BACK CHANNEL IN INTERACTIVE DIGITAL TELEVISION SYSTEMS: STRATEGIES FOR PROTOTYPING APPLICATIONS USING AN INTERACTIVE SERVICE PROVIDER

Internet Computing - Interactive and Multimedia Web Applications

João Benedito dos Santos Junior, João Carlos de Moraes Morselli Junior
Iran Calixto Abrão, Fabiano Costa Teixeira, Gabriel Massote Prado, Paulo Muniz de Ávila
Mateus dos Santos and Rinaldi Fonseca do Nascimento
Pontifical Catholic University of Minas Gerais – PUC Minas, Poços de Caldas – MG, Brazil
TVDILab – Interactive Digital Television Laboratory

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Abstract: This work, developed at the Interactive Digital Television Lab of the PUC Minas (Brazil), aims to present strategies for implementation of a prototype of a sufficient platform for building of Interactive Service Provider (ISP), which can store, analyze and generate reports based on information derived from the interaction of viewers with applications in Digital Interactive Television, characterized by the use of a back channel via Internet Protocol (IP). In case of brazilian scenario (Brazilian Digital Television System), the development of a ISP platform is based-on the experience accumulated with the development of the platform JiTV (Java Interactive Television), which includes the production in broadcaster enterprise, transmition over communication network and receiving on access terminal of the viewer, increasing for the use of back channel to interactivity actions.

1 INTRODUCTION

One of the main innovations that are expected with the advent of the Digital Interactive Television (ITV), especially in the context of Brazil, is the possibility of providing a wide range of new services and applications (e-commerce, distance education and the electronic government) with possibility of interaction of the viewer, offering forms of interactivity unknown in the analogical television system (DVB, 2003). However, as a relatively new technology, with few patterns and research in progress, the building of applications, services and systems for ITV still is a challenge, especially for those who have their business or personal interests associated to the television system, but do not dominate technologies and computational tools. In this sense, it is actually a complex and new universe for activities such as planning and development, especially in terms of strategies to be adopted for the interaction of the viewer.

In this context, this paper presents and discusses the aspects of implementation of the JiTV platform (*Java Interactive Television*), which is under development since 2002, in the context of research in the laboratory of the Interactive Digital Television at PUC Minas (Santos Junior et al, 2007a). The JiTV platform, through its components and modules of software, covers the various stages in the lifecycle of a interactive digital television program (pTVDi), which starts with the production and distribution of the data carousel (streams of audio, video and data), followed by formatting of audio-visual content and controls of interaction for presentation on the access terminal of the digital television system (Souza Filho et al, 2007; Soares et al, 2007); this lifecycle is finished with the viewer interaction, both at the local level in the access terminal access and with the use of a back channel.

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2 ISDTV-T

The project of the Brazilian Digital Television System (SBTVD) has been started in 2003, through CPqD actions (agency for managing of the research) and FINEP (agency for funding of the research), that decided to offer the national science, through their universities and research centers, the opportunity to present solutions of hardware and software to support the building of a new digital television system. In mid-2005, the activities of research was halted by government decision.

The ISDB (Integrated System for Digital Broadcasting) has been chosen as basic technology for broadcasting in Brazil. However, in the view of the needs and specific conditions for the deployment of digital television in Brazil and is also looking at the good results obtained from the brazilian research projects, a hybrid solution was proposed and accepted by the brazilian government. This solution includes aspects of transmission and reception with ISDB technology and software levels/interactivity (middleware) developed in Brazil (ISDTV, 2006). This pooling of efforts, resulting in the ISDTV-T (International Standard for Digital Television Terrestrial) – the official name of the Brazilian System for Digital Television.

2.1 Middleware

As mentioned, unlike in other contexts (United States, Europe and Japan), where digital television systems have been developed and are in use (DVB, 2003), the conditions for deployment and use of the system of digital television in Brazil have very specific characteristics, such as the case of the need for digital/social inclusion of the brazilian population.

The features of the software that provides the display of audio-visual content and control of the viewer actions (interactivity) must be related to the specific system. The layers of middleware must provide resources for hardware and software components (viewer's access terminal) operate together transparent way to the viewer, providing robust interfaces and simplified use.

In the context of the ISDTV-T, the results of the brazilian research projects led to the specification of middleware named Ginga, result of synergy of researches made with the environments FlexTV (Souza Filho et al, 2007) - giving rise to the Ginga-J - and Maestro (Soares et al, 2007) - giving rise to the Ginga-NCL.

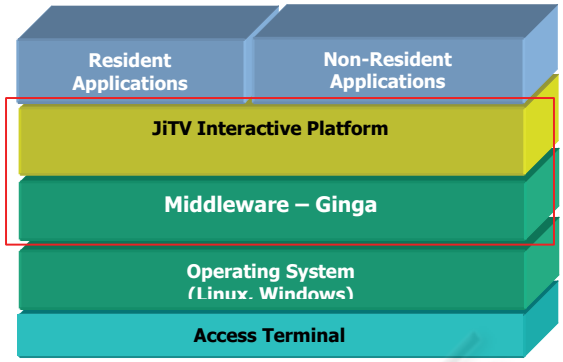

Figure 1: Architecture of the JiTV Platform.

In design of the JiTV platform, development aspects of the both FlexTV and Maestro environments have been considered. In further, after defining the requirements of middleware Ginga for ISDTV, aspects of implementation have been considered in the development of the JiTV platform, allowing the prototyping of scenarios based on Ginga (ISDTV, 2006), as illustrated in Figure 1.

3 TELEVISION PROGRAMS

The current stage of the development of interactive television applications, in world-wide level, is focused on the increasing of some aspects of interaction to the traditional television programs (*enhanced television*) (ATSC, 2001; ISDB, 2001; DVB, 2002). However, this work proposes a new model of interactive television program that considers new interaction criteria as a part of the program, instead of to add new interaction criteria to the program (*enhanced television*).

This kind of architecture is common to the video-on-demand applications; however, new interaction criteria are not fundamentally important (*personalization* is important).

3.1 Building Interactive Programs

In this proposal, the interactive program is the central element of an interactive television system. The interactive program can be defined as the set of all the medias (and its descriptions), scenes (and its descriptions), a summary (or synopsis) and its programming, as showed in the Figure 2.

Initially, the use of profiles allows better adaptation of interactive programs to the viewer.

In this kind of environment, software agents can provide contextual information to the STB (Set-Top Box), enhancing the capabilities of the profile. Thus, the STB can use this information (contextual data), for the automatic adaptation of the interactive program to the viewer interests (*profile*).

4 THE JITV PLATFORM

The current approach to the development of interactive applications in worldwide provides, in most cases, the addition of some controls of interactivity, such as menus and buttons, to the audio-visual content of the traditional TV. Practices included in this context have led to applications such as Enhanced Television, for example. However, with a similar technological framework it is possible to develop applications and services with other levels of interactivity and high level of adaptation to classes of users/viewers of a digital television system, such as the ISDTV-T, which has particularities and specific characteristics in relation to other international systems (DVB, ATSC, ISDB) . In this context, one aspect is desirable to subsidize the developer of pTVDi: the possibility to offer the same interactive program to viewers with different interests (profiles) (Santos Junior et al, 2007b).

4.1 The Interactive Program

In designing the platform JiTV, the program (pTVDi) is the central element of an interactive application, being composed by the set of all elements of media (audio, video and images), a summary (or synopsis) containing the content television descriptors, bytecodes and information elements, as showed in the Figure 2.

For the implementation level, the pTVDi is structured with the use of XML schema, as encapsulated in two other macro-structures (Santos Junior et al, 2008a): a) issuing b) programming. Additionally, external structures also affect the definition of pTVDi: a) genera catalog of the program; b) catalog of languages; c) special services (close caption and translation to LIBRAS – Brazilian Sign Language, by example). Some details of these structures can be seen at recent work published about the JiTV platform (Santos Junior et al, 2008b).

From the media elements, the bytecodes and of the information available on the synopsis, it is possible format the multimedia content for the different viewers, allowing different levels of interactivity, which is compatible with traditional

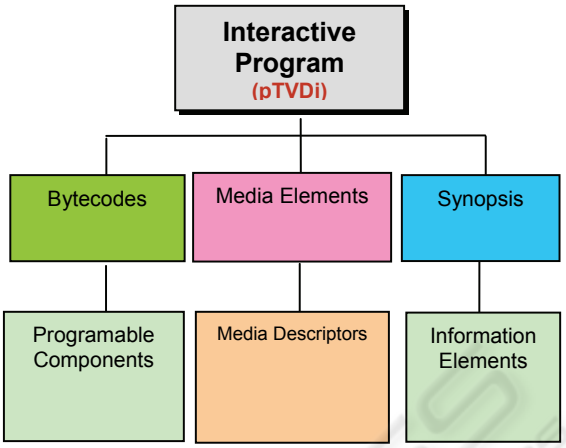

Figure 2: pTVDi Components.

proposals related to the Multimedia Home Platform, as far as presentation of multimedia content (DVB, 2003).

4.2 JiTV Platform

In a Digital Television System, there is a basic premise: television should not be confused with TV (televisor). This premise is very relevant in the context of integration of the media, where communication networks - cabled and wireless – terrestrial and satellite, are in full motion of convergence.

These aspects of convergence allow new modern arrangements of communication for supporting Digital Television systems, as is the case IPTV (Internet Protocol Television), which is, briefly, the possibility of distribution of television content, and the resulting interaction with this content, through communication networks typically organized over the IP protocol. Furthermore, from the point of view of the traditional broadcasting businesses, the Digital Television System must be organized using, exclusively, a radio-broadcasting on air (terrestrial and satellite), being explored, also exclusively, by companies that hold concession for transmission of television signals.

4.3 Systemic Vision

A draft of a platform for prototyping of television programs should contain tools that support testing both in the broadcasting environment as an IPTV environment. In general lines, the tools of the platform should allow sufficient shares of authors to build a pTVDi structure and its distribution to viewers. Moreover, in terms of the receiver, tools

should be available to format the content according to the access terminal of the viewer (TV, PDA, personal computer, mobile phones, among others) and present it in that terminal, allowing the actions of interactivity previously set in the construction of pTVDi.

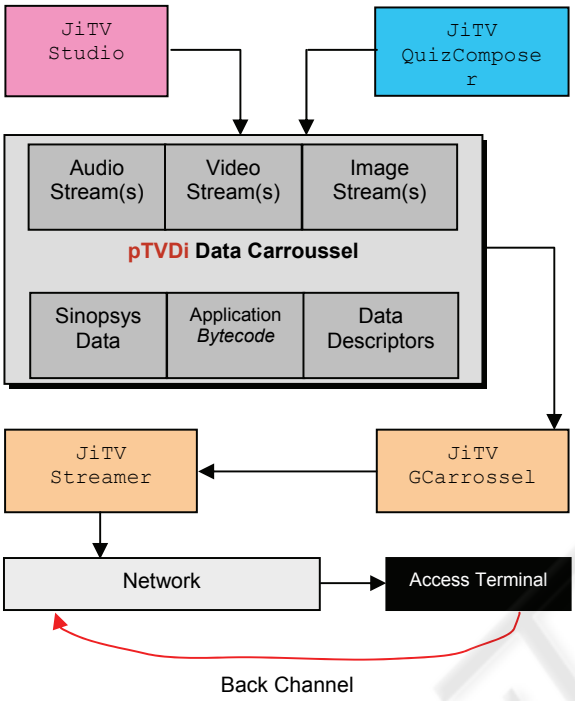

Figure 3: Architecture of the JiTV Platform (production, distribution, interaction and back channel).

Figure 3 presents the architecture of the JiTV platform, with focus on the production side and transmission of pTVDI; a similar architecture exists on the reception side and interactivity, and is not reported here for reasons of space (Santos Junior et al, 2008a).

4.4 Tools and Features

As presented, the JiTV platform consists on a set of tools to cover the complete lifecycle of a pTVDi. This lifecycle has its beginning in stages of construction and formatting of pTVDi, followed by stage of distribution via the communication infrastructure (by radio-broadcasting or via IP). Figure 3 presents a summary of the JiTV from the viewpoint of a pTVDi author/producer. As a final step, the data carousel can be transmitted via the communication infrastructure; for this, the JiTVStreamer tool manages the tasks of distribution, as also illustrated in the Figure 3.

The main features of the JiTV Tools can be viewed as: a) general software platform for fast application development and integration; b) pre-integrated with leading middleware applications, conditional access systems and video servers; c) open standard interfaces for browser or native application level development; d) separates software and hardware for increased product lifetime; e) a true multi-application for the both IP and STB infra-structure; f) modular architecture designed for reliability in operation; g) conditions to scalability in number of hardware and software models.

As described in section 3.4, the JiTV Platform can be applied to full lifecycle of a pTVDi. For this scenario, the platform is composed by: a) JiTV Application Development Kit (JADK); b) JiTV Application Suite (JAS).

Figure 4: Interface of the JiTVPlayer showing support for multi-programming.

In JADK, it is found Support for Java fonts (Sun, 2006), communication support for remote control using serial and USB ports and bluetooth connections. Besides that, to manipulate the media objects, the JADK has the follow resources: a) data carousel builder (Audio, Video and Data); b) suite for choosing interactive program mode (mono and multi-programming); c) metadata for interactive program structure using XML Schema; d) support for streaming in several distribution modes (unicast TV clients, multicast TV clients, broadcast TV clients). For testing the JiTV features and resources, are being built two demo applications: 1) the BlueTV Mono-Programming; 2) the BlueTV Multi-Programming.

In the JiTV Application Suite (JAS), the main tools are organized into two modes: a) JiTV Set-Box Mode; b) JiTV MobileTV Mode. Figure 4 shows the interface of the multimedia player based on multiple channels of programming. In an even viewport display, it is possible to control the presentation of a

channel of audio and recorded video, a channel of live audio and video, a audio channel, a connection with a web browser, as well as areas for viewing, interaction objects and widgets (menus, quiz, captions, among others).

In Figure 4, there is an interface element for flagging (upper right of the viewport) which enables the viewer to select the desired programming among the four options (multi-programming) available on the system

5 INTERACTIVE SERVICE PROVIDER

The back channel is one of the most important parts of a TVDI system due the fact it is involved with the revolution of the system as whole. When there is any viewer's interaction, there is need sending these information (access level, votes, terminal data, among others) to the broadcaster's studio, by a return channel, which is a direct link to data delivery. Another important factor is that between the broadcaster and viewer there is another module called Interactive Service Provider (ISP).

In a typical TVDI system, the treatment of viewer's interaction can be classified in two ways: a) the Pseudo-Interactive System (Figure 5a); b) Full-Interactive System (Figure 5b). In the pseudo-interactive system, the treatment of interactivity is processed into access terminal of the viewer and there is not return of information to the ISP; in this case, the presence of a back channel is not mandatory and all applications must be of the kind resident.

Figure 5a: Architecture for Pseudo-Interactive System.

As shown in the Figures 5a and 5b, the interactive programs are produced by the broadcaster station and transmitted via broadcasting network until to reach the viewer STB. In this point, for the case of pseudo-interactivity system, the viewer can interact with applications, but no return of information for the broadcaster. In other hand, in a full-interactivity system, information generated by viewer's interaction can return to broadcaster, using the infrastructure of the ISP.

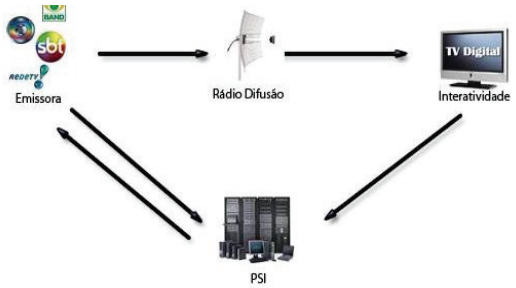

Figure 5b: Architecture for Full-Interactive System.

In this research, the JiTVPSI Studio was developed for supporting all operations between the follow entities (Figure 5b): 1) broadcaster to viewer; 2) viewer to ISP and ISP to viewer; 3) broadcaster to ISP; 4) ISP to broadcaster. For supporting viewer's operations, the JiTVPSI Studio provides functionalities for data receiving, information storing, information sending to ISP. For supporting broadcaster's operations, JiTVPSI Studio offers functionalities as to select data filters on the volume of data which is received from the viewer's interaction. For validating of the JiTVPSI Studio under the ISDTV-T test suite, two applications for full-interactive system have been developed. The first one, called JiTVDengue, has been developed for health purposes; the another application, called JiTVElection, has been developed for government interests.

The JiTVDengue has been developed in order to investigate the possibilities of the occurrence of dengue (a typical disease which occurs in tropical countries, like is the case of Brazil) into a residence, allowing to the viewer to interact with the interactive application in order to answer four questions concerning the possible cause of dengue. Soon after the interaction of the viewer, the data are stored in the STB as a XML structure and sent to the JiTVPSI Studio, which store these data for use in government actions. In this context, the JiTVPSI Studio offers a set of tools for filtering data before sending reports to the government entities.

Another interactive application - JiTVElection - has been developed to simulate an majory election in a city, state or country, allowing to the viewer to interact with the interactive program in order to select in which candidate he wants to vote. After the interaction and confirmation of the vote, the data for related to the candidate are saved in an XML file and sent to the JiTVPSI Studio, which store these information for government interests.

In the broadcaster entity, the JiTVPSI Studio has as main function to receive data from filtering

proccess performed in ISP, containing information stored about the viewer's interactivity. This module completes the lifecycle of interactivity, which has its cycle described in the creation of interactive programs, interaction of the viewer, suite of software for storing in the ISP.

6 FINAL REMARKS

This work presented aspects of the design and implementation of strategies for prototyping applications for interactive digital television system using an Interactive Service Provider as infrastructure for back channel. In this scenario, the JiTV Platform is used for supporting the complete lifecycle of interactive television digital programs. As described in the Section 5, are being built two real applications to demonstrate JiTVPSI Studio applicability: 1) JiTVDengue (for health purposes); 2) JiTVElection (for government interests). In the both cases, the JiTV Tools (JAKD and JAS) have been used by TV producers and viewers. The first results indicate the versatility of the JiTV Platform for interactivity operations in the both Broadcasting and IPTV infra-structures, specially in terms of the needed infrastructure for supporting back channel (main focus of this work). Furthermore, a new business partner (SofTV Enterprise - www.softv.com.br) has interest on use of JiTV Tools (JiTV MobileTV Mode) for educational purposes and applications; for this case, a new application scenario is under definition and it should be developed /tested on the next months.

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