

# Creating Home Network Access for the Elderly

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**Abstract.** Wireless broadband networks for home environment present us with many challenges unfamiliar in more public settings. At home, we encounter the end-users with little ICT experience. Probably among the most challenging members of the home network are the elderly, who may have demanding needs for ensuring accessibility. Either living in a joined community as in a home for the elderly or at home on their own, the possibility to have a remote connection to the homes of their extended family may become important by e.g. decreasing mobility. Interconnectivity between various heterogeneous networks across multiple homes means for example situations where the family shares a photo album or web server with various pieces located at different homes. In this paper, we identify usability challenges presented by internetworking multiple homes, with a special focus on universal accessibility.

**Keywords:** Home networks, accessibility, usability, user interface design, security, accessibility, authentication.

## 1 Introduction

In this paper, we identify usability challenges presented by internetworking multiple homes, with a special focus on universal accessibility. The analysis was conducted in order to find out, on basis of analyzing existing user behaviours and needs, what kind of user needs the elderly, as part of an extended family that includes their children and grandchildren and other relatives, may have in connection to home networking. Either living in a shared, yet private community of a special home for the elderly or in their own home, the additional connectivity offered by the emerging home network may prove to provide for true enrichment of the daily lives all family members. The study included a perspective on using these future connections for creating increased value for their own personal habitats inside the elderly home by having their own network access, of having connections to the other inhabitants of the home for the elderly, as well as of having access to and being accessible from the homes and networks of their relatives and friends elsewhere.

In a typical home for the elderly, there are several “user groups” that make up the community and have quite differing roles and amount of involvement in the daily routines of the home. Firstly, there are the inhabitants, the elderly, who for one reason or the other no longer wish or can live on their own. Secondly, there is the personnel,

for whom the home is a working place. Thirdly there are the family members of the inhabitants and friends, who visit the home on a more or less frequent basis.

We were especially interested in seeing what type of *contents* the elderly would be most interested in sharing with others. Also, we were interested in any *privacy* issues involved in getting connected with both the elderly home's inhabitants and personnel, as well as with the family members and friends outside the elderly home. We were not so much focusing on how the connectivity could be utilised for monitoring the health of the inhabitants of the elderly home as often is the case with studying the elderly, but more on how it could enhance their lives by enabling them to be more involved with others, both inside and outside the home. Thus, we were not concentrating on the life-enhancing technologies and their usability or accessibility.

The work was done as part of a project focusing on wireless broadband home networks, where the goal is to build interconnectivity between several home networks through broadband access networks in an easy-to-use and secure fashion. This research aims at ensuring reliable and secure broadband end-to-end connectivity between peer devices within one home. The peer devices can also be in multiple sites in several wireless home networks. This is a challenging environment to begin with, since the target recipient is a consumer without technical expertise.

A further challenge is created by the multitude of end devices, legacy and new ones, entering and leaving the home network at any moment, and the number of technologies provided for enabling the connectivities both within the home and between the homes. In addition to developing system architectures and internetworking solutions, the project will also analyze business value systems: identifying future service possibilities for the vendors in the field based on the discovered user needs.

The work at hand was a natural continuation of user studies conducted with families with children earlier. That work was done in order to gain a basic understanding of the current situation of the home networking in families. Families with children were selected, since the family members might have interestingly conflicting interests in sharing and withholding information from other family members. This work is reported in [7]. We wanted to probe further into understanding the user needs of the extended family as these questions were constantly raised during the initial interviews, in the case of families of divorced parents, and especially in regard to the needs of the elderly.

The paper is organized as follows: First, we will present an overview on the approach to building a home network in our project. We will proceed by describing the different use scenarios identified earlier in the project. Then, we will present relevant work done in the area of usability work in home networks, especially in relation to the elderly, including some work on the accessibility issues. We will then present the method, study setup, and the results of the user need analysis conducted. On basis of the analysis of the findings, we will present enhancements to both the usability and accessibility of our proposed user interface solution for home network management, as well as an analysis of the possible future uses of such network in the context of a home of the elderly and its individual inhabitants.

## 2 Home Network and Its Users

### 2.1 The Home Network

What constitutes a home network in practice is not a simple question [3]. In order to identify the challenges embedded in building internetworking via broadcasting

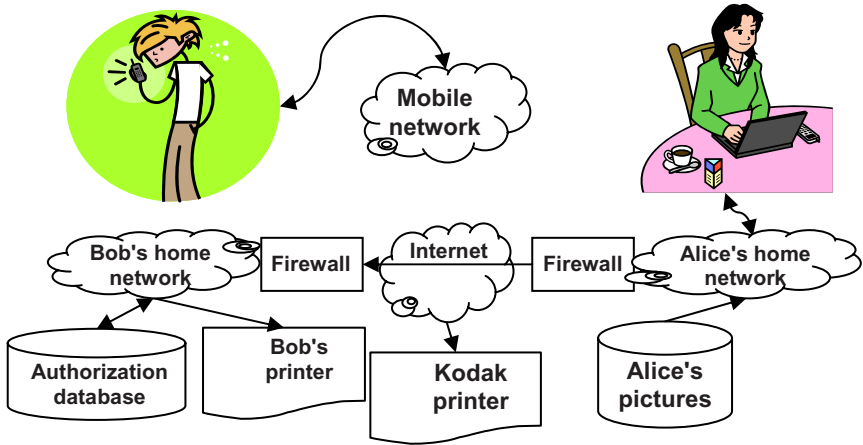


Fig. 1. An example of home network content sharing

between multiple homes in a secure and easily manageable way, we first need to understand what kind of totality of devices, applications, and information we are to manage. The basic concepts of “home”, “network”, “internetworking”, “user” etc. are ambiguous – in order to proceed we need to build working definitions of the basic concepts we are dealing with.

One of the main advantages of wireless home network is that it allows the creation of totality where different kinds of terminals can be used together for accessing any content and services that are part of the home network. The home network can be used for *sharing content*: photos, records, or videos can be accessed both within home with own or visiting terminals, or remotely from outside the home, enabling a wider audience of this type of personal content, but with restricted access that enhances the privacy as compared with completely open ways of sharing, as e.g. by using flickr.com or similar services for sharing photographs with others online. Sharing photos – and thus sharing memories and experiences – is one of the key uses that will have core place in the emerging home networks also. For example, in one family in the user study we have reported in [7], a grandson had placed a “home server” in his grandmother’s apartment, allowing easy access to the joint digital photo collection of the two for the grandmother.

Home networks also allow mixing of content coming from different sources. A typical example of this could be interactive television. In the home networking scenario, members of the family could share and join experiences by interacting with their personal devices on the TV show, competing against each other or against the

others as a team. In the future, it will also become possible to enrich the contents by tagging and marking, enabling the *sharing experiences of the content* as well. A simple example is music sharing, where it is already possible to add tags to the streams for others to look up as “interesting parts”.

Of course, a fully-fledged home network could also be utilised for surveilling purposes. For example, the parents might want to check if their kids already arrived home from school and how they are doing while still at work. In the case of the elderly, the possibility to monitor the users with special needs and, possibly, also stay alerted on any changes of a fragile state of health may become an important addition of the possibilities enabled by the home network.

One more possibility is to control the home devices when away. A good example of remote control user needs is in [6], who report on the users’ expressed wish to “take care of the home” remotely in their study. In case of progressing memory loss, an elderly person might want to access their home from a distance, in order to “make sure the stove was turned off”.

The above scenarios illustrate some cases of how the home wireless network can be used. To realize these visions, further development is required on several technology areas. For example, novel circuit and radio technologies are required for the implementation of the network itself. In addition, terminals must be able to work in heterogeneous networks, which must be made secure too. Finally, the applications and the content have to be interchangeable between the different devices.

On basis of these observations, we have defined the home network in the following way: *Home network is a constantly changing totality of devices – computer, A/V systems, mobile devices – that can be connected to each other, together with the internet and broadband connections, and that is used by a non-technical user group, typically a family, for personal needs.*

## 2.2 Home Users

Analyzing the user needs of the household inhabitants is not an easy task, since these needs may vary substantially. Defining different user roles with corresponding privileges and restrictions clearly is a must. Also, what users understand as home, network and its boundaries may not be self-evident.

According to [5], currently most broadband adopters typically have several computers in their household and these early adopters are also more familiar with the networking than the majority of home users. So the level of understanding and know-how about technology and security issues among the current users of home networks is likely to be higher than average and inferences from their experiences must be made with caution [2].

An important issue to understand when trying to create a home network with security features is that *perceived* security might differ from the actual security. [1] make an excellent point in examining how people experience security in their everyday lives. People make mistaken inferences about what is secure and what is not, and for them, the boundary of computer or network security may not differ from physical security, or at least the boundaries of these areas is unclear and ill-defined for them. This will have major repercussions on building the security, since people may

not feel safe if we only provide them with the technological answers, without really understanding their needs.

Continuing in the lines of study of [10], [2] point out that some devices are of more individual nature than others clearly intended for collaborative usage, so user expectancies about their usage may also vary accordingly from device to device. This became evident also in [6], where the initial attitudes towards the various devices also changed during the study phase of six months of actual usage. This study on couples living in a smart home is reported in [6]. In this work it was evaluated how the usage behaviours and UI expectations will develop in a smart home environment with several users over extended period of time (6 months). Three devices, PC, mobile phone, and a media terminal, were tested, and UI prototypes for these devices were designed and adjusted according to user feedback. It became clearly evident that the user expectations for each device were different, mobile phone becoming the most used device to control the smart home functionalities despite initial reluctance and suspicion towards it as suitable for operating the home. Initial emotional response may affect the adoption of usage for extended periods. The recent work of e.g. Donald Norman on the importance of affective responses to inanimate objects also enlightens this point [11].

### 2.3 Managing the Home Network

Usually, in the homes studied by [3], one household member had the major responsibility over managing the network, and the other household members did not need to be as knowledgeable about the network. This seemed to be the case in the homes studied by us as well [7]. Grinter et al [3] have identified three themes potentially causing trouble in home network maintenance. These are: 1) the myriad of networks that exist in households, 2) the household tensions that emerge due to different personalities and individual needs 3) the collective challenges met with in network administration and troubleshooting. They identify also the invisibility and (in)comprehensibility of the networks as problematic issues in home network management.

In regard to the special needs of different household members of varying ages and capabilities, the [4] presents a good report on the current level of understanding of the behaviour of the teenage members of the families. [4] also presents nicely the current state of existing home network usage practises, the telephone still dominating home communications. Yet, they report on increasing awareness of households on Internet technologies, and the family becoming a source of recreational computing. This increased usage of computers at home has also been the source of research studies, especially email and the World Wide Web (WWW) (e.g., [9], [12], and [15]). They further report on the findings of Kraut et al. [8] on how households tended to prefer *communication* activities over *information* activities. According to the authors, this ability to use the computer as a communication appliance may require not only personal access but also that members of our social circle have this, as well. In case of the elderly, this might have big impact in affecting communications between the elderly, since they might have asymmetrical access to computing and networking resources between them.

Edwards and Grinter [2] have presented seven challenges that home environment presents to ubiquitous computing technology. These include the deployment of such technologies; technical questions in interoperability, manageability and reliability; social issues in adoption of domestic technologies, as well as design issues. We will now consider three of these challenges from the accessibility point-of-view, on basis of our observations and the user studies reported in [7].

### **3 Analysis of Three of the Challenges in Home Networks from Accessibility Viewpoint**

The three challenges are chosen as examples of how accessibility issues may affect how the home networking should be realized and communicated to the users in the case of the elderly users.

#### **3.1 Challenge One: The "Accidentally" Smart Home**

The general question of the first challenge by [2] is how the occupant-users adapt to the idea that their home has suddenly reached a level of complexity at which it becomes unpredictable. A specific question this scenario raises is how will they begin the process of making sense of what has happened. From an accessibility point-of-view, the analysis is two-fold. On one hand, an elderly inhabitant may in fact be used to uncontrollable changes, and accept them *as is*. The elderly tend to have to give some amount of their privacy and self-control away as they grow older. Having the home change in the same way, in an uncontrollable fashion may be experienced as a natural continuation of this process. On the other hand, the new situation may raise fear and resistance to change may occur, as more control is taken away from the users. With the wireless nature of this new technology, the invisible actions of the network may cause the incontrollability to seem unbearable.

#### **3.2 Challenge Five: Social Implications of Aware Home Technologies**

How the new "smart home" or "networked home" may affect its inhabitants social awareness also. The privacy issues may become pending when the home becomes aware and connected to the outside world in ways that cannot really be detected and monitored by its inhabitants. In the case of the elderly, it may be hard to judge, what is left from the privacy of the life led in the networked homes. What these implications may be is not clear and cannot be foreseen for any home users. However, the difference between the elderly users is, again, in that of level of the control that these users probably have about finding out and deciding on just how aware the home may become.

#### **3.3 Challenge Seven: Inference in the Presence of Ambiguity**

Challenge seven deals with the levels of smartness that the home should, in the end, achieve. Where are the boundaries, what should be monitored, for whom, and how? [2] present a thought-provoking example on how the smart environment can infer that some state exists by aggregating a number of other factors. For example, if a number

of people are gathered together in a meeting room, the system might assume that a meeting is taking place. This type of inferences is unforeseeable and uncontrollable – and probably undesirable, too, for all users. Will the new technologies of the networked home be seen as tools for extended monitoring and surveillance by the elderly inhabitants and thus resisted by them, depends to a great extent on the ethicality of those embedding the connectivity and its controls in these domestic environments.

## 4 Conclusion

On basis of the analysis conducted on the challenges presented by the home networks from an accessibility point of view, we can clearly see that a lot needs to be achieved before the home network can become a desired reality to the elderly users also.

### 4.1 Future Work

As continuation of the theoretical work presented in this paper, and the already conducted user studies with families, we are in the process of testing our prototype UI implementation for pairing the home devices and personal devices, such as mobile phone and laptop, for example, with each other to form connections between them in a secure fashion in order to exchange contents such as digital photos between them, also with the elderly in order to detect accessibility issues and the special usability needs and user acceptability issues that these users may have with our current solution. We have already tested this type of connection forming between two mobile phones [13] and between a laptop and a mobile phone [14] with tens of users within the age range of 18-60.

However, the user base for these studies needs to be extended. Such initial connections form probably the most personal and graspable part of the emerging home network for all users, also the elderly for whom the mobile phone may be more of an asset in the less than perfectly private homes and lives that the new technology may mean to them. Assuring the accessibility and usability issues for these users is key enabler for safe, trusted, and successful communication for this special group of users – for staying connected, without becoming the new “Johnnys”[16] of the home networking world.

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