© 2011 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.

Presence-Aware Personalized Television

Patricia Arias, Rosa Sánchez, Florina Almenares, Daniel Diaz-Sanchez, Telematics Engineering
Department, University Carlos III of Madrid, Leganés, Madrid (Spain)

Abstract—Since the advent of the digital era, the traditional TV scenario has rapidly evolved towards an ecosystem comprised of a myriad of services, applications, channels, and contents. As a direct consequence, the amount of available information and configuration options targeted at today's end consumers have become unmanageable. Thus, personalization and usability emerge as indispensable elements to improve our content-overloaded digital homes. With these requirements in mind, we present a way to combine content adaptation paradigms together with presence detection in order to allow a seamless and personalized entertainment experience when watching TV.

I. INTRODUCTION

Convergence both in the consumer electronic devices capable of displaying TV and in the different ways for content diffusion have led to a new revolution in the television market. In fact, the combination of traditional broadcast TV services and video delivered over either managed IP networks or the public internet is an increasing trend. Emerging standards such as HbbTV [1] promote the utilization of hybrid set-top boxes for the reception of broadcast and broadband digital TV and multimedia applications with a single user interface. Nowadays, consumers are enabled to access a wide range of advanced interactive services via a television set, such as Video on Demand (VoD) and catch-up TV, as well as internet applications, including video telephony, gaming or shopping. This immense range of options can both improve and hinder the TV entertainment experience. Thus, personalization and usability emerge as key features to prevent viewers from feeling overwhelmed by complex management tasks and allow them to get the best from their TVs.

With the aim to enhance the viewing experience taking these premises as a foundation, we introduce a presence-aware personalized system. *Presence-aware* means knowing which users are present at each moment, and the *personalized* term indicates the ability to show the best possible content depending on the current viewer(s).

Related works in the field usually focus on content-filtering based on recommendation techniques and semantic rules [2] for personalization. However, the combination with presence detection is an innovative aspect. We envision a TV that is smart enough to determine what a user (or group of users) wants to watch and, therefore, detection and identification of persons are basic conditions. Thus, user devices (e.g. mobile phone) can interact with the TV in a seamless way to communicate user presence, which is a pivotal concept as

envisaged by Weiser in his definition of ubiquitous computing [3]. With the aforementioned goals in mind, we propose *FamTV*: a prototype architecture with family-oriented applications aimed at enhancing the TV viewing experience. To show the benefits of our ideas we list some potential use-cases that could be built upon the *FamTV* framework: *Personalized content*: All the content (channels, widgets, etc) is automatically displayed according to the preferences and habits of the person who is currently in the room.

Prediction-based services: If the viewer is not present at the starting hour of her favorite TV show, the program is recorded by the application. Then, upon detection of the user arrival, the program is automatically reproduced from the beginning in a transparent manner.

Profile-roaming: A user can move her profile between different TVs in order to maintain a smooth personal experience even when changing her usual location.

Privacy-enabled configuration: The viewer is watching TV and her personal widgets, such as social network comments, are configured to also appear in the screen. When another user comes into the room, his presence is detected and the elements considered private are automatically hidden.

The rest of this paper is structured as follows: In Section II we give a global overview of the proposed architecture. Then, Section III goes into the details of each individual component. Finally, Section IV ends with an explanation of our work in the implementation and the main conclusions and future lines.

II. ARCHITECTURE FOR PRESENCE AWARE TV

The architecture of *FamTV* is comprised of a series of interconnected software blocks that distribute all the functionality in a modular fashion. In Fig.1, we represent all the involved components in a layered model. At the top of the architecture, which is the part closer to the user, we have the user application interfaces. On the one hand, the *Presence Manager Service* provides endpoints to detect which users are in the room. Currently, we have only implemented a Bluetooth service since this technology is widely deployed and present in almost every mobile phone today. However, other different wireless-based detection techniques could be inserted (i.e. Radio Frequency Identification, RFID). On the other hand, the *Personal Content Adapter* offers a user-friendly web interface for configuration. As far as configuration concerns, the main tasks include adding family members, registering devices for detection and adjusting user preferences and security policies with the aim to provide a completely customizable TV experience. These tasks can be accessed on TV by means of the native browser, or they can be updated via the Internet.

All the logic functionalities required by the applications in

This work has been partially supported by the Community of Madrid (CAM), Spain under the contract number S2009/TIC-1650.

the upper layer are performed by the modules in the *Logic Layer*. Such operations include profile creation and maintenance, user device and user identity mapping, managing of privacy and security features, etc. To dive deeply into the details of these modules, we provide an individual explanation of each one in Section III.

Finally, the *Data Layer* accommodates the information required for the applications to operate, that is: user credentials (e.g.: username/passwords), security policies and user/group profiles and history logs. Our approach manages all these data locally so it is impossible for providers to track the user behavior, thus improving privacy.

Fig. 1. Architecture for presence-aware personalized TV

III. LOGIC SOFTWARE MODULES

The core of *FamTV* is build up of the following components:

A. Presence Detector

The *Presence Detector* (PD) is consisted of Bluetooth server and client applications for the set-top box (STB) and the mobile terminal respectively. Note that the first time that a user uses *FamTV*, he has to introduce his PIN in order to do the device pairing.

The PD is in charge of storing Bluetooth or RFID MAC addresses of present devices at every moment. In addition, the PD is connected to the *Profile Handler* (PH) to perform profile management. Therefore, detection is automatic and if the number of family members varies, the PD notifies this event to the PH which readapts the content dynamically.

B. Profile Handler

The *Profile Handler* (PH) builds an Association Table (AT), so that each MAC address is assigned a user identifier (User ID). When the PH receives a notification from the PD, it looks up in the AT and returns the user's profile. Moreover, our proposal also considers the case of detecting the presence of multiple users. So, we have introduced a matching algorithm which asks the SM for the detected users' security policies. Thus, the PH is able to filter the multitude of available channels and if a father and his child are in the same room, the PH would opt for the most conservative policy.

Note that, the PH adapts live streams to DVB-HTML [4]. On the other hand, in order to adapt in a future the contents of *FamTV* to preferences and habits of family members, the *Profile Handler* maintains a history of the individual and group behavior. Finally, XML is used to store user profiles and history logging.

C. Security Manager

The *Security Manager* (SM) module is in charge of dealing with security and privacy features. It interacts with the PH in order to determine the most appropriate security configuration for the current user or group of users. This block has three fundamental functions, namely:

1) *policy enforcement*: security policies are created and managed by this module to ensure that an adequate security context is active. For instance, *parental control* rules might be established to prevent children from watching inappropriate contents when their parents are away.

2) *credential management*: user credentials are stored by this module to provide additional functionality in the application. For example, when a specific user is watching TV, her personal widgets could be automatically presented without asking for authentication since the SM performs this task on behalf of the viewer.

3) *session management*: in order to create and maintain a valid security context at each moment, the SM also manages sessions that can dynamically change and readapt depending on the present users.

IV. IMPLEMENTATION AND CONCLUSIONS

Personal Content Adapter has been developed using Java and deployed in a Tomcat Server. We have also tested the Bluetooth connectivity function in the PD, as well as the interaction of this module with the PH. Furthermore, an adaptation service is being developed to offer personalized *Electronic Program Guides* (EPGs) based on XMLTV [5] feeds that vary according to which users are detected.

Our presence-aware personalized system combines the benefits of content-filtering and presence-aware technologies for personalization. With the introduction of the *Presence Manager Service* and the *Personal Content Adapter*, we have designed a user-centric scenario to allow the set-top box to know who is watching TV. As future work, we want to enhance the presence detection module by adding other mechanisms apart from Bluetooth, and also test several prediction algorithms to construct more intelligent services.

REFERENCES

- [1] HbbTV, "HbbTV Overview," EBU/ETSI Hybrid Broadcast Broadband Wksp., Amsterdam, 2009.
- [2] S. Alam, et al., "Semantic Personalization Framework for Connected Set-Top Box Environment". IEEE *CENTRIC '09*, 2009.
- [3] M. Weiser, *The Computer for the 21st Century*. Scientific American, September 1991.
- [4] P. Perrot. DVB-HTML - An Optional Declarative Language within MHP 1.1, *EBU Technical Review*. 2001.
- [5] The XML TV Project, <http://wiki.xmltv.org/>