Making Connections: Designing for Home Networking

Marshini Chetty and Rebecca E. Grinter
Division of Interactive and Intelligent Systems, College of Computing
Georgia Institute of Technology
85 Fifth Street NW, Atlanta, GA, 30332-0760
{marshini, beki}@cc.gatech.edu

ABSTRACT

Visions of domestic computing often imply the presence of a home network that seamlessly connects devices together and allows applications to share media within the home or with others connected to the Internet. We have not yet reached the stage where this scenario is straightforward for the average consumer who may not be technology savvy. To realize this vision, we need to make home networks usable for the average user by understanding which devices users want to connect together and why. Furthermore, we need to understand how problem solving occurs when devices do not connect together or to the Internet. We review different techniques for studying the home; highlighting the aspects that pertain to understanding home networking. Next, we describe our upcoming project which builds on previous work investigating the complexities of home networking. We outline our approach and conclude with alternative suggestions for learning more about home networking.

Author Keywords

Home networking, domestic computing, domestic studies.

ACM Classification Keywords

H5.m Miscellaneous

INTRODUCTION

Many of the visions of domestic computing imply the presence of a home network that connects devices together and allows applications to share media within the home and with others connected to the wider internet. Indeed, there is already a plethora of devices that exist in the home from computers, televisions, personal video recorders such as TiVo, radios, iPods that the average user would like to connect together. Yet, despite this desire, consumer reports suggest that consumers are struggling to network their devices because of the complexity of today's solutions [1].

Clearly, if we are to realize many of the posited benefits of domestic computing we need to make networking usable for home users. We believe that this begins by asking two critical questions. First, we need to understand which devices people want to connect together and why. Second, we are also interested in determining how people cope with problems occurring as a result of trying to connect several devices together or to the Internet, one of the many challenges associated with computing in the home [8].

In this position paper, we review different techniques used for studying the home, describing what the purposes of the methods are and how they can apply to learning about home networking. We will then describe the study we plan to conduct to examine our two questions in greater detail. Our study builds on previous work examining the complexity of home networking [10]. We will outline our approach and conclude with remarks about approaches to gathering data about home networking.

PREVIOUS APPROACHES FOR STUDYING THE HOME

In the last few years, the home has become an increasingly important site for research investigation. Studies of the home fall, broadly speaking, into two categories: studies of computer usage in the home, and studies of the home to inform computer application design [10]. Studies of computer usage in the home have looked at a variety of questions, such as what internet activities dominate home life [3]. The other broad group of studies have explored the home as a location of human activity and interaction, and using results from these studies, have proposed a series of application insights [7].

Despite topical differences, one common feature many of these studies share is an emphasis on qualitative, sometimes ethnographic, data . The advantages of this method when used in settings like the workplace are that you observe activities in situ [2]. However, with the home often being seen as a private haven for its occupants, using ethnography is not straightforward. Consequently, we examined a variety of techniques and theoretical approaches that have been employed in previous studies of the home to see what they might offer for our own qualitative work.

In the rest of this section we describe four types of ethnographic methods and theory that have been applied to the home setting. Three groupings, as identified by Rodden and Benford [14] are ethnographic studies of routines in the home, longitudinal studies of the home, and design based approaches exploring culture in the home. We have added a fourth grouping that provides a particular methodological focus, the use of touring approaches. We describe examples of each of these studies below, highlighting how they apply to studying home networks.

Ethnographic Studies of Home Routines

Ethnographic studies of the home were among the first HCI studies to explore the role of technologies at home. For example, O'Brien *et al.* [13] conducted an ethnographic study of the deployment of a set-top box. In addition to uncovering problems for end-users related to the storage of media, they also explored the role of television viewing in the home and how that interacted with people's use of space in the home. Studies such as this, and others including Tolmie *et al.* [16] have identified the routines of home life, and the place of technology in shaping those patterns.

Another line of research sought to identify where to locate devices and technologies to augment home activities by identifying routines of communication. Crabtree *et al.* [7] present 3 concepts to help designers situate ubiquitous computing applications in the home and to ground design of technologies for the home; ecological habitats, activity centers and coordinate displays.

These 3 criteria describe the places where communications in the home are accomplished and highlight routines whereby communication is coordinated and action is undertaken as a result. Participants were asked to videotape places of communication and these places were mapped onto diagrams of the home. The study revealed interesting results about where people place artifacts to communicate.

Taylor and Swan [15] build upon the work of Crabtree *et al.* [7] by extending the ideas above into the concept of an organizing system. An organizing system organizes households and schedules but also shapes the social relations in families, By examining the material properties of informational artifacts and how assemblies of artifacts make up an organizing system, one can inform design for technologies for the home.

The results of these studies provide an important foundation for our own work. Specifically, they highlight the organizational aspects of family life, and the routines of communications. By being aware of the types of routines and interactions device integration might support, we can better understand the context in which home networking occurs and the motivations for why people might want to connect devices together.

Longitudinal Studies in the Home

Another set of studies used empirical methods to gather longitudinal data about the use of technologies in the home. Anderson *et al.* [3] describe a year long study that assessed various data capture techniques such as surveys, time use diaries and interviews. They also gave participants disposable cameras to take photographs of their products, household artifacts and household members. Use of multiple methods was critical because it allowed the researchers to cross check behaviors reported in the questionnaires with the time use diaries for instance.

More interestingly, from our perspective, the photographs that participants took provided a qualitative view into the participant's lives without requiring a researcher to be present.

Clearly, longitudinal data takes significant time to collect, which of course provides significant power. However, what makes these studies particularly interesting for our own research is the techniques that supplemented the main data recording techniques. The use of a variety of probes allowed the researchers to complement their statistical data with a host of rich examples of technologies in use. In the next two sections, we describe further types of methodological probes that have allowed researchers to explore the home in other studies.

Examining the Culture of the Home

The third branch of studies examines different cultures and ideas of home. Bell *et al.* [4] stress that in order to understand how users experience technologies, researchers need to uncover the social and cultural meaning of technology. In other words, one needs to know what a product means to a user and what it means in particular cultural contexts as well as its broad impacts on the social and global environments.

One method to sensitize home research to different cultures is to use cultural probes as proposed by Gaver *et al.* [9] which are designed to elicit information about the culture of a particular design environment. Cultural probes are packages of various items such as postcards, disposable cameras and other materials. The probes are not explicitly used to inform design but to understand the culture of the design space from the perspective of the people one is designing, revealing their needs and desires.

A similar method is described in Hutchinson *et al.* [11]. They extend the concept of the cultural probe to that of a technology probe. A technology probe involves installing a technology into a real use context and observing its use over time. This probe is used to involve families more in the design process, to refine design and inspire new ideas for technologies. Both types of probes will provide insight into how culture affects technology use in the home.

Finally, Bell *et al.* [5] describe how to defamiliarize oneself with the home in order to see it with fresh eyes and to reinterpret our views of everyday objects. Bell and her colleagues describe studies of American, British, and Asian homes from this viewpoint to highlight issues that arise when designing for the home.

Culture operates at a variety of levels. In some of these studies, culture has been examined as something that shapes different nations - however people's cultural identity can be shaped by many sources, not just where they live, but what cultural traditions have come to shape their daily existence. In terms of our own research, probes have an important role to play once we have come to understand more about the domain. Given their ability to

open up design directions, we think that they have utility for home networking, but first we see the need to explore the problems so that we can apply these probes more creatively in the future.

Touring the Home
A final methodological approach that has influenced our thinking is the idea of touring the home. A home tour has the interesting property of allowing the participants to determine what the researchers will see within the home, while preserving participants' privacy. Home tours have been used in a variety of home studies.

For example, Mateas *et al.* [12] visited about 10 households around dinner time and asked to be given a home tour to gather preliminary ideas about how technologies were used in the home. After the tour, they encouraged participants to discuss a typical day in their household using props to facilitate recall.

Blythe and Monk [6] used a technology biography which extends the methods used by Mateas and his colleagues. Aside from a home tour, they also asked last time questions about the last time something happened and the critical incident method; asking about one particular event of interest. Additionally, they collected a personal history from each participant, guided speculation on future developments and asked participants to nominate three ideas or wishes for products participants want to see.

Home tours have much utility for studies of home networking. Sufficiently complex networks are spread around the house, and as previous work has already shown are often less connected than visions of domestic networking might imply. The home tour allowed the researchers to access a variety of nodes, and questioning participants while in the presence of these technologies allowed them to inspect the devices for answers [10]. For studying how people use their home networks, using elements of the home tours described above also allows the researchers to learn more about the location of different devices in the home.

APPLYING THIS TO HOME NETWORKS AND HOME MEDIA DESIGN
We have only touched on a few of the approaches used in the past for data gathering in the home. For our upcoming study, we will build upon the work by Grinter *et al* [10]. Specifically, we will draw on the results and methods used in a variety of these previous works to explore a new area of research within the home, that of improving home networking. In the rest of this section, we describe our planned study (which we hope to have preliminary results from by the time of this workshop).

Home Networks – What are people doing, why are they doing it and how do they solve problems?
Workshops such as this one demonstrate a growing interest in solving the empirical challenges presented by current home networking solutions. Yet, currently little is empirically known about the sources of complexity as well as the integration desires of end-users. An early empirical investigation [10] highlighted some of the issues that home networks present including the difficulty with set up and maintenance, the mis-match between individuality and collectivity as embedded in the network versus those boundaries in the family, and administrative problems running the systems.

However, this study represents a first step to exploring this area in much greater depth and many questions remain. For example, we think that there is much more to learn about how people comprehend their home networks. We are exploring a range of techniques inspired by these previous studies that allow us to explore people's mental models of home networks. We will continue to leverage the sketch-based probe inspired by previous studies, and we seek to develop this further to capture a greater variety of information.

Previously we identified a tension between notions of collective action among families, and how those came into conflict with individuality embedded in devices. Again, we began to identify examples, but we strongly believe that others exist. Our continued work will search for these additional examples, through the use of our interview guide and home tour.

Finally, we also believe that troubleshooting is an area of much promise. We would like determine how the average user arrives at a solution to resolve network problems. By examining the paths followed to resolve an issue, we hope to form a picture of how people view their home networks components and their relationships. We seek to explore this further in future studies.

ALTERNATIVE DATA GATHERING APPROACHES
In addition to being focused on the collection of data from this study, we are also concerned to explore the development of methods to study the home and contribute to the growing literature about how to gather and analyze home data. Although not the primary thrust of our current work, we have begun to think about other methodological and theoretical approaches to understanding the home.

Methodologically speaking, another way to find out how people are connecting up devices is to instrument the devices or technologies to log usage statistics. This method would also allow researchers to check reported usage of devices with real usage. We could also use probes to get another perspective on the mental models people build up of their networks. For example, these probes could consist of disposable cameras, where participants would be tasked with taking pictures of things that frustrate them. These pictures might uncover problems with the network.

For conducting studies in the home, gaining the participants trust may be an issue that warrants further

discussion. For instance, when one instruments devices to collect statistics, it may be pertinent to show the participants sample data or allow them to inspect the data collected to be assured that no personally identifiable or incriminating data is being harvested. To some degree, trust may not be a barrier particularly when a participant has already agreed to have a researcher visit them in their home since this already requires a degree of trust. To hold that trust, it is up to the researcher to ensure that the participant in the home, their private sanctuary, never feels that inviting a researcher in means ceding control of her environment to this outsider.

In addition to methodology, it is important to open up the theoretical space of the home. Methods of collection and analysis are closely coupled with theoretical stances. Making these explicit, and discussing what these bring to studies of the home, as well as what they omit, is essential, not just for studies of home networking, but for domestic work generally. In our own work, we are considering a variety of theoretical lenses.

CONCLUSION

In order to make home networks usable, we need to understand how users view these networks, which devices they want to connect together and why. We also need to understand how users solve problems that occur with their home networks. In this paper, we have described several approaches for gathering data on the home and technology use. For our upcoming study, we feel aspects of these methods are useful and we have described how they have informed our own approach. In the workshop, we would like to discuss other ideas for gathering information on home networking. This will allow us to better inform the design of home networking devices, applications and services with the goal of making home networks usable for the average consumer. We will also share any preliminary results we have from this round of study.

REFERENCES

1. Accenture Digital Home Solutions: Issues, Trends and Consumer Insights. *Digital Home Survey Document*, *June*. 2005.
2. Anderson, B. *Work, ethnography, and system design*. Marcel Dekker, New York, 1997.
3. Anderson, B., McWilliam, A., Lacohee, H., Clucas, E. and Gershuny, J. Family Life in the Digital Home — Domestic Telecommunications at the End of the 20th Century. *BT Technology Journal*, *17* (1). 1999. 85 - 97.
4. Bell, G., Blythe, M., Gaver, B., Sengers, P. and Wright, P., Designing culturally situated technologies for the home. In *Proceedings of CHI '03 extended abstracts on Human factors in computing systems* (2003), ACM Press.
5. Bell, G., Blythe, M. and Sengers, P. Making by making strange: Defamiliarization and the design of
domestic technologies. *ACM Trans. Comput.-Hum. Interact*, *12* (2). 2005. 149-173.
6. Blythe, M. and Monk, A., Notes towards an ethnography of domestic technology In *Proceedings of Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques* (London, England 2002), ACM Press, 277-281
7. Crabtree, A., Rodden, T., Hemmings, T. and Benford, S., Finding a place for UbiComp in the home. In *Proceedings of In Proc. UbiComp 2003*, (2003), Springer, 208-226.
8. Edwards, W.K. and Grinter, R.E., At Home with Ubiquitous Computing: Seven Challenges In *Proceedings of Proceedings of the 3rd international conference on Ubiquitous Computing* (Atlanta, Georgia, USA, 2001), Springer-Verlag, 256-272
9. Gaver, B., Dunne, T. and Pacenti, E. Design: Cultural probes *Interactions 6*(1). 1999. 21-29.
10. Grinter, R.E., Edwards, W.K., Newman, M. and Ducheneaut, N., The Work to Make the Home Network Work. In *Proceedings of ECSCW*, (2005).
11. Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B.B., Druin, A., Plaisant, C., Beaudouin-Lafon, M., Conversy, S., Evans, H., Hansen, H., Roussel, N., Eiderback, N. and Technology probes: inspiring design for and with families. In *Proceedings of CHI '03: Proceedings of the SIGCHI conference on Human factors in computing systems*, (Ft. Lauderdale, Florida, USA, 2003), ACM Press.
12. Mateas, M., Salvador, T., Scholtz, J. and Sorensen, D., Engineering ethnography in the home In *Proceedings of Conference companion on Human factors in computing systems: common ground* (Vancouver, British Columbia, Canada 1996), ACM Press, 283-284
13. O'Brien, J., Rodden, T., Rouncefield, M. and Hughes, J. At Home with the Technology: An Ethnographic Study of a Set-Top-Box Trial. *ACM Transactions on Computer-Human Interaction*, *6* (3). 1999. 282-308.
14. Rodden, T. and Benford, S., The evolution of buildings and implications for the design of ubiquitous domestic environments In *Proceedings of Proceedings of the SIGCHI conference on Human factors in computing systems*, (Ft. Lauderdale, Florida, USA 2003), ACM Press, 9-16
15. Taylor, A.S. and Swan, L., Artful systems in the home In *Proceedings of Proceedings of the SIGCHI conference on Human factors in computing systems* (Portland, Oregon, USA 2005), ACM Press, 641-650
16. Tolmie, P., Pycock, J., Diggins, T., MacLean, A. and Karsenty, A., Unremarkable Computing. In *Proceedings of ACM Conference on Human Factors in Computing Systems (CHI 2002)*, (Minneapolis, MN, 2002), ACM Press, 399-406.