Usages of the Secondary Screen in an Interactive Television Environment: Control, Enrich, Share, and Transfer Television Content

Pablo Cesar,[1] Dick C.A. Bulterman[1,2], and A.J. Jansen[1]

[1] CWI: Centrum voor Wiskunde en Informatica Kruislaan 413
1098 SJ Amsterdam, The Netherlands
p.s.cesar@cwi.nl, dick.bulterman@cwi.nl, jack.jansen@cwi.nl
[2] VU University Amsterdam
De Boelelaan 1081a, 1081 HV Amsterdamm, The Netherlands
dca.bulterman@cs.vu.nl

Abstract. This paper investigates a number of techniques and services around a unifying concept: the secondary screen. Far too often television consumption is considered a passive activity. While there are specific genres and programs that immerse the viewer into the media experience, there are other times in which whilst watching television, people talk, scan the program guide, record another program or recommend a program by phone. This paper identifies four major usages of the secondary screen in an interactive digital television environment: control, enrich, share, and transfer television content. By control we refer to the decoupling of the television stream, optional enhanced content, and television controls. Moreover, the user can use the secondary screen to enrich or author media content by, for example, including personalized media overlays such as an audio commentary that can be shared with his peer group. Finally, the secondary screen can be used to bring along the television content. This paper reviews previous work on the secondary screen, identifies the key usages, and based on a working system provides the experiences of developing relevant scenarios as well as an initial evaluation of them.

1 Introduction

The television watching experience can be enriched by using other devices than the traditional television set and remote control. This paper focuses on the usages of the secondary screen. Figure 1 shows the ubiquitous computing sphere of two viewers at different homes. The sphere of each user is composed of a number of devices that can be used for rendering multimedia content or for interacting with such content. Worth mentioning is that the multimedia content can be split onto different devices, each one rendering part(s) of the presentation, while other device can be used for controlling such presentation. As we will see in this article, the sphere of a user is not isolated, but is linked to his social network, thus including a path to other people's spheres.

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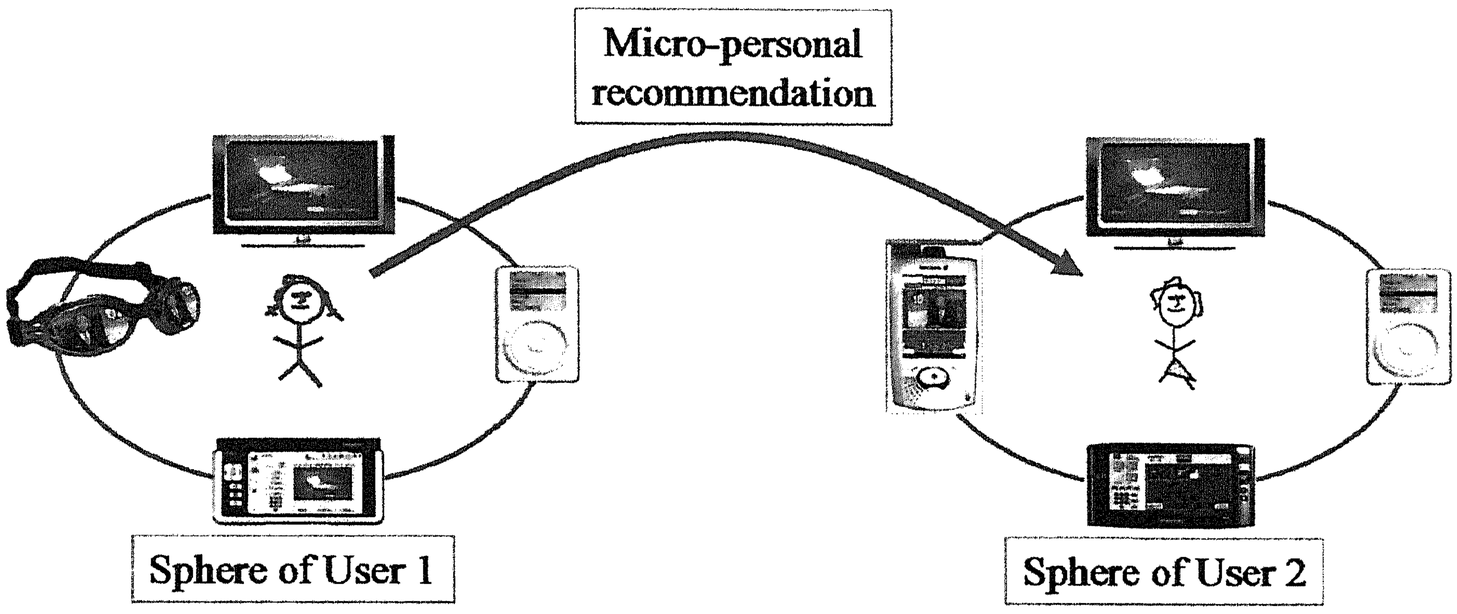


Fig. 1. Ubiquitous Computing Sphere at Two Homes

In this article, we consider the sphere of the user as a television set, connected to a personal video recorder or a set-top box, and his handheld device. The handheld device acts as a secondary screen providing both rendering and interaction capabilities. This article studies four basic scenarios: control, transfer, enrich, and share. We assume that the content reaches the home via various input paths. Once the content arrives we differentiate a number of end user behaviors:

- *Personal content selection/preview*: this is basic viewing functionality that allows a user to navigate through a set of content objects (and, where appropriate, within content objects) to find and activate particular content sequences of interest. The content may be gathered by explicit user scheduling activity (such as tagging a program in an electronic program guide), by indirect user scheduling (via a recommender system) or might be sent as a micro-personal recommendation message from a family member of a social network member.
- *Presentation continuity*: even though television watching normally takes place in the living room, it can happen that a user wants to continue watching the program in her personal device while moving to another room or outside the home. In this case, the current state of the content stream should be stored, the presentation should be streamed to her personal device, and the presentation should be restored there. This process should be as seamless and dynamic as possible.
- *Micro-personal recommendation generation and sharing*: the end user can generate direct recommendation messages. That is, he can explicitly fragment the video stream. This fragmentation is saved separately from the base content and may be used as the basis for a direct recommendation message, together with user-generated media overlays, that one user sends to another within his family or social network.

The rest of the article will elaborate on these representatives scenarios and will report on our experiences implementing them. Moreover, the results of a

business analysis and a user evaluation are provided. This paper is structured as follows. Section 2 reviews the related work, indicating previous research on the secondary screen. Section 3 introduces the architecture and the design goals. Section 4 presents the results in terms of implemented services, while Section 5 introduces the initial results as business analysis and user evaluation.

2 Related Work

We cannot claim that the idea of using a secondary screen in the television environment is new. Back in 1996 Roberston et al. [1] presented a system where handheld devices are used for interacting with the television. Nevertheless, as interactive television systems and handheld devices are becoming more popular a body of research is emerging around the usage of the secondary screen.

Two specific areas of research that can take advantage of the secondary screen are interactive learning and content selection. As presented by Fallahkhair et al. [2], non-desktop technologies fit learning activities. The authors use the secondary screen for a number of scenarios such as to provide help for difficult cultural or language items, to provide extra information about specific concepts, and to manage the personal learning sphere. Other active research field for the secondary screen is the electronic program guide (EPG) as exemplified in [3,4,5]. Park et al. [3] provide rough guidelines about the foreseen service, while Cruickshank et al. [4] present a detailed study on system design and implementation, together with a comprehensive user study. They report on a working system in which a PDA is used for displaying a personalized EPG. Moreover, the PDA provides functionality such as volume controls and channel navigation. On the other hand, Karanastasi et al. [5], provide a solution for a ubiquitous personal video recording interface in handheld devices. Their system is capable of recording, deleting, and summarizing recorded television content. Finally, other usages of the secondary screen includes advertisement and commerce [6] and user participation in television quiz games [7].

In terms of social communication, one can highlight the capability of the handheld device for personal, or multi-participant, phone calls. Moreover, the viewer can use his mobile phone for sending messages that will later appear as an overlay of the television content, as a broadcast chat [6], or to allow the end-user to become a participant in the show [8]. For example, the Finnish Broadcast company, YLE, aired a television series, which narrative could be affected by the viewers using their handheld devices [9]. All in all, as Jensen [10] highlighted, the mobile phone is currently the most popular return channel technique and it is used for a number of activities while watching television (e.g., voting).

Apart from enhanced information rendering, content control, and communication, the secondary screen can be used to bring along the content. The viewer is a mobile being, thus when leaving the place in which the television screen is located, he might want the media content to follow him. Previous work in this subject is mainly focused on the enabling technology [11,12,13].

The justification of our work is based on all the mentioned research plus several additional studies. Firstly, Bernhaupt [14] found that remote controls are often considered as unusable, moreover the results indicated that the rendering capabilities of the remote control could be exploited. Cruickshank et al. [4] concluded that 'a more sophisticated form of input and control needs to be introduced for iTV to reach is full potential'. And Seager et al. [15] write that users 'frequently use their laptop to surf the web, use email, or shop online whilst watching television' and 'there was a preference for accessing different services on different display panels rather than overloading one shared display channel'.

3 Architecture

Our research studies new paradigms for multimedia interaction with content that is available to social groups of users in a consumer electronics (that is: non-PC) setting. Our home architecture consists of a home media server which may be implemented in a set-top box, a home networking gateway or a separate server device that stores content that is provided via standard broadcast channels, via peer-to-peer content sharing networks or on high-density optical disks such as DVDs or BluRay HD content. We expect that this content will be fetched on the users behalf using an intelligent recommender system, and may be post-processed in the home to allow differentiated viewing based on the individual interests of family members.

A schematic diagram of the home environment is shown in Figure 2. For a more detailed description of the technological aspects of the architecture, the reader can refer to [16]. One distinguishing characteristic of this architecture is that multiple remote control devices are presented to home users. These personal remote control devices form the basis of a system that supports differentiated content delivery and differentiated personal recommendation delivery and generation. The devices range from a conventional remote control, through low-powered handheld devices like telephones and minimal pen-based devices such as the Nokia N770, up to full-featured (but reduced size) tablets such as the Samsung Q1. In the home environment the devices are connected using a wireless home network, while when transferring a session to a mobile phone, the mobile network is used to retrieve the media content.

The central content storage and management component within our architecture is a home media server. This server can ultimately be implemented in many different forms (as a PC Media Center, as a conventional set-top box, as a network controller hidden in a utility closet). Our concern was not to study the commercial models for home media storage, but to study a model in which multiple control clients could be managed in a home environment. For this reason, we made the pragmatic decision to use a small-size personal computer (in our case, a Mac-Mini) upon which our server infrastructure could be implemented.

Our server architecture has been designed to be aware of DRM issues in the home. All operations on actual media content are abstracted away from the actual media encoding into a higher-layer structure. A portion of this structure uses

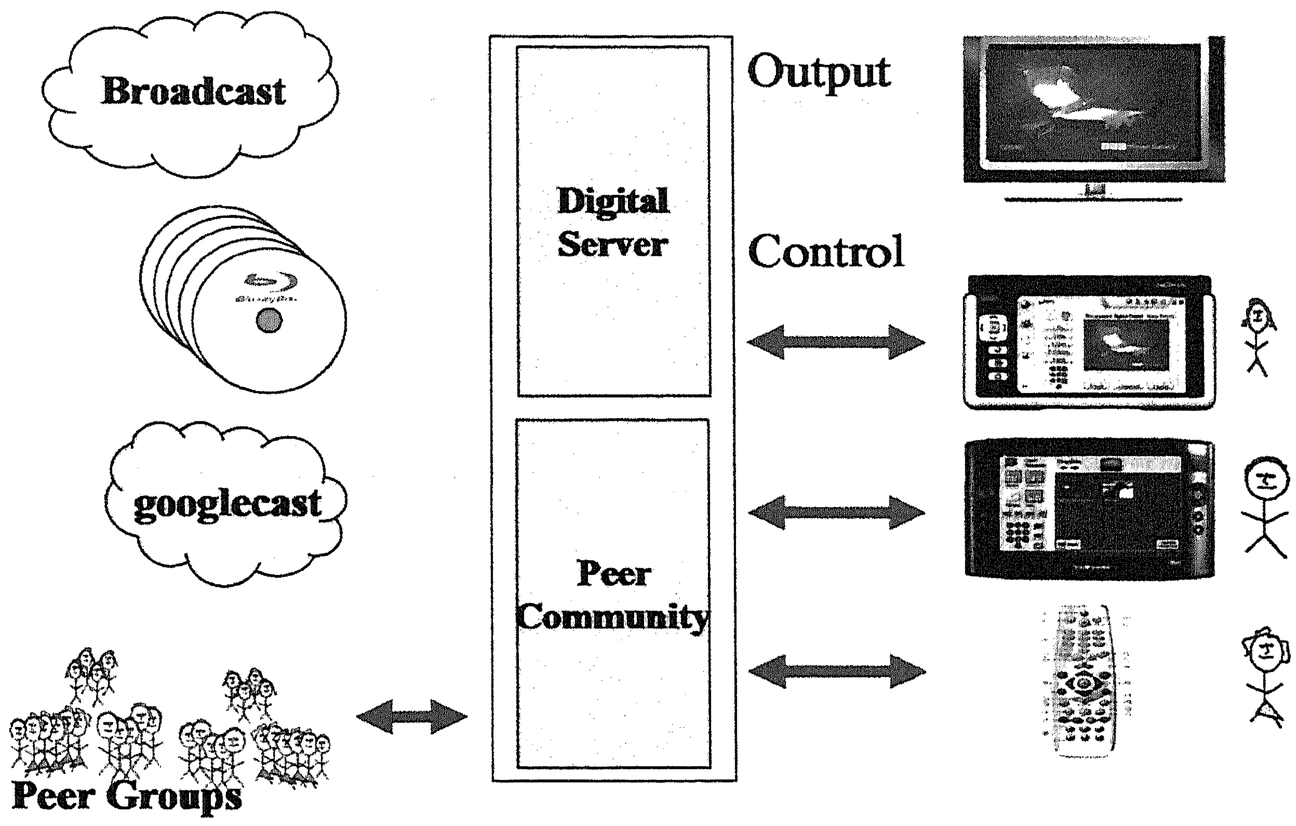


Fig. 2. Schematic Diagram of the Home Environment

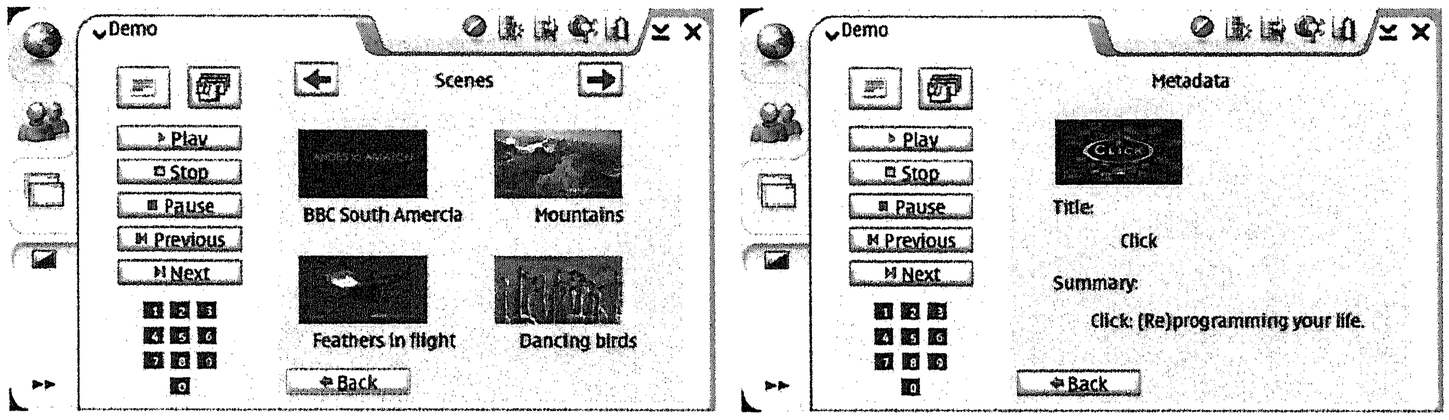
the TV-Anytime specification for program and package descriptions. The local user operations are implemented by dynamically generating SMIL presentations that describe the transient structure of content modifications and annotations within a program.

4 Control, Enrich, Share, and Transfer

This section introduces the first set of results in the form of implemented services. These services include control and transfer services, in which the secondary screen is used for rendering enhanced information of the television content and to control the content itself. Moreover, the concept of a 'presentation following the user' is shown. Finally, this section reports on a service for sharing fragments of television content, and possible personal media overlays, with other friends and family members. The contribution of this paper is not so much the implementation of each of the services that can be found in previous articles [16,17], as a study on innovative services for the secondary screen and as an initial evaluation.

4.1 Control and Transfer

The control service is capable of differentiating the shared/personal nature of the media content. For example, the video content is a shared resource that can be shown in a shared screen such as the television set. While the enhanced material is private information that might not be of interest for the rest of the viewers, thus it can be displayed in the private display, that is the secondary screen. In

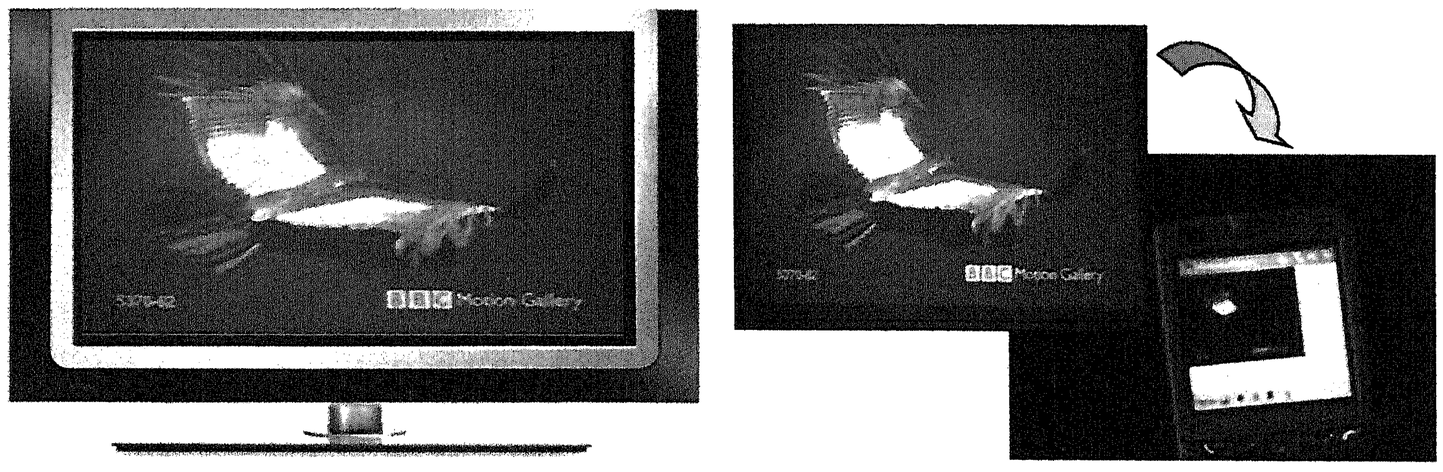


(a) Content Selection Interface (Nokia 770) (b) Extra Material Interface (Nokia 770)

Fig. 3. Screenshots of Non-Intrusive Interfaces (Nokia 770)

previous work we refer to it as *Non-monolithic rendering* [16]. Figure 3 shows two examples of such interfaces. The first one (left) is used to navigate, select and preview media within a television program, while the second one (right) is used to view enhanced information about the current active program, about stored content, or about the EPG.

In addition to using the extended remote control for selecting and previewing personal content, for showing enhanced information, and to control the television content, it can be used for presentation continuity. For example, when the user is moving out of the living room, but still wants to bring along the presentation shown in the television set. In this case a dynamic evaluation of the context of the user, in terms of available devices, takes place and the presentation can be transferred to the secondary screen. Figure 4 shows an screenshot of transferring a presentation from a television screen to a mobile device.



(a) Screenshot of the Television Content (b) Screenshot of the Content Transfer

Fig. 4. Presentation Continuity

4.2 Enrich and Share

The last few years have seen an increasing interest on sharing media material on the web, YouTube and MySpace being two clear examples. Nevertheless, in spite of their success, current systems contain a number of serious restrictions. First, the user is unable to share a bounded fragment of the video, which is what in most of the cases the user wants. Second, the user cannot customize the recommended video by including, for example, a voice commentary or strategically placed line art overlays. Our system allows users to share personalized fragments of television content. These enriched fragments can be sent as personal recommendations to friends within a users social network using a number of messaging technologies such as MMS, e-mail, and blog posting. Figure 5 shows the television media sharing interface. The actual fragmentation of the video and the inclusion of media overlays are done using the secondary screen. Detailed information about this asynchronous social television feature, named micro-personal recommendations, can be found in [17].

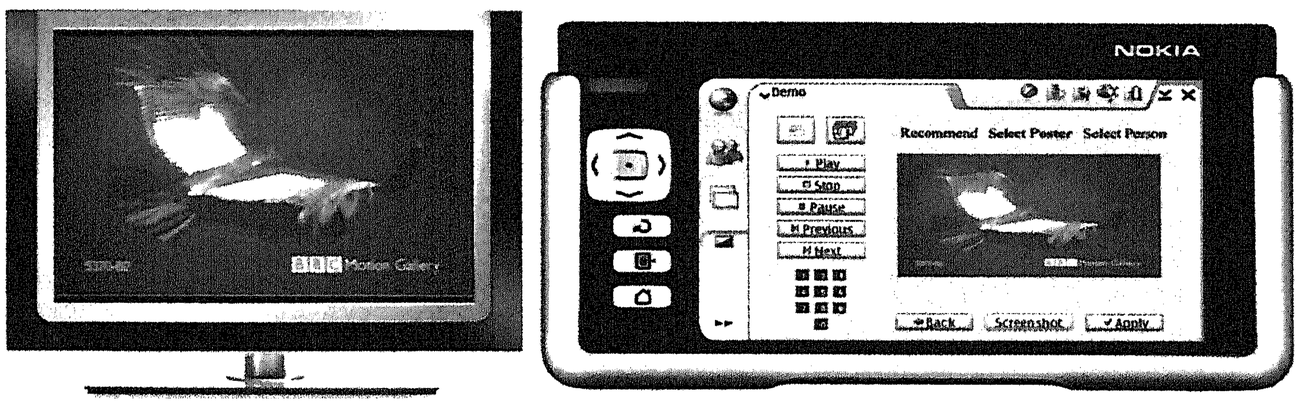


Fig. 5. Screenshot of TV Media Sharing Interface

5 Results

This section reports on the results of two independent tests of such services. It is important to notice, though, that the market analysis, technology development and user testing were performed by independent groups, across three countries. In addition to the results presented in this paper, other research in the topic suggests the benefits of the secondary screen in the interactive television environment [4,14,15].

5.1 Business Analysis

In order to analyze the business opportunities we were able to gather a panel of representatives from a European quadruple-offer player, a European equipment provider, an international advertising company, and a major international mobile video service provider. The goal of the focus group was not to jointly design a new interface, but to analyze the commercial prospects of a distributed home

control paradigm from a non-technical perspective. The panel was presented with a stylized presentation of the capabilities presented in this paper. The panel was told that the intention of the project was to define a value-added service that could be offered as an enhancement to a home PVR offering.

The participants were globally enthusiastic about the services presented in this article. The majority of them think that this sort of application should be deployed as soon as possible because some of its main features would be covered by major market players within a 24 month period. Nevertheless, the application should be deployed progressively.

It was felt that the micro-personal recommendations should not be restricted to a family or neighborhood circle, but should focus on networked communities. Users should have a choice about being included in a local or global community of recommenders. All participants agreed that a distributed control application should be offered to the end user by a service operator as a part of a larger package. Its functionalities would not only benefit the end user, but also help to expand the base of the operator and to position the operator as a value-added supplier. Finally, one business case highlighted by the panel was the possibility to use the secondary screen for displaying targeted and personalized advertisements.

5.2 User Testing

We modeled a representative user community of up to three people watching television together. The viewing environment consisted of three handheld control devices, a small library of content, a high-definition television set, and the prototype server. Even though it was clear that the system was still in prototype status, the obtained results about its functionality are relevant. Each of the participants, sometimes three of them at the same time, were given a handheld control device, which was a personal device they could carry around as a mobile phone. The goal was to get feedback on the services, so we encourage them to explore the different capabilities, to play around, and to complete a number of predefined tasks (e.g., to share a fragment of a video with some friends).

Due to space restrictions, this paper only includes a summary of the obtained results. Nevertheless, the interested reader can refer to [18], in which detailed information on how the tests were conducted and analyzed, together with comprehensive set of results can be obtained. As a summary, we can highlight that the users were attracted by the possibility of having a personal display that allowed for browsing, personalizing, and enriching content. On the other hand, while sharing content with other people outside home was seen as a value-added service, the end-users did not find appealing to share the content within the home. We can conclude that in order of relevance, the secondary display for previewing and viewing content as well as for accessing enrich information was the most valued usage. Secondly was the possibility of sharing fragments of television content. Finally, most users liked the idea of enriching the micro-personal recommendations with personal overlays.

6 Conclusions

This paper focused on the usages of the secondary screen in an interactive digital television environment. Based on previous studies we have justified that hand-held devices will be used in the living room, in conjunction with other consumer electronics appliances, for consuming and manipulating television content. This article proposes four main usages: to control, to enrich, to share, and to transfer television content. One of the differentiating factors of the results proposed in this paper from previous work in the field is that it is not restricted to any specific service (e.g., T-learning or the EPG), but it is a general architecture that can be applied to a variety of end-user situations. Nevertheless, an important topic that should be investigated in the future is which genres or programs types can better be benefited from the secondary screen.

The contributions of the work presented in this article go beyond the description of an architecture or implemented scenarios. We placed this work in a spectrum of activities that included an initial market assessment by professionals in the areas of media creation and distribution, and we subjected our prototype implementation to test by a dozen groups of users in a social setting. So far, the results are encouraging, even though more implementation work is needed and testing work remains to be done.

Acknowledgments

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