements for universal use must always be present for manual options.	Requirements - CENELEC TC 205 must include in their work user aspects and design for all related to the installation of smart house systems. - Standardised interface must be developed for input devices across smart house systems and suppliers. - Convergence of different modes for operation is recommended.
 **Auditory**	- Handling also includes being able to hear alerts and alarms. All audio events (signalling, receiver and loudspeaker) should be presented in scaleable volume, and in visual displays or vibrating components, especially in dangerous situations.	Requirements - Standardised interface to external amplification system is recommended.

Requirements	Standardisation
Visual	
- All interaction elements must be easily detectable and recognisable, and logically distributed in terms of the interaction process. Display resolution and illumination should be adequate. - Tactile markers for orientation on the keypad must be used. When new ICT is used to operate and handle controls of smart houses, they need to be accessible also through tactile media.	Requirements - Standardised symbols e.g. for on-off, and standardised interface to external display system (e.g. TV, large display) should be developed. - There is a need for standards for tactile markers.
Cognitive	
- Simple, intuitive use and tolerance for error is important when operating a home, because implications of errors can be serious in an automated environment. This applies to operating controls as well as understanding and accepting automatic functions. - All the interaction points must be easily detected and recognised. Flexibility for different mental models of how the house works must be accessible. In some cases the user cannot be axpected to operate the smart house, but the system must be intelligent enough to do it for him when necessary.	Requirements - Guidelines for ethical procedures to ensure informed consent and ethical use of technology to improve quality of life can be a European project, but need to be adapted to the legislation issues in each country. - Develop standard guidelines and courses for electrical suppliers and installers in order to understand how to incorporate procedures for securing user needs into their planning and installations. This is a task for electrical contractors associations quality assurance systems, in close co-operation with potential planners and purchasers.
Dexterity	
- In relation to assistive technology devices like environmental controls, these must be customised to each user if he is going to be able to control the house. Many functions can be automated to ease use, for example automated lights and heating controls or door and window openers.	Requirements - CEN TC 293 is about environmental control systems, and needs to adapt their work to relate to smart house systems in order to be integrated and achieve added benefits for both systems.

Requirements	Standardisation

Combination

- The interaction elements should offer the possibility of multimodal feedback (acoustic, tactile and visible). Service help facilities available.

Requirements.

- Create common standards on interaction elements (shape, colours, feedback, dimensions...) for physical and screen controls and status feedback. Relate to ISO/DIS 13407.

User Interface (UI)

Home Environment

- UI must be consistent with user expectations and intuition.
- Arrange information consistent with its importance.
- Provide compatibility with a variety of techniques or devices used by people with sensory limitations.
- Discourage unconscious action in tasks that require attentiveness.

Public Environment

- If the public is required to operate smart house systems, make requirements for better public instruction panels.

Mobile Environment

- UI adjustable to individual needs (individualisation, user profiles).
- The UI must be consistent independently from environmental influences (e.g. type of mobile communications network).
- The UI of components used by mobile care workers must be easy to understand with logical and consistent user interfaces. *See Chapter 6.*

	Requirements	Standardisation
Physical	- It is necessary to be able to operate the smart house system with as many different individually adapted user interfaces as necessary through a life time.	Requirements - Make a list of standard basic installation of the most frequently used modes of control, with potentials for individual adaptations.
Auditory	- Optional provision of redundant presentation of visual and acoustic feedback when operating the system or in case of status messages or alarms. - Scaleable volume is recommended on the auditory information providers. Human voices are preferred. Ensure low background noise.	Rquirements - CENELEC TC 100 X and TC 205 must include universal design into their work. - Create standards on hearing aid coupling (inductive loops, possibility to plug in hearing aids).

Requirements	Standardisation
 **Visual**	
- The entire user interface must be adaptable so it is “readable” by a visually impaired persons. - Do not invent “strange” new interfaces that have not been tested and evaluated with representatives for “all users”. - Provide auditive feedback and possibilities for interface with speech control.	Requirements - Develop standard visual and auditive displays for feedback of status and control messages in co-operation with human factors specialists and standardise trials methods with users representatives. These ideas for standard interfaces and pictograms must be accessible by all suppliers and systems.
 **Cognitive**	
- Option for no operations being expected by the user. - Simple and intuitive use. Use established graphical symbols for common functions. - Use consistent and distinguishable UI layouts for different applications. Tolerance for error. Consistency of UI across systems and suppliers. - Provide continuous feedback during operation. Avoid confusing information or too much information at once.	Requirements - Continue co-operation between CEN, CENELEC and ETSI on these issues. This is recommended for a specific European standards project: - Create standards on UI symbols for smart houses. - Create standards on feedback typology for all major user groups.
 **Dexterity**	
- User interfaces that require small manipulations will be a problem to many users, especially older ones.	Requirement - Provide standard choice of different interfaces, individually adapted.
 **Combination**	
- Follow the Universal design guidelines for all UI.	Requirements - User tests of interfaces must be carried out before putting them on the market. - ISO/DIS 13407, a specific project is recommended under the IST Programme: Human centered design of processes for interactive systems.

Operation

Home Environment

- Consistent dialog requirements between home and alarm centre or home care service.

Public Environment

- Standardised modes of communication and operating alarm messages and potential remote control. CLC/TC 79 needs to include this in their work.

Mobile Environment

- Same requirements as for Mobile communications.

Requirements	Standardisation
Physical	
- Requirements for the control devices, like environmental controls	Requirements - It is necessary to integrate the work on standards for Environmental controls; CEN TC 293 and work on standards for smart houses. - Consumer issues must be included in the work of CENELEC TC 205
Auditory	
- Operations should be possible without auditory alerts, but visual or tactile	

Requirements	Standardisation
 **Visual**	
- Operations must be possible without visual alerts and feedback. For example, use voice messages and/or tactile input prompts or biometric systems. As it is common to display status feedback on a display in the home, these must be designed to accommodate visual impairments by standardised signs with accompanied text (in national language) displayed in sufficient size and placed in close context with where the user is most likely to notice it. Auditory alerts help.	Requirements - Include consumer issues in the work of CEN TC205
 **Cognitive**	
- Here are special requirements because many elderly people and people with cognitive dysfunction find smart houses entirely new and unfamiliar. Therefore the principles for universal design are even more important for these user groups than for “all”. - Use the necessary minimum of new and unfamiliar information and operations. - There has to be sufficient time to understand and react, and user support is particularly important. One requirement is that there should always be a manual option to operating elements of a smart house, for example a light switch. - Prompts should be recognisable, clear and unambiguous.	Requirements - Continued co-operation between CEN, CENELEC and ETSI on the standards or recommendations for different modes of operating smart houses, taking non-proficient users into consideration.
 **Dexterity**	
- Make different modes for operation, some that do not require dexterity, or with large and easy to manipulate controls	Requirements - It is recommended to integrate the work on standards for Environmental controls; CEN TC 293 and the work on standards for smart houses.
 **Combination**	
- Universal design principles , particularly flexibility in operation	- Include Design for All issues into TC 79 work.

Adaptation to User Profile

Home Environment

- Make individual adaptation to the different residents´ needs and desires. The basic installation must be flexible enough for these options afterwards and as users needs change.
- Modularity is important; and standard procedures for periodically adapting the system and the service.

Public Environment

- Not many public spaces have possibilities for adaptations of the smart house installations, but in some working places it may be necessary.

Mobile Environment

- Provide possibilities for adapting the remote operation of functions in the house to individual profiles.

Requirements	Standardisation
Physical	
- For example, provide flexibility through integrating the smart house with environmental controls, or by providing automatic functions as much as possible and desired by the user.	Requirements - Necessary integration of work on standards for Environmental controls; CEN TC 293 and standards for smart houses. - Develop standard requirements for the basic functions a house must have, and where they are placed in the building to provide flexibility. CENELEC TC 205 must take on this responsibility.
Auditory	
- For example, provide a choice between visual or tactile feedback, and/or with possibilities for varying the volume. Adaptation to hearing aids must be possible.	Requirements - Additional auditory signals in dialogues are recommended. Create standards for interface between hearing aids and smart houses.

Requirements	Standardisation
 **Visual**	
- Visual alerts and feedback needs to be visually adaptable for varying visual abilities, as well as auditory and tactile modes of operation and response. Flexible basic installation must allow for these adaptations.	Requirements - Ensure standard interface between smart houses and assistive technology. Co-operation between CENELEC 205 and CEN TC 293 is recommended.
 **Cognitive**	
- Provide options for different requirements for persons who cannot understand how to operate the smart house themselves. Some may require that the house is so smart that it looks after them. Ethical implications are present in case of surveillance. Hazardous elements must be eliminated, isolated or shielded.	Requirements - It is necessary to develop procedures for ensuring legal issues, informed consent and other issues in connection with cognitive dysfunction and surveillance, for example for people with dementia. This could be dicussed in a CEN/ISSS or ICTSB workshop.
 **Dexterity**	
- Require options for input, for example through voice control or other environmental control systems.	Requirements - Recommend necessary integration of standards for Environmental controls; CEN TC 293 and standards for smart houses.
 **Combination**	
- All requirements from universal design can be applied to individual adaptation.	Requirements - Include procedures for ensuring universal design in all standards relating to users and consumers.

Security of Operation

Home Environment

- The system must be fail safe and easy to learn.

Public Environment

- The system must not be accessible to undesired users that can put it out of function.

Mobile Environment

- As for Mobile communications.

Requirements	Standardisation
Physical	
- Provide individually adapted operation mode to give security of operation, despite physical dysfunction.	Requirements - CEN TC 247 and EN 12098-1. - CENELEC TC79 for social alarm systems. - CENELEC standard prEN 50134 1-2, 1993E. All these working groups must adapt their work to smart housing issues.
Auditory	
- Require understandable alerts, for example louder, in relevant positions, visual or tactile.	Requirements - Develop standard adaptation to hearing aids. - CENELEC TC79 to include the issues.
Visual	
- Provide different modes of operation without seeing, for example speech input and output or bio-metric prompts.	Requirements - CEN TC 225 (bar codes), and ISO/IEC JTC1 SC31 sets standards for biometrics, for example for admission to buildings. This must be adapted to be combined with smart house standards work.

Requirements	Standardisation
 **Cognitive**	
- Confusion can lead to insecure operation., therefore it is particularly important that the system is easy to understand and error safe. Controls with dangerous implications must be kept out of reach of users with cognitive dysfunction.	
 **Dexterity**	
- Replace PIN by biometric identification (e.g. fingerprints or bar code).	Requirements - CEN TC 225, and ISO/IEC JTC1 SC31 sets standards for biometrics, for example for nurses or alarm personnels admission to buildings. This must be combined with smart house standards work.
 **Combination**	
- Service and maintenance	Requirements - Require quality assurance for work by electrical contractors associations and planners.

Issues not Covered by the Tables

Automatic smart house functions

There are some smart house functions that do not fit into the above tables, but still represent some of the main advantages of smart houses with regard to universal design.
These functions do not require action from the user, but the system carries out the necessary functions automatically upon messages from other components in the smart house system. An example is a fire alarm that is set off by the smoke detector in the house, automatically sending a message to the fire department, opening all entrances and turning on the lights to make evacuation easier, and sending a message to the home care service.

Another example is lights and heating being automatically turned off of when there is nobody present or when the person leaves the house, for energy savings purposes. Remote control and metering of energy supply are advantages that all users are interested in, regardless of their functional level.

Programmable flexibility

The modularity of smart house systems makes it easier to achieve flexibility. This is important because it makes the house easily adaptable to individual changes and new needs. This is easier to achieve if there is interoperability between smart house systems, and between different suppliers within the same system. The programming is normally done one a PC, stationary or portable, or by a mobile or Internet telecommunications system. This requires the same standardisation issues as chapter 7 and chapter 14 and 10.

Alarm services connected to smart houses

When smart house installations are used for elderly and disabled people, it requires a chain of services that connects the alarms in the house with the home care service and an alarm centre. There are specific requirements for this transmission and how the interaction functions between the residents and the helpers.

• A standard interface between alarm systems and smart house systems must be developed.
• Different actors should be alerted for different accidents.
• The messages must be differentiated in order to help the carers to act relevantly and quickly.
• It is particularly important that the alarm system and the smart house system functions in a fail safe way.
• The alarm reception must be operated on a 24 hour basis.
• There must be a contract between the user and the alarm centre that specifies what can be expected, for example maximum how long the user can be expected to wait for a response and how long they can be expected to wait for a visit in an emergency.
• There is a need to always be an open two-way communication between the alarm receiver and the alarm giver when an alarm is activated.
• There must be active, as well as passive alarms available.
• There must be regular maintenance and service of the system.
• Safety alarms need to be a natural part of an installation, which is covered by the public social service.
• Alarms must not mean reduced personal and social contact for the user, but optimise the personal contact by taking away some of the chores of controlling the user.
• Alarm presentation must be standardised. This is both with regard to alarms in buildings and in control centres. Alarm presentation includes choice of media (visual, acoustic) signal characteristics (intensity, pitch, duration) and presentation (e.g. symbol, message, etc).
• Alarm handling techniques such as grouping of alarms, alarm prioritisation needs to be standardised.

Conclusions

The conclusions, challenges and recommendations of the ICTSB Consumer requirements project in relation to Smart Housing issues and standardisation are seen in relation to today and in relation to the future. The conclusions are divided into:

- standards work areas
- codes of practice
- research and development work required
- inclusion of consumer influence

The issues are primarily placed within the CENELEC and CEN areas, but in all parts of smart house systems that require medias for communications within the house or to the outside, ETSI standards are of importance.

Standards Work

CENELEC TC 205, 122, 215

Combine the work of CEN TC 293 with CENELEC TC 205 to standardise the interface between assistive technologies (for example IR environmental control systems) and ordinary consumer products on one hand and the smart house systems on the other.

Develop standardised links between the smart house installations and the alarm centres and the system for ambulant care through co-operation with TC 79.

It is necessary to sort out which issues from the Consumer Report and which recommendations must be dealt with by TC 205 and TC 215 working groups respectively. The recommended issues are:

Recommendations within TC 205

Create consistent user interface
Standardise user interface of smart house systems
Make smart house systems interoperable
Require upward compatibility of systems
Create standard choice of different interfaces, individually adapted
Provide failsafe features and manual override systems
Create standards on feedback typology for all major user groups.
Develop standard requirements for which basic functions a house must have, and where they are placed in the building to provide flexibility.

Recommendations to be sorted out within TC 205 and TC 215

Require flexibility and modularity
Develop standardised installation aspects
Provide centrally placed and easily accessible technical centre in the house

The components must be placed within easy access for people with all physical varieties and mobility modes, as well as auditory, visual and cognitive needs. Standard height for hidden conduits.

Provide sufficient room for extra components and extensions for electricity and ICT in the technical centre

Hide conduits to windows and doors for electricity for control or alarms

Within TC 122

Create standardised interface to control and input devices across smart house systems and suppliers

Convergence of different modes for operation

Within other TCs

Standardised symbols e.g. for on-off. Standardised interface to external display system (e.g. TV, large display).

Adapt standards on interaction elements (shape, colours, feedback, dimensions...) for

physical and screen controls and status feedback. Relate to ISO/DIS 13407.

Standardised and user tested symbols and terminology which is understandable to others than engineers must be requirements to be standardised for suppliers of smart house systems.

Adapt standards on UI symbols for smart houses, like metaphors, icons, navigation. (ISO 10646).

Include standards for good lighting in smart house standards, (co-operate with CENELEC TC on lighting)

CENELEC TC 79

CENELEC TC79 for social alarm systems. Include Design for All issues into TC 79 work.
Adapt CENELEC standard prEN 50134 1-2, 1993E.
Provide standard adaptation to hearing aids.

CENELEC Mandate 273

CENELEC Mandate 273 is recommended to be co-ordinated with TC 79. There may be other relevant areas within TC79, especially because integrated alarms and transmission of these into other alarm systems is one of the main aspects that relate to smart house technology for universal design purposes. In addition, assistive technology needs to be integrated into the requirements in order to allow disabled persons to send alarms.

CENELEC TC13, IEC TC13 and CEN TC 294

Include smart house issues into their work on control and metering of gas, water and electricity supply. Make these issues easy to understand and use for consumers.

CENELEC TC 100 X and TC 206

Adapt standards to require audio/video and other entertainment systems to be compatible with smart homes. Create standards on hearing aid coupling coupling (inductive loops, possibility to plug in hearing aids).

CEN TC 225, and ISO/IEC JTC1 SC31

Include user issues in standards for admission to buildings and include smart house issues.

CEN TC 247 and EN 12098-1

The TC and the standard must include users issues in their work on energy savings systems.

Future standards

Future standards must be influenced to enable all users to take advantage of new developments in the area of wireless and Internet applications in the smart home, outside the home and in other buildings. Entirely new paradigmas will put new demands on the users, and this is why their needs must be included in the convergence related development and standards in Europe, US and Asia. Wireless media will dominate the smart house communications systems, for example with power line, wireless, radio frequency, Internet and coaxial cables. All these have their own standardisation issues and varying degrees of open standards. A strategic plan for how user requirements are integrated in the future developments must be made. This plan must include and converge standards in relation to digital services and products.

Technical developments are faster than the standards work, and the standards increasingly belong within several areas; CEN, CENELEC and ETSI, and depend on standards within IEC and ISO, and for example Asian standards. It is recommended that the co-operative activities that have started within ANEC and ICTSB are intensified. A special meeting of officials of all TCs involved must be arranged by ICTSB.

Codes of Practise

Some of the recommendations are the responsibilty of the planners, some of the electrical suppliers and contractors or their organisations.

Identify and manifest minimum quality guidelines and courses for electrical suppliers and installers in order to incorporate procedures for securing user needs into their planning and installations. This is a task for electrical contractors associations quality assurance systems, in close co-operation with potential planners and purchasers.

Make standard recommendations for ensuring reliability and maintenance and recommend service contracts with clear division of responsibilities.

Develop guidelines and procedures for ensuring legal issues, informed consent and protect against invasion of privacy in connection with cognitive dysfunction and surveillance, for example for people with dementia. This is an issue for legislation.

Develop procedures for standard and compulsory quality assurance and user testing before putting new components into use. This is a task for electrical contractors associations.

Develop standard procedures for testing systems after installation and before actual use. This applies to all elements and functions of the system, and the installer as well as the users must be present and go through the installation with “hands on” experience. This must be the responsibility of the electrical contractor and installer.

There must be standard procedures for service and periodic maintenance, and clear lines of responsibility. This is a task for electrical contractors associations.

Research and Development Work Required

Develop guidelines for identifying and ensuring universal user needs as well as individual user needs and requirements at each step in the process of planning and implementing smart house systems. Such a project is urgently recommended and must build on existing experience with implementations and users.

Create standard visual and auditive displays for feedback of status and control messages in co-operation with human factors specialists and standardise trial methods with users representatives. These ideas for standard interfaces and pictograms must be accessible by all suppliers and systems. They must relate to and be included into ETSI, CEN and CENELEC issues.
This is a clear task for suppliers and developers of the technology, in conjunction with the standards developments.

Evaluate how existing, simple light switches are designed to enable people who are unfamiliar with ”smart” designs on switches to turn on the light manually in a smart house without learning entire new controls and smart fixtures. The results must be design recommendations for the manufacturers.

In order to raise the safety, security and efficiency issue of using smart housing alarms to help look after people in care housing, a project must sort and standardise the user aspects of the connections and interfaces between smart house systems and alarm services. To be seen in conjunction with standards work in CENELEC TC 79.

Ethical issues of surveillance must be discussed in a European workshop, for example organised by ICTSB, but needs to be adapted to the legislation issues in each country.

Make a list of standard basic installations of the most frequently used modes of controlling the smart house, with potential for individual adaptations. This could be a project or national organisations task.

Targetted projects are recommended on European level, in conjunction with ISO/DIS 13407

Inclusion of Consumer Influence

Recommend co-operation between consumer organisations and standards organisations.

Require cost transparency upon planning and buying smart house systems.

Final Conclusion

The flexibility that smart houses can offer make universal design desirable for all users through a life time, therefore standards work is particularly important for future homes and other buildings.

The work being done in CEN, CENELEC and ETSI must be integrated with the developments of codes of practice and recommended research projects and consumer involvement.

ICTSB has tried to monitor the work and ensure proper co-ordination of the work done in the respective organisations and report back to ICTSB, but so far very little progress has been made. This is particularly important in the smart house area, because smart house standardisation and developments are indeed complex and the concerns of many organisations and many related technologies.