A framework for community-oriented interactive digital television

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This paper presents the SAMBA Framework for community-oriented idtv. The main objective of this framework is to provide local communities and citizens – including low income population – to access community-oriented content and services by means of idtv channels. In order to achieve this, SAMBA implemented several steps such as: 1) development of a Content Management System for creating interactive applications that are cross-compatible between DVB-T MHP and DVB-H, 2) considering usability issues related to technology adoption by non expert users and 3) addressing low cost requirements for meeting the needs of low-income users and communities with use of power line communications for providing interactivity to remote rural areas.

1. Introduction

In the latest years, media generation and its consumption patterns by users has been going through a major transformation. The increasing participation of users in the development of content for the web and their active involvement in online communities of interest has redefined their role of mere consumers of media to become "prosumers" [1]. This trend that started as a phenomenon in web domain is migrating to other spheres such as the mobile web [2] and more recently to other platforms such as the interactive digital television *(idtv)*. In particular in this latest platform, the involvement of users has recently shown to be present across all the production-consumption lifecycle in a similar way as happened some years ago within the web domain [3] including the emergence of virtual idtv communities dedicated to social networking [4-7].

In particular, the community-level dimension of idtv has a significant peculiarity when compared to traditional online web communities. Since idtv coverage is limited to well defined geographic areas, the communities built around idtv are intrinsically connected to particular territories and can be naturally associated to specific local services. Moreover, for territories affected with low accessibility to the Internet such as rural areas in developing countries, idtv can be presented as a potential good candidate for providing interactive services covering the local community needs at different levels such as entertainment, education and social inclusion, among others.

The access to idtv infrastructure alone cannot tackle the digital divide in marginalized areas unless it is accompanied by equipping users with the necessary skills to utilize its potential for creating and consuming inclusive services. In this paper, we present an idtv framework developed by a European Project *(SAMBA – System for Advanced interactive digital television and Mobile services in BrAzil)* for providing rural communities in Brazil with the capabilities and means to develop sustainable interactive, community-oriented services [8]. In particular, the SAMBA framework enables local communities to produce idtv content and broadcast it through community access idtv channels. In this way, citizens, including low income population, are empowered with a way to participate in the process of creating and accessing digital content and in the services derived from it [9].

The platform being developed by SAMBA allows the development of innovative interactive applications focused on social local communities including services with a strong social focus, such as T-Learning, T-Health, T-Government and T-Commerce. SAMBA framework has proven to be generic enough to be adaptable to diverse contexts by its implementation in two different environments, one in Brazilian North-East in the town of Barreirinhas and one in the Alpine region in Northern Italy in the town of Naz-Sciaves [10].

2. Framework overview and system architecture

2.1 General framework overview

The SAMBA framework consisting of three main domains is presented at a high level in *Figure 1*. The main components highlighted in the figure are: 1) *User Domain;* in which primary users consume the interactive services, 2) *Platform Domain;* where transmission of applications and reception of interactive input is performed and 3) *Content Domain;* related to the tools for producing interactive contents by local communities.

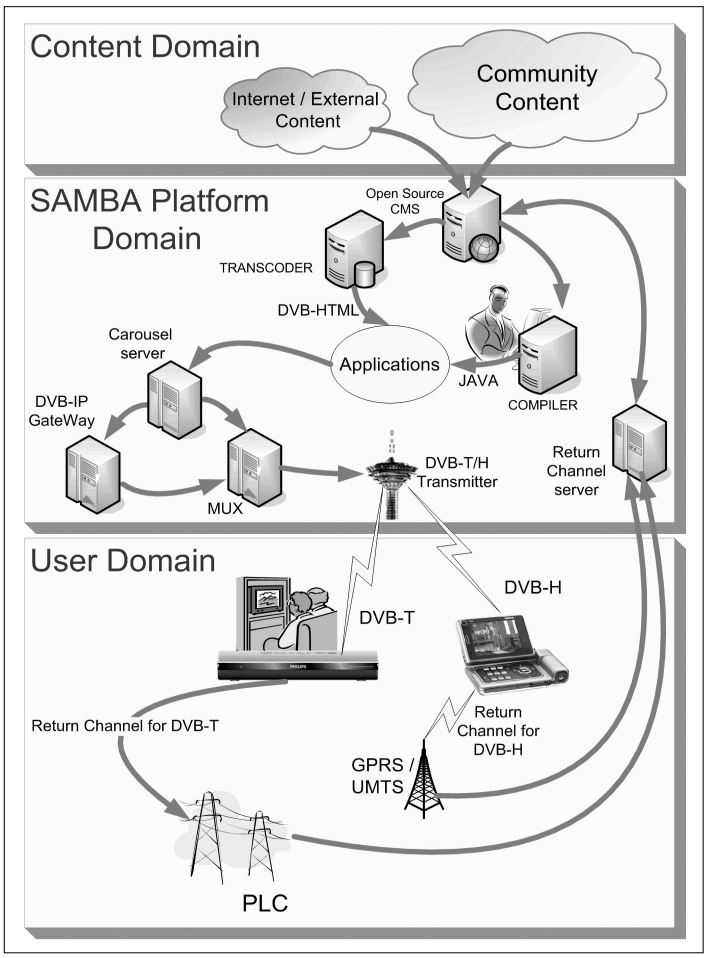


Figure 1. SAMBA framework overview

Regarding the *Users Domain,* SAMBA framework comprises two different types of users: Primary users that are those who consume content and Secondary users who are the ones that create content. Eventually, primary and secondary users could be the same individuals.

Both types of users interact with the *Platform Domain* in different ways: Primary users interact with idtv applications through a setup-box that 1) receive the idtv signal and interactive services from local broadcasters and 2) provide interactive input from users through the return channel. SAMBA framework allows for adaptation of the return channel according to the specific needs. In particular, during SAMBA project implementation the use of power line communications (PLC) was identified as the most suitable return channel to fulfill the requirements of the testbeds in remote rural areas. Specifically in the case of Barreirinhas town in Brazilian North-East, PLC was the best way to provide sustainable interactivity to idtv due to the ubiquity of power grid in Brazil even in remote rural locations.

The applications created in the *Content Domain* are developed with the use of a Content Management System (CMS). In SAMBA, the CMS can work both in a local server or in a remote one accessible through the internet that allows secondary users to create their own content and to reutilize other existing content available in the web through RSS feeds.

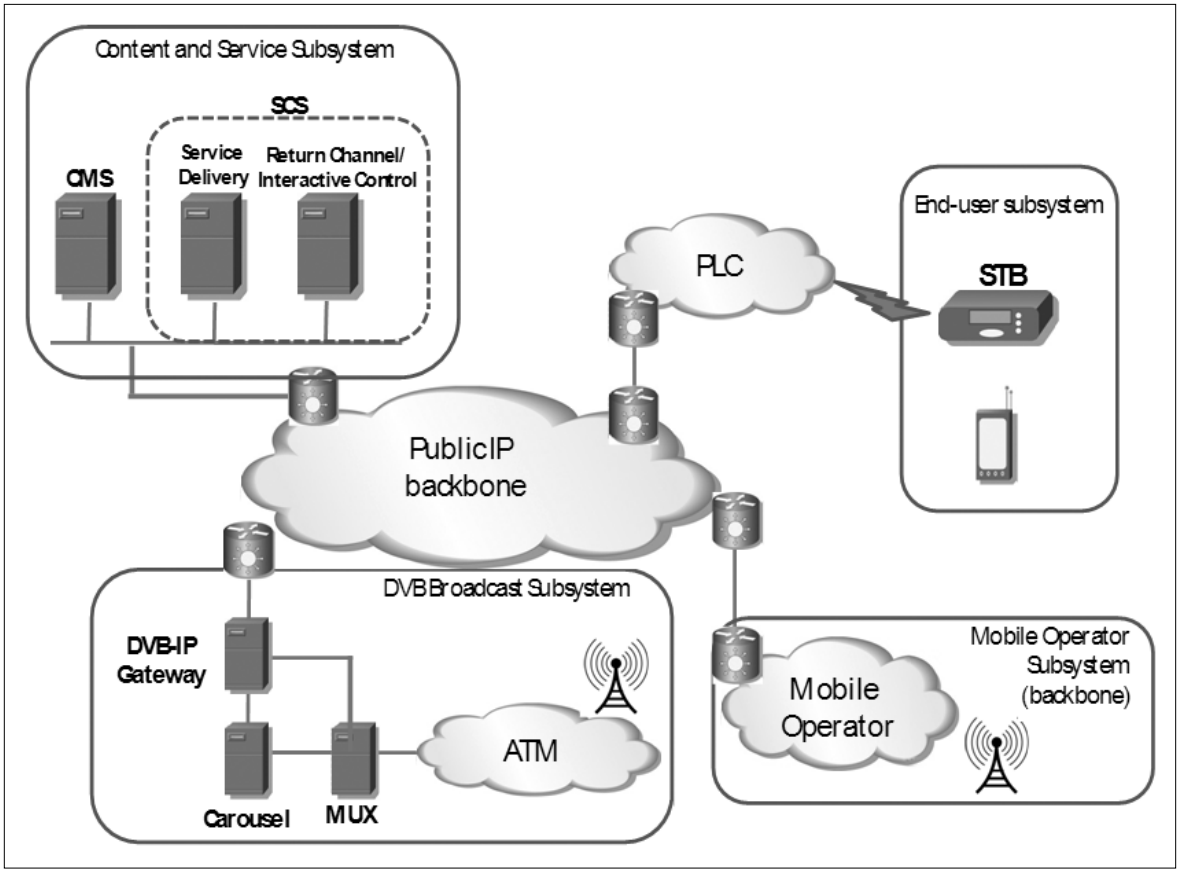


Figure 2. SAMBA architecture overview

2.2 System architecture and detailed description of components

The SAMBA architecture is split among the different system domains described in the previous section and is outlined in *Figure 2*. The next items describe the several sub-systems of the SAMBA architecture defining its functionalities and showing the set and stack of protocols that it uses to interact with the other sub-systems.

• *Content and Service Subsystem (CSS)*

The CSS in SAMBA includes the CMS and the Service Creation Subsystem (SCS). The CMS is responsible for handling the content which is provided by the end-user. The multimedia content is created and stored in the CMS to be delivered to the idtv broadcasting system. The CMS requires adaptation of the content items for each kind of user device (TV, mobile receiver, etc.). Additionally, the CMS sends all information about the content (such as duration, type of device) to the Service Creation Subsystem in order to make possible the delivery of content to the right kind of device. In SAMBA framework, the CMS enables the secondary users to create the following applications:

– *T-Photo*
  Allowing to upload and comment pictures to a given group of users.
– *T-Vote*
  Related to conducting surveys based on voting between different options.
– *T-Info*
  Consisting mainly in text information displayed to the user.
– *T-SMS*
  Enabling users to send SMS from the TV set.
– *T-RSS*
  Concerning use of web content through rss feeds.
– *T-Video*
  Application enabled only for mobile devices for uploading video (only for mobile)

Regarding the SCS its main scope is to handle the multimedia content in order to build the Electronic Program Guide (EPG) and other useful information about the content. This equipment creates and sends the EPG and information about other multimedia content in order to provide additional information to the final user.

• *DVB Broadcast Subsystem*

The DVB Broadcast subsystem is composed of two parts in order to emphasize the aspect of IP/DVB conversion. The DVB-IP Gateway converts the IP traffic, including transport stream, EPG (Electronic Program Guide) and other data, into a DVB streaming in order to be sent to the MUX. This equipment may receive data from several Carousel Servers and must organize all data in an appropriate manner in order to be transmitted by MUX.

– *Carousel Server:* In the Digital TV DVB Systems, the Data Carousel is based on the DSM-CC (Digital Storage Media – Command and Control) standard ISO 13818-6. The Carousel Server is used to send data files and content pages to the users.
– *MUX and DVB-IP Gateway:* The DVB-IP Gateway is an end system, which has the role of adapting the IP services to the DVB world. Its main functionality is to configure the MUX in order to allow MUX encapsulating data. Therefore, the DVB-IP Gateway needs to exchange information with the SCS.

The Multiplexer (MUX) is equipment composed by audio and video coders/decoders whose task is to code all content provided by SAMBA into MPEG streaming (MPEG2 or MPEG4) and send it to the DVB-T/H transmitters. MUX builds the Packetized Elementary Streams (PES) and based on this MUX generates the transport streaming because of the interaction of several DVB-IP gateways. Neither of these equipments provide any interaction with the end user or the other SAMBA systems. The only data sent by the MUX to the other systems are managerial data, such QoS information and about its operation status.

• *End User Subsystem*

The end user subsystem in SAMBA includes the utilization of both a TV set connected to a setup-box (STB) as well as a mobile TV enabled phone. Regarding the STB, it contains the hardware for DVB-T reception and PLC transmission and reception and the basic software for the DVB standard functionalities, including Transport Stream processing with the respective formats, reception and running of applications in the required standards (MHP for SAMBA case). In the PLC interface, the STB needs to support the required standard for the metropolitan access in the local network considering the physical layer and the MAC sub-layer. Concerning the management of the mobile device, it has the same requirements and constraints of the STB, considering the support of SNMP agents aimed at the mobile environment of DVB-H with a GSM/GPRS return channel.

• *Mobile Operator Subsystem*

The mobile network can be integrated into the management architecture by the same approaches of the Digital TV Broadcasters. It is possible to consider a solution with the sharing of information through the communication of the NMSs using SNMP or data base synchronization. Another possible approach is to use the integration of QoS monitoring information and control over the mobile DVB-H services.

• *PLC Network*

The PLC Network is composed of two main parts: the low voltage and medium voltage networks. The providers of equipments and solutions for PLC networks have implementations of network management. They consist of NMSs that monitor and control the network using proprietary communication and support the use of SNMP. This means that the equipments of a PLC network can be managed in three different ways:

– through the communication between the NMS of the PLC network and the SIMP using SNMP;
– through the synchronization of management data base of the NMS of the PLC network and the SIMP;
– through the direct management of the PLC network equipments by the SIMP, using SNMP.

3. Testbeds implementation and usability evaluation

3.1 Testbed implementation

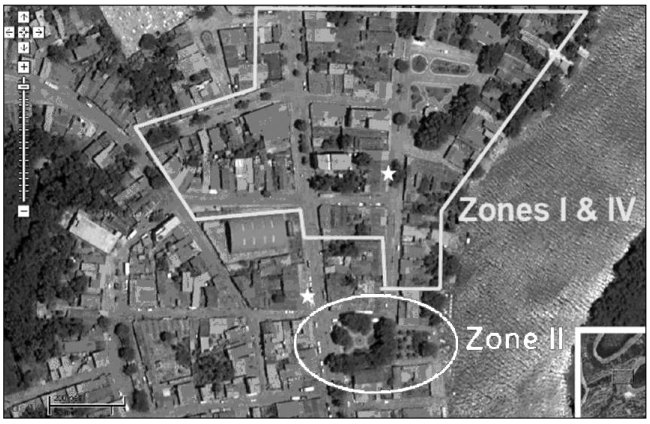
• *SAMBA Generic Infrastructure*

In order to implement the different testbeds of SAMBA Platform, a general infrastructure for the delivery of the interactive services was defined. The different components of this general infrastructure are shown in *Figure 3*. Each component in this infrastructure corresponds to the modules defined in SAMBA system architecture and the three different domains of the framework. Once defined the generic infrastructure, it was instantiated and customized for operating in both testbeds: Barreirinhas and Naz-Sciaves. A common characteristic of both testbeds was the use of power line communications for providing interactivity as the return channel.

• *Brazilian Testbed*

The testbed in the Brazilian environment was set up in the context of an ongoing project on PLC in the town of Barreirinhas. This project provides already the access to the PLC network infrastructure within the context of this small village in the Maranhao State. The testbed allowed for validation in a living environment the complete system, composed of CMS, Community Access Channel and PLC return channel for interactivity. The PLC backbone in Barreirinhas is connected to the external world through a bi-directional satellite link that provides connectivity to the ground, and a gateway takes this connection to the PLC backbone. The entire village is already connected via the power distribution system to this backbone. The system has been tested in some public buildings as well as in users' homes. *Figure 4* presents an aerial view of the area of coverage of SAMBA testbed. In this figure 'Zone II' corresponds to the place where the satellite link is located (Municipality office) and the area denoted by 'Zones I & IV' corresponds to the places covered by PLC infrastructure.

Figure 4. Barreirinhas testbed site



• *Italian Testbed*

Given its particular geomorphologic structure, South Tyrol region in Northern Italy is affected by a particular digital divide situation between the cities and the alpine valleys. Indeed outside the cities there is a lack of broadband connections and in general Internet connection is slow if available whatsoever. For this reason, idtv was

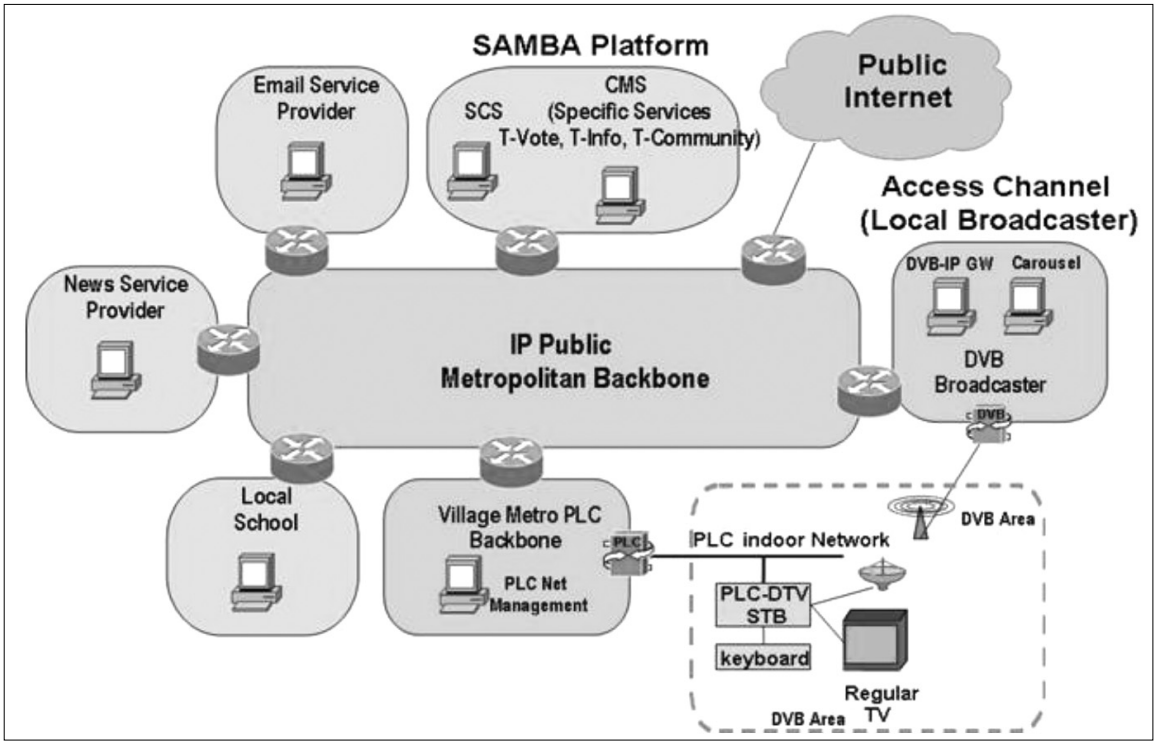


Figure 3. SAMBA basic infrastructure services

Figure 5. Naz-Sciaves testbed site

identified as a good alternative in this region for providing citizens with the means for accessing relevant information regarding more specifically the different communities of the valleys. Moreover, in order to solve the problem of low connectivity, the PLC technology was considered as the best solution for the area to give to it a broadband connection.

Due to its particular position, Naz-Sciaves was chosen as the locality of a first pilot PLC test of the local electric company located in the city of Bressanone. Naz-Sciaves has been the first town not only in South Tyrol but also in Italy in which the PLC technology is used to provide connectivity through the electric distribution network. *Figure 5* presents the areas connected with PLC distribution lines in Naz-Sciaves.

3.2 Usability evaluation

• *Verification and Validation*

Usability inspection and evaluation was conducted following first a Verification and Validation approach (V&V) [11].

The verification of SAMBA applications was done in two parts. In the first part, the verification of the applications was made by a heuristic evaluation of usability conducted by three experts. In particular, the Primary Users applications were tested through the use of a specific idtv emulator for PC. During these testing phases, the evaluators started an application and tried to simulate the typical behaviour of a user interacting with the system. Some preliminary set of usability problems were identified such as duplication of pages, inoperative buttons, low time response, text and images lost. In the second part, an ad hoc verification of the system based on a list of heuristics and checklists performed by the

Table 1. Evaluation methodology

Types of Evaluation		Focus and method (group/individual)	Artifacts and techniques	Examples
Evaluation of system usability	Indicators of user performance	Focusing on user performance as it is perceived by the HCI specialists (in group)	Observations and Checklist about **Efficacy**	Difficulties to complete a task
	Indicators of system usability	Focusing on usability as it is perceived by the HCI specialists (in group)	Observations and Checklist about **Learnability**	Compatibility with user tasks; verbalizations expressing users' judgments on the compatibility of the interface with a given task; help frequency
Evaluation of users' acceptance and system utility		Focusing on usability as it is perceived by the users - the users' perceived usefulness and their perceived ease of use (in group and by individual)	Post-experimental one to many and many-to-many interviews and focus group;	Questions will concern: general satisfaction, particular aspects of the user interface that are judged problematic and utility for social inclusion
			Observations	Observations related to users perceived usefulness (the acceptability and the way users faced problems) and observations related to users' perceived ease of use(problems concerning the use of the devices for interaction).
			Diaries	Analysis of the users' involvement with the application after having used it

team of evaluators together with one of the developers the applications were corrected.

The purpose of the validation process was to evaluate the technology acceptance by the users to attain three main objectives, namely:

– the evaluation of system usability;
– the evaluation of system utility;
– the evaluation of user acceptance.

• *Usability, Utility and Acceptance Evaluation Approach*

The evaluation of system usability in SAMBA aimed at identifying potential problems related to serviceability, difficulty to use the system, etc. These problems were identified on the basis of the usability characteristics needed to guarantee the product quality, according to the ISO9126 (ISO/IEC 9126, 1998) criteria.

The following indicators of user interactions served as a basis for the analysis of the observations of the use of the SAMBA applications in the primary users' homes.

– Indicator of user performance: an indicator related to the efficacy characteristic of ISO 9126
– Indicator of system usability: an indicator related to the learnability characteristic of ISO 9126

Based on these indicators, the evaluators designed and used a checklist as the main artifact while observing the users interactions. The evaluators also focused on usability as it was perceived by the primary and secondary users. The perceived usefulness scope was that of verifying the social acceptability by analyzing the users' behavior related to the acceptance of interaction with the system, its potential for social inclusion and for social practice intended in terms of involvement with the content.

In order to conduct the evaluation, the experts performed direct observations, questionnaires, checklists, interviews and focus groups for both, Primary and Secondary users.

A summary of the evaluation methodology is described in *Table 1*.

• *Evaluation results*

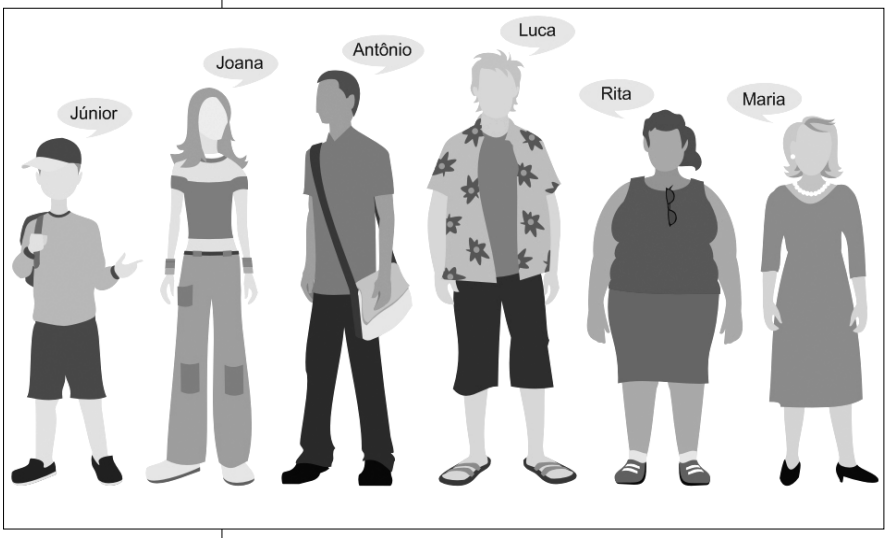
In both contexts (Brazilian and Italian), primary and secondary users were involved in testing the SAMBA system. In general, the system was perceived by users, especially in the Brazilian context, as a very relevant tool for supporting the local community. Such affirmation is related to the limitations of the town on the basis of factors such as: restrictions on access to the Internet or other forms of interactive information sharing, few secondary schools and few options of entertainment offered to the community.

The summary of the results on the verification and validation process and the usability inspections is presented in *Table 2 (see on the next page)*.

4. Sustainability of SAMBA approach

One of the main contributions of SAMBA framework stands in the fact that idtv presents an ideal way for bridging the digital divide, especially in remote areas where people have difficulty to access Internet services. SAMBA approach pursues the goal of enabling local communities in such areas to produce and broadcast idtv content and services while using accessible means such as Power Line Communications (PLC) as return channel. In this way, SAMBA aims to guarantee a sustainable model of idtv service provision even in underdeveloped areas.

Figure 6.
SAMBA users profiles represented as PERSONAS



Accordingly, preliminary studies on user-requirements and expectations were done in both locations and a set of prototypic primary users profiles were identified and modelled as Personas (*Figure 6*) [12,13]. These Personas were used for producing scenario-based representations and definition of SAMBA services.

Additionally, in order to assure sustainability of SAMBA approach, the services identified were analyzed in terms of potential business models considering the economic and cultural constraints imposed by the target regions as well as the expected actors to be involved. In general, five potential actors involved in services and business models were identified:

– Primary User
– Secondary User
– Infrastructure Provider
– Content Manager
– Service Provider.

The business model proposal is a hybrid model situated in the middle between open TV (free-to-air) and pay-per-view TV (paid broadcasting). In this model, pri-

V & V activities	Brazilian context	Italian context
General descriptions		
Products Verified in simulated context: CMS, idtv and mobile idtv applications	yes	yes
System Verified in real context	PLC network	PLC network and ADSL as complementary
Types of Verification tests	ad hoc verification in group and Heuristic evaluation	technical tests
System validated in real context	CMS applications, T-Info and T-Photo Gallery	CMS applications, T-Info, T-Photo Gallery, T-Vote and T-SMS
Methodology used for the validation		
Sample	5 users of 3 local organizations	4 users of TIS organization
Needed support	Training	no need of Training
Artifacts used	CMS tutorial, questionnaires, diary and consent term	idtv applications tutorial, questionnaires and consent term
Environment used in usability tests with primary users	tests with 10 users in primary users' homes and of their friends (n=5)	usability tests with 9 primary users in 4 homes in Natz-Shiaves
Contextualization with users	invitation by correspondence and by personal contact as well as via telephone, five meetings with gifts, snacks and certificates	invitation by correspondence and telephone and two meetings during the project
Usability tests	during three days, team at least of 3 (designer, evaluator and psychologist) and 1 technician	during four weeks, team at least of 2 (evaluator and technician)
Created content		
Type of content	education, business, tourism, news	education, business, tourism, news
Main results		
Users´ acceptance and utility of CMS applications	Users showed interest in producing content for all types of people including the desire to reach users from more far away houses. They were very positive about the access of users to the local content.	Users appreciated the potentialities of the tools to create different types of contents for different services scenarios.
Usability of CMS applications	Despite reporting an average degree of difficulty, users were able to create their contents using the applications and the CMS manual and requested eventually the assistance of the evaluators' team. Main problem: low internet access.	Users impact with the application was straightforward and did not require to much support by the evaluators. Users provided some useful suggestions to improve further the tools. Some minor bugs of the applications were found and corrected.
Users´ acceptance and utility of idtv applications	Most users had positive experiences when using the applications. "I liked more the application of text. Because as a teacher I am part of that context." They were involved by the content and by the possibility of seeing what they referred to as a "possibility" becoming "real". The utility for tackling digital divide was perceived by most users, according to the fact that TV is the most common communication mean in the city.	The primary users had a positive feedback about the tests. Most of the users appreciated the possibility to use the applications in specific scenarios of use. The highest level of appreciation was provided by older people. In general, younger users were not interested by TV oriented content, instead they preferred the PC and Internet-based technologies. However they were very interested to see Brazilian content on TV.
Usability of idtv applications	Some difficulties appeared in function of the lack of familiarity with technology, legibility (in some TV screens, the applications were cut or had a black line) and the buttons on the remote control were in English. Suggestions were mainly related to have dynamic information.	Some difficulties appeared when inputting text. The users' perceived level of interactivity provided by the applications was high. Suggestions were mainly related to have dynamic information instead of static (more animation, zoom). Others suggested to make navigation easier for the users in T-Info and to improve the quality of the service (reduce waiting times originated by slow connections).

Table 2. Evaluation results

mary user is a free of charge player. The sustainability of the model will be assured by the advertisements generated by the services providers and by the secondary users. These players are in fact mainly content providers and sponsors. *Figure 7* shows the service flow.

A set of prototypical potential services identified by the sustainable business model analysis are presented below. All the following services are mere examples that could be taken as basis for defining more sophisticated services:

S-Business – this service can provide advertisement or general information about business subjects. The information can include information about products, services or general information about business opportunities such as information about procedures to register a small business according to local regulations, quotations, taxes, etc. The candidate secondary users for this service could be any kind of service provider or product advertiser as well as governments and regulatory agencies, unions, business consultants, user and/or provider associations, etc.

S-Tourism – this service is a variation of the S-Business with focus on tourism activities. The information can include information about hotels, restaurants, crafts shops, local tours, etc. and the service would be directed to tourists staying e.g. in a hotel in the specific location.

S-Health – this service includes presentation of information related to health campaigns, available pharmacies, available doctors, information about emergencies or epidemics, etc. The service could be offered by local/national health institutions and directed to all the population.

S-News – this service includes provisioning of information related to relevant news. The service could be offered by local broadcaster and could be sustainable based on the advertisement that could be sold to different customers. The service is directed to all the population and could use interactive input from users to monitor interest in certain topics.

S-Energy – this kind of service may consist of presenting the information related to energy consumption of individual users as well as general information about energy campaigns and other tips about reduction of energy waste. The service could be relevant to all the population.

S-Government – this service could allow the local, regional or national governments to provide opportune information to citizens on different relevant issues related to government practices and services. The beneficiaries of such service include the whole population.

S-Education – through this kind of services, the population could get relevant information regarding educational materials. This service could be a very relevant one especially in remote areas where the number of teachers and the availability of educational resources is limited.

5. Concluding remarks

In this paper we presented SAMBA framework for enabling production and consumption of community-oriented idtv in a sustainable way. The framework proposed in this paper was implemented in two testbeds with different characteristics. These testbeds had their own specific requirements for using a PLC infrastructure as return channel to provide interactive services to a sample of the population. Additionally to the final outcome of providing a mean for delivering interactive services to the population, SAMBA implementation provided the construction of a modular solution. This means that each individual component utilized in SAMBA such as CMS, broadcasting technology, etc. could be easily replaced and adapted according to new available resources such as more sophisticated interactive channels or transmission means (e.g. based on GPRS, ADSL, WiMAX etc.) [14]. Within the SAMBA framework business models were defined that allow for the creation of sustainable services that could be utilized as a powerful tool towards reduction of digital divide.

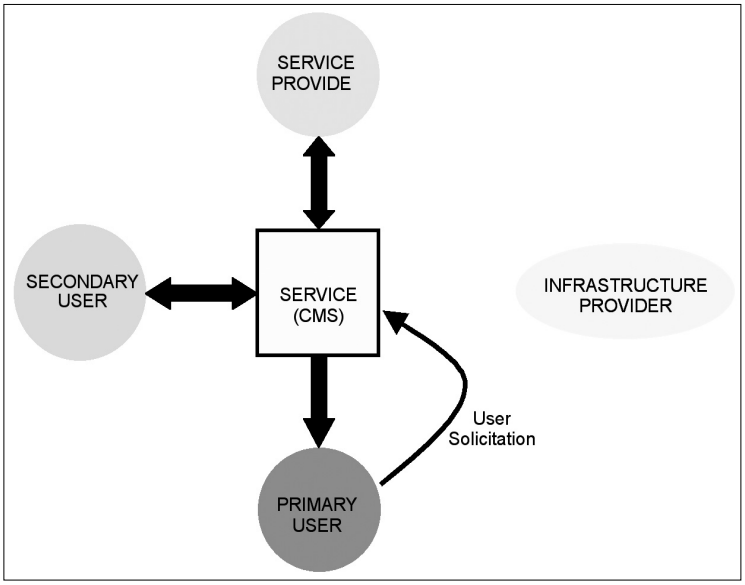
SAMBA's encouraging results allow for envisioning relevant impact in three main dimensions including societal, economical and technological domains:

Societal impact

Promoting the creation of Community Access Channels based on idtv, for the improvement of public services, local community administration reinforcement and decision making and democratic processes in developing countries. The content, created by local communities to their own citizens and users, have a good potential to foster creation of strong social-focused content, e.g. in the fields of eLearning, eHealth, eGovernment, etc.

In a broader scope, the results of SAMBA are envisioned to impact the characterization of key issues re-

Figure 7. Service flow diagram



levant for the adoption of idtv as a feasible technology for bridging the digital divide, especially in development areas. This creation practice would allow moving towards higher societal impact in a self-motivated synchronization process between people and technology.

Economic impact

SAMBA results are envisioned to favor the development of digital terrestrial TV infrastructures and services in developing areas, e.g. the Latin American region, as a successful example of the use of Community Channels in rural areas through PLC infrastructures. SAMBA introduced an easy to use front-end for fostering services and social inclusion through the introduction of idtv as a content production system to be used by local communities under specific business-cases conditions.

Moreover, by bringing together different low cost tools for content production (mobile, web etc.) integrated into Globally Executable MHP, SAMBA is open to a huge potential for new applications and services both in developing and industrialized countries. Additionally, a successful integration could also have potential positive impacts on DVB/MHP adoption in Europe and elsewhere.

Technological impact

The users studies and in specific usability tests performed in SAMBA with real users have brought clear insight to the definition of idtv services in developing countries. The technological solution of SAMBA system is compatible with GEM standard for allowing MHP applications but nothing excludes an easy transformation into other approaches (e.g. Ginga).

Additionally, the identification of relevant features to be included in the PLC equipments to enable convergent multimedia interactive traffic in future applications has been identified as a good approach for improving digital inclusion through SAMBA services; making possible the offering of interactive contents with appropriate user end-to-end QoS perception.

Authors

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References

[1] Participative Web and User-Created Content: Web 2.0, Wikis and Social Networking. Source OCDE Science et technologies de l'information, OECD Organization for Economic Co-operation and Development, September 2007.

[2] M.A.M. Kramer, E. Reponen, M. Obrist, MobiMundi: exploring the impact of user-generated mobile content – the participatory panopticon. Proceedings of MobileHCI'08, September 2008.

[3] P. Cesar, K. Chorianopoulos, Interactivity and user participation in the television lifecycle: creating, sharing, and controlling content. Proceeding of the 1st International Conference on Designing Interactive User Experiences for TV and Video (UXTV'08), October 2008.

[4] E. Mantzari, G. Lekakos, A. Vrechopoulos, Social tv: introducing virtual socialization in the tv experience. Proceeding of the 1st International Conference on Designing Interactive User Experiences for TV and Video (UXTV'08), October 2008.

[5] B. Collini-Nocker, Community TV: a new dimension for immersive social networking. Proceedings of the 6th International Conference on Advances in Mobile Computing and Multimedia (MoMM'08), November 2008.

[6] K. Squire, C. Johnson, Supporting Distributed Communities of Practice with Interactive Television. Journal of Educational Technology Research and Development. Vol. 48. No. 1, 2000, pp.23–43.

[7] O. Mayora-Ibarra, C. Costa, "Sociability Issues for Designing Usable Mobile idtv Applications." CHI 2006 Workshop on Investigating new user experience challenges in idtv: mobility & sociability. Montreal, Canada, April 2006.

[8] Oscar Mayora, Cristina Costa, The SAMBA Approach to Community-Based Interactive Digital Television. Proceedings of ChinaCom Conference, Shanghai, China, August 2007.

[9] Martucci M., Hirakawa A., Jatoba P., "SAMBA Project: A test bed for PLC application as a digital inclusion tool". In Proceedings of IEEE ISPLC'08 – International Symposium on Power Line Communications and Its Applications, Jeju, Korea, April 2008.

[10] Elena Bensi, Giuseppe Franco, Margarita Anastassova, Oscar Mayora-Ibarra, "User-Centric Requirements and Design of a Testbed for iDTV in Alpine Rural Areas". Proceedings of IEEE ISCE'08 Conference, Algarve, Portugal, April 2008.

[11] Lee, K., Phongpaibul, M., Boehm, B., Value-based verification and validation guidelines, Technical Report USC-CSE-2005-502, February 2005.

[12] Furtado E., Kampf T. , Piccolo L., Baranauskas C., "Prospecting the Appropriation of the Digital TV in a Brazilian Project", In Proceedings of EuroiTV'08, Salzburg, Austria, July 2008.

[13] Furtado, E., Mayora, O., Anastassova, M., Kampf, T., Vasconcelos, P., An investigation of iDTV user needs in Brazilian and Italian communities: Preliminary cross-cultural findings. INTERACT Workshop on "Innovation inspired by diversity: Perspectives, Challenges and Opportunities for Human-Computer Interaction in Latin America – CLIHC 2007", Rio de Janeiro, Brazil, September 2007.

[14] L.G. Meloni, A New WiMAX Profile for DTV Return Channel and Wireless Access. Proceedings of Mobile Wimax'07. Orlando, FA, 2007.