

# A Model for the Application of Interactive Digital Television to Communities of Practice

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**Abstract**—Communities of Practice make intensive use of information and communication technologies (ICT) to meet their needs of interaction among their members. At present, the main supporting tool for these communities is the Internet and the software tools available for their users. With the advent of digital TV, however, new resources have become available to these interactive communities. This study aims at analyzing the basic needs of technology support for virtual communities, identifying the essential software services that can meet these needs and propose an application model for interactive digital television that can meet the main needs of a Community of Practice. To achieve that, the essential services for a Community of Practice were identified by means of a field research applied to a knowledge management Community of Practice in order to propose an application model for Interactive Digital TV to Communities of Practice. The results discussed here may be used to develop applications for Interactive Digital TV and Communities of Practice, exploring the interactive resources of this new platform.

**Index Terms**—Communities of Practice (CoP), Interactive Digital Television (iDTV), Knowledge Management, Social Networks.

## I. INTRODUCTION

The introduction of the Brazilian Interactive Digital Television model (iDTV) may lead to the development of several applications and services, exploiting its interactivity resources. This interactivity is the key competitive advantage in relation to the analog model. Moreover, iDTV is a resource with a great deal of possibilities as it is not possible to determine exactly its scope [1]. Several areas of human knowledge can benefit from the resources brought by iDTV, including Communities of Practice.

Communities of Practice (CoP), according to Wenger, McDermott and Snyder [2], are groups of people who have common interests, problems to be solved or a passion for a subject and want to deepen their knowledge and experiences in these areas, interacting with each other regularly.

Communities of Practice can be viewed as a subject that, in the last ten years, has attracted the interest of the academia mainly in engineering and knowledge management areas, due to its characteristics that allow its application in the organizational environment in activities of creation and knowledge management activities.

The design of an application model based on Digital TV resources for Communities of Practice can become a difficult task to be carried out due to the many resources that currently exist in the various software platforms for CoP. However, it is possible to make a considerable

simplification in the proposed model, in which the essential services required by a Community of Practice have been identified.

In a previous study [3], the essential services to a CoP were identified by means of a study applied to a knowledge management Community of Practice. In this study, eleven services were considered essential to a Community of Practice. Based on these services, a model for the application of iDTV was designed for Communities of Practice, enabling the development of a software platform for the environment Ginga [4] in the Brazilian Interactive Digital TV model.

In Section 2, the Brazilian model of Interactive Digital TV model is discussed along with its main services and applications. Section 3 presents the concept of Communities of Practice and its application to knowledge management in organizations. Section 4 describes the methodology adopted in this research. Section 5 presents the proposed model, incorporating the essential services for a Community of Practice. Section 6 discusses the expected results, and finally, Section 7 displays the final considerations and suggestions for future research.

## II. INTERACTIVE DIGITAL TELEVISION (iDTV)

Television, as we know it, is going through a critical phase of renovation in the entire world, with the gradual implementation of the digital system. This change is already setting up a scenario rather different, requiring new business models and new habits from its users. Television is nowadays the mass medium of greater world-wide coverage. Winck [5] presents an interesting estimation that there are currently more viewers than the sum of all readers of Western history: somewhere around four billion people. To Zuffo [6], the model of open TV in Brazil is an instrument of national cohesion, being accessed by more than 90% of Brazilians living in urban areas and partly in rural areas.

The Brazilian System of Digital Terrestrial Television (SBTVD-T) was created to ensure digital inclusion through the interactivity resources that allow future access to the Internet and the democratization of access to information. iDTV will offer a true revolution, considering that this new technology will provide users with features that do not exist in the analogical model of television (e.g. interactivity).

Interactivity, along with portability and mobility allowed by SBTVD-T, are the main competitive advantages in relation to other existing systems: the American system (ATSC-T), the European system (DVB-T) and even the Japanese system (ISDB-T), its predecessor.

This interactivity can be made available, basically in three ways [7]: locally (with the TV and no return

channel), interactivity through a one-way return channel and interactivity through a bidirectional return channel. The higher levels of interactivity require bidirectional return channels and imply higher implementation costs.

The interactivity resources brought forward by digital TV models in the U.S., Europe and Japan were not very attractive, because in those regions the possibility of interactivity already existed for the vast majority of the population, due to the deep penetration of cable TV and the Internet, a fact that does not occur in Brazil. In the Brazilian scenario, as already shown, the broadcasting TV is the mass medium of great penetration, because it is accessed by more than 90% of households. The Brazilian model of Digital TV needs, essentially, the resource of interactivity, because it is precisely this feature that will promote the viability of inedited applications and services to a large portion of the population, due to its high penetration of Brazilian households. This is its great motivation: the possibility of promoting digital inclusion of the Brazilian population across the vast extension of its territory. Interactivity is a critical success factor of SBTVD-T.

The Brazilian System of Digital Terrestrial Television implements its interactivity by means of a middleware called Ginga [4], and a declarative language called NCL - Nested Context Language [4], which were designed to meet three types of users [8]:

Developers - for the development of more complex applications;

Producers of content for iDTV - for the development of applications of intermediate complexity and;

Viewers - to build simple applications based on graphical facilities.

The design and development of applications for digital TV are not simple and they present details that make this process distinguished from the development processes of applications on the Internet and traditional software engineering [1]. As previously seen, in the Digital TV the layer of the middleware is responsible for the characteristics that enable the development of specific applications for this new media [9].

It is in this layer that the interactivity resources can be implemented. This layer, in the global standards of iDTV, is just below the application layer. The layers of compression, transportation and transmission/modulation execute other features for the iDTV system (Fig. 1).

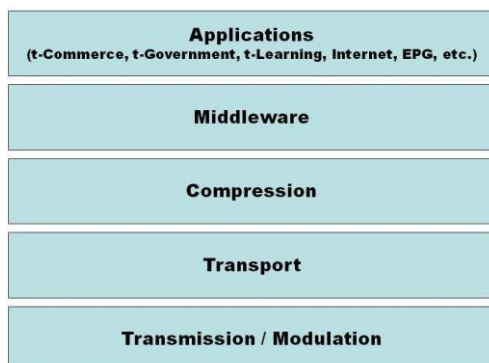


Figure 1. Layers of the Brazilian System of iDTV. Source: [10].

The middleware Ginga of SBTVD-T was created from the joint projects Maestro (PUC-RJ) and Flex-TV (UFPA) developed for the Brazilian Government (CNPq). Of these two initiatives, the Ginga received the declarative characteristics (NCL) and imperative (Java) for the development of applications, generating a product of greater flexibility. Soares [11] points out that Ginga is currently the only middleware that provides support for simultaneous interaction from multiple devices and this is one of the greatest innovations of SBTVD-T.

Several applications can take advantage of the iDTV model bringing their interactivity resources for the design of new products and services. Ferreira, Braga, Santos and Santos [12] present a model for applying these resources to e-Learning. Braga, Santos and Rover [13] propose a model for implementing iDTV for Electronic Government and Macedo, Braga, Gauthier and Dantas [14] for Communities of Practice.

As this is a new technological resource, digital TV is open to several innovations, mainly in terms of applications in various areas of activity. With its interactive capabilities, digital TV can be a powerful tool for Communities of Practice, enabling the creation of applications still unexplored.

### III. COMMUNITIES OF PRACTICE (CoP)

In many organizations, Communities of Practice put together, periodically, groups of people to share knowledge in a particular domain of human knowledge. Among the suites of software currently on the market, there are a wide variety of applications or services designed to meet the needs of interaction among members of a Community of Practice. These needs can be met satisfactorily, through the resources offered by information and communication technologies (ICT), overcoming barriers arising from factors such as time and distance, different among their members.

The concept of Communities of Practice derived from studies by Jean Lave and Etienne Wenger [15] on situated learning. Learning as a situated activity has as its main characteristic a process called “legitimate peripheral participation” that deals with the relationship between newcomers and veterans of a particular profession [15]. These interactions among members generate identity, artifacts and knowledge exchanges, enriching all participants.

According to Hara [16], Communities of Practice are informal collaborative networks that give support to the practitioners of a profession in its efforts to develop a shared understanding and in their commitment to the building of a body of knowledge relevant to their work. The reunion of experts in virtual communities supported by information and communication technologies represents a practical approach for creating and managing knowledge in organizations.

Most software applications available to Communities of Practice are based on the Internet. Such applications cover almost all the needs of virtual interaction among members of a CoP. However, in several developing countries such as Brazil, the Internet penetration in the population is still considerably low, being limited in 2008 to 17% of households [17]. This limitation gives rise to the creation of an iDTV application that can meet the needs of a CoP, exploiting their high penetration.

An application of iDTV that runs the essential services to a CoP can be used to promote the creation of several virtual communities throughout the Brazilian territory, promoting the generation and dissemination of knowledge among professionals from diverse areas that do not already have Internet access.

IV. METHODOLOGY

The methodology adopted in this study has its origins in a quantitative research developed by [3] to determine the software services deemed essential to a Community of Practice. Based on the results of this research, an application model for the Brazilian System of Digital Terrestrial Television for the CoP is proposed, covering the essential services previously identified. This model will serve as the basis for the creation of an application to be developed at NCL language to the Brazilian middleware Ginga [18], which can be used by Communities of Practice, exploring the new resources of Interactive Digital TV.

A systematic literature review was conducted to identify related studies that addressed the subjects of Digital Television and Communities of Practice in two large databases: Scopus (www.scopus.com) and ISI Web of Knowledge (www.isiknowledge.com). Various combinations of the following terms “digital”, “television”, “interactive”, “community/communities”, “practice”, “virtual” and also the abbreviations “iDTV”, “DiTV” and “CoP” were used. There were no papers, among the items recovered in the search, with similarities to the research topic in this article.

The present study aims to answer the following research question: how the interactive resources for the Brazilian Digital TV model can be exploited to design specific applications for Communities of Practice? Fig. 2 shows a graphical representation of the methodology adopted.

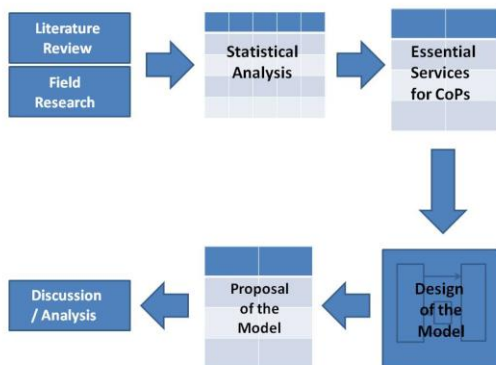


Figure 2: Methodology adopted in this study.

The objective of this study is to create a model that enables the use of interactive resources of Digital TV in the design of applications for the various Communities of Practice existing in the country. The design of the model of application in Interactive Digital TV in Communities of Practice uses the traditional techniques of software engineering. The results of this study may contribute to the consolidation of SBTVD-T and to enhance the interactions among different members of a Community of Practice, through these interactive resources available in this new media.

V. PROPOSED MODEL FOR iDTV IN COP

In the designing of an application model for iDTV, one must be aware of the limitations imposed by the equipment of Set-Top Box (STB) that works as a digital converter for the older TV sets. These limitations should be considered in the design of applications for the iDTV environment, influencing in the specification of the functionalities of an application.

In this study, the limitations of the model of iDTV justified the need to determine the software services considered essential to a Community of Practice, simplifying the design of the proposed model.

Among the various software services currently existing for the CoP, only eleven (11) of them were considered essential to a platform for a CoP [3]. The eleven services identified as essential are summarized in Table 1.

TABLE I. ESSENTIAL SERVICES FOR A COP.

CoP Essentials Services	
Description	Group
1. e-Mail	1
2. Discussion Boards	1
3. Slide/Video Presentation	2
4. Presence Indicator	2
5. Chats	2
6. Community Entry Page	3
7. Search	3
8. Security Management	4
9. Schedule	4
10. Library/File Management	5
11. Document Repository	5

According to Wenger, White, Smith and Rowe [19] these services could be grouped into five kinds of activities that correspond to different needs of interaction among members of a CoP: Asynchronous Interactions (1), Synchronous Interactions (2), Individual Participation (3), Community Cultivating (4) and Publication (5).

The essential services of asynchronous interactions (group 1) are the e-mail and Discussions Boards. The e-mail service, such as in the Internet, enables users to send and receive messages through the application. The services of Discussion Boards enable asynchronous communication between users through messages posted within a limited space of conversation.

The essential services of synchronous interactions (group 2) are the Slide/Video Presentation, Presence Indicator and Chats. The service Slide/Video Presentation is a tool that allows users to present sequences of slides or videos in the application. The possibility of transmission in large-scale of high-quality video and in a synchronous mode is one of the benefits of iDTV. The service Presence Indicator allows identifying which users of a community are active (online) at that moment. While the Chat rooms service allows the exchange of texts synchronously in the application and can be used by the community in events that bring together large numbers of participants.

The essential services of individual participation (group 3) are the own community home page and the searches. The service Community Entry Page (home page of the community) corresponds to the main page of community entry in the application, listing the main services provided (Fig. 3). While the search service, corresponds to the tools



that enable its users to perform searches for words or phrases in the document repositories, databases and in other sources of information contained in the application.



Figure 3. Model of the Community Entry Page.

The essential services of Community Cultivating (group 4) are those of Security Management and Schedule. The Security Management service corresponds to the controls of the levels of access, information protection, backup and other related factors. The Schedule service is a tool that enables that users have access to a schedule of activities to be developed by different groups over a period.

Finally, the essential services of Publication (group 5), which correspond to the Library/File Management and Document Repository. The Library/File Management service enables users to create, read, modify, copy or print files, controlling their level of access. While the services Document Repository are tools that enable the management of the documents posted by the group and differ from management service libraries and files to be more sophisticated, enabling indexing and searching in the documents posted.

The services are selected by users through the remote control of Set-Top Box. In some situations where the text input is large, the users can make use of a wireless keyboard that communicates with the STB.

### VI. ANALYSIS AND DISCUSSION

The design of an application model of Digital Television for Communities of Practice, which meets the basic needs of interaction, requires the coverage of several communication possibilities offered by interactivity. This interactivity of iDTV can be achieved through various modalities of communication networks such as telephony and mobile networks, Power Line Communications (PLC), Wi-Fi and other existing ones.

The model proposed in this paper is not intended to exempt the use of the Internet by the virtual communities, but to enable the social inclusion of a portion of the population that still lacks access to Internet in the current Brazilian context. As broadcasting TV has high penetration and the access to interactive digital TV will be cheaper, with the prices reduction of STB devices, this alternative allows considerably broaden the participation of Brazilian professionals in communities of practice. Thus, the proposed model would add to the efforts of other technologies in order to allow human interaction among members of diverse virtual communities existing on the national scenario. The insertion of the proposed

model in the current scenario can be represented in Fig. 4. These several communication possibilities may exist due to digital convergence provided by the information and communication technology.

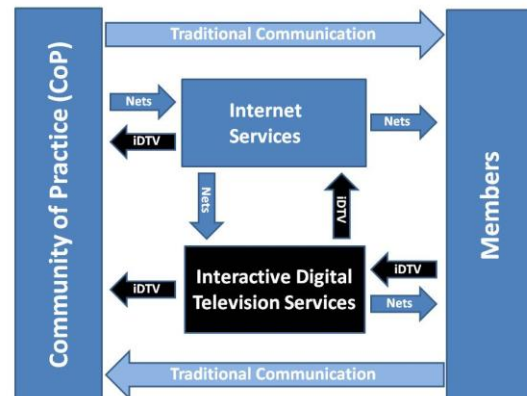


Figure 4: Insertion of the proposed model in the current scenario

As in other applications of iDTV, the main difficulty and the limiting factor detected in the design of iDTV applications to communities of practice is that many features present in the computers are not available to all users of iDTV, such as the resources of input and output (keyboard and mouse), the size and resolution of the monitor where the data are displayed, among others [20].

### VII. CONCLUSION

Despite the fact that studies on applications of digital interactive TV are still incipient on the global scenario, it becomes clear that this is a new and powerful resource for the design and creation of new applications and services for various areas of human knowledge.

A variety of activities carried out under a Community of Practice require a computer support to facilitate virtual interaction among its diverse members, which may be spread across numerous regions of the country and even the world.

The model proposed here, although implementing just some basic functionality required for a Community of Practice, serves the needs of the five groups of interaction among its members and serves as an initial proposal to be refined to their construction and practical use in a virtual environment.

The results of this study may contribute to the development of a portal for Communities of Practice in the environment of Interactive Digital TV that enables the creation of virtual communities through interactivity resources, regardless of the Internet.

It is vital to recognize that the design of products and services for Communities of Practice is influenced by the ability to invent new uses and applications that the community itself creates, adapting new technologies designated to activities that were not foreseen by its designers. Thus, the process of developing applications for the CoP should consider that the community itself strongly influences this process by adapting the new features to their needs, expressing their needs or even rejecting the created resource.

The adherence of other Latin American countries to the Brazilian System of Digital Terrestrial Television (SBTV-D-T), as in the case of Peru, will allow the

potential expansion of the applications listed in this study in digital divide communities in developing countries.

Future research on this theme could investigate the implementation of the proposed model of iDTV in a Community of Practice of a private organization or in a higher education institution, aiming to improve the model and identify its strengths and weaknesses.

Another research topic can be the digital convergence provided by the merger of several resources or services of the information and communication technologies currently available to virtual communities.

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