Collaboration in Broadcast Media and Content

Sabine Bachmayer
Department of Telecooperation
Johannes Kepler University Linz, Austria
sabine.bachmayer@jku.at

ABSTRACT

In recent, we have observed a marked shift in broadcasting from mainly passive analog, such as conventional television, towards digital technology. This caused a boom in developing interactive applications (beyond teletext in TV) and in inviting the viewer to participate with the content in a collaborative manner. Several popular participatory TV program formats have demonstrated this by inviting their audiences, for instance, to vote for a person. To date, the collaborative acts have been executed via parallel platforms, such as telephone and Internet. In summary, broadcast formats with audience involvement, and technologies for adding interactivity both exist but remain unlinked in most cases. This poses a problem since synchronicity is lost, and collaboration requires a common focus which, in broadcasting, is the broadcast content.
This proposal describes the challenges and working process of my PhD research in the field of computer science which focuses on collaboration in the broadcasting area. The main research issue is examining whether it is possible to expand 1:n parallel broadcasting into collaboration without the usage of parallel platforms. The main contribution is the development of a reference architecture for realizing such scenarios.

Categories and Subject Descriptors

H.5.3 [**Group and Organisation Interfaces**]: Collaborative Computing—*Synchronous Interaction*; H.5.1 [**Multimedia Information System**]: Video—*Interactive TV, Collaborative TV, MPEG-J*

General Terms

Design, Human Factors

Keywords

Collaborative TV, Interactive TV, Collaboration in Broadcasting

EuroITV2011, June 29th - July 1st 2011, Lisbon, PORTUGAL.

1. INTRODUCTION

In the past decade, digital and participatory broadcast technology have emerged besides the traditional analog, mainly passive (except simple interactive applications like teletext) and informative broadcasting.

Therefore the concept of collaboration in broadcasting is not completely new. A simple and well-established example is inviting the audience to vote for or against a person or an item as it is practised by most participatory reality and casting shows.

State-of-the-art work in collaborative broadcasting can be categorized firstly concerning to the boundedness to TV content (if it is (1) loose or (2) tied to TV content[1]) and secondly if it focuses either on (a) enhancing broadcast environments with collaborative services or (b) using parallel platforms (e.g., telecommunication features).
Case (1a) and (2b) were found quite often in state-of-the art work. Examples of (1a) are synchronous and asynchronous chats or commendation functions, tools for group building and recommendation [1, 3, 5, 6, 11, 12]. (2b) deals with participatory content, using parallel platforms for participation (mostly individual) and collaboration [13, 14]. The gap reveals in case (2a) describing collaborative applications enhanced to TV environments and tied to a certain (genre of) TV program format. Exceptional cases occur in T-Learning, for instance by Lópes-Nores [9, 10], and in entertaining TV by the LIVE system. The LIVE system provides passive collaborative influence on the content through the viewer's behavior (e.g., channel switching), which is observed by the broadcaster [7]. Case (1b) is not relevant for this work.

The main contribution of this PhD research is to create the missing link between medium, content and collaboration from a technical perspective.
In detail, the following three steps are comprised:
Firstly, the key feature is the development of non-linear and participatory broadcast content which invites the audience to become active instead of adding activity to passive, linear content. Secondly, the development of collaborative applications, which are embedded in the television environment. Thirdly, the realization of a linkage mechanism between the delivery medium, participatory content and the collaborative activity, regardless of whether the collaboration influences delivery medium and content.
Delivery medium (hence termed as *medium* or *media*) deno-

[1]Adapted from `http://soc.kuleuven.be/com/mediac/socialitv/results.htm`, introductory presentation, slide 7

tes the technical realization and representation of the content. Well-known media standards are, for example, MPEG-2 and MPEG-4 as employed in the digital video broadcasting (DVB) standard in Europe. Characteristics of the medium are metadata, frames, time stamps and other features that are defined by the used standard. Content defines the substance that is transmitted via the medium as abstract model (e.g., a movie or radio show) and consumed by the audience. Characteristics of the content are, for instance, start and end point(s), scenes and characters in scenes. Its course is defined by the narrative structure, timing and pace. Access to the content is provided via the medium by a mapping mechanism (mapping characteristics of the medium to those of the content).
I want to develop a reference architecture for realizing prototypical collaborative broadcast scenarios beyond the well-known voting. One option is to extend MHP[2] with collaborative support. This was, for instance, suggested in T-Learning by López-Nores [9, 10]. Another possibility is to use the MPEG-J framework [8], in MPEG-4 scenarios. For this research, I will pursue the latter possibility.

The next section presents the aim and objective of my research, including the main research questions. This is followed by a description of the methodologies applied and previous work. The paper concludes with prospects and future work.

2. AIMS AND OBJECTIVES

This research project aims to develop a reference architecture incorporating a pool of predefined collaborative services on the one hand and standard linkage mechanisms on the other hand. The architecture shall act as a tool kit for realizing a prototypical collaborative broadcast scenario.
The main research question "What is necessary to expand 1:n parallel broadcasting into collaboration?" implies five research challenges:

Q1: How can the linkage mechanism be designed?
This question addresses the challenge of linking collaboration with both, the medium and content.
Link to the medium: by linking to characteristics of the medium. For instance the audience is invited to participate a live chat to a certain topic, for a certain time period. The service is called, activated and deactivated by metadata embedded in and transmitted via the broadcast medium.
Link to the content: by linking to course or characteristics of the content. For instance activating a collaborative service to help a candidate answering a question in a game show. The linkage is realized by using the candidate, who is acting in the scene, as a hook point.

Q2: How must broadcast content be structured, and where are the hooks to link medium and content to collaboration?
Structuring the content is related to the content's storyline. The key is to design and produce participatory content that invites people to collaborate. Which genres are suitable?
For the linkage, a set of hooks must be defined, for instance, the appearance of a certain person or object in a scene of the content, the beginning of frames, time stamps or metadata in the medium.

Q3: How must collaboration be designed for this purpose?
Are existing collaborative mechanisms (e.g., communication mechanisms, concurrency control, context awareness) and tools (e.g., computer-supported cooperative work tools, rating and recommendation systems) applicable for this purpose and for connecting to the broadcast medium / content [4]? In addition, hooks in the collaboration that correspond to those in the medium and content, are necessary (e.g., to ascertain the majority, reactions and counter-reactions).

Q4: How can collaborative interaction be measured for further application in a collaborative broadcast scenario?
To use collaborative interaction for further application (e.g., to influence the course and characteristics of content), it is necessary to measure (e.g., the level of activity), analyze (e.g., outcome of the collaborative activity) and finally quantify (i.e., indicate the outcome of the measurement and analysis as numeric values) the collaborative activity.

Q5: What requirements and support must be satisfied?
In general, which technology best supports user participation and collaboration? Define technical requirements (e.g., a run-time environment), security requirements (e.g., privacy and resistance against attacks), exception handling (e.g., handling the unexpected drop-out of participants) and the manner of support for this real-time system.

3. METHODOLOGY AND PREVIOUS WORK

This section introduces the applied methodology, consisting of two main steps, and work done so far.

3.1 Step 1 - Descriptive and Non-Empirical Research

The descriptive and non-empirical research phase consisted of literary research work and scenario construction.

3.1.1 Step 1a - Literature Review

To classify the state-of-the-art work in "collaboration in streaming and broadcasting", as this work was initially entitled, it was necessary to construct a new taxonomy because, firstly, most of the existing taxonomies were too specialized (e.g., those covering the geometric structure of video content [2] and those relating to the network and the user interface) and, secondly, a focus on the linkage mechanism was missing completely. 32 approaches in this area were chosen for the state-of-the-art analysis with the aim to build a representative overview of scientific work done so far.

The taxonomy developed consists of six categories, namely the *narration space* of the content (to analyze whether the content is participatory), the *level of linkage* between collaboration and medium / content (to analyze if any linkage exists), the *scope of collaboration* (to analyze the level of collaboration), the *type of interaction* (to analyze the type of interaction used for the collaboration), *delivery medium* and *delivery network* (both to distinguish between streaming and broadcasting).

After conducting this analysis, it was necessary to focus on the linkage between collaboration and content. For this purpose, the results of the analysis were narrowed down by building five classes from the categories *level of linkage*, *narration space* and type of *delivery network*. The classification indicates whether linkage exists and, in case it does, (i) whether it relates to the content (storyline, topic, genre, etc.) or to the delivery medium (e.g., by changing the mediums state collaboratively from play to pause), (ii) to which type of content it links (linear or participatory) and (iii) whe-

[2]Multimedia Home Platform `http://www.mhp.org`

ther the linkage is realized by streaming or broadcasting. As mentioned in the introduction, linkage between content and collaboration has been realized in very few cases. In streaming, collaboration has been realized more frequently with focus on controlling the state of the medium collaboratively or enhancing the medium with interactive elements.

In the following, this work focuses on the broadcast area, to be more exact, on television environments. The decision is justified firstly on the mentioned findings, secondly on technological differences which make broadcasting more attractive for collaboration as for example:
- Connectivity - 1:n in broadcasting, 1:1 in streaming.
- Marked standardizations in broadcasting - DVB which uses MPEG-2 / MPEG-4 media format in Europe, by contrast in streaming where a lot of media formats are in use (e.g., Windows Media, Quicktime, MP4, Flash, ...). And thirdly the possibility to tie in with popular and in the broadcasting sector well-established participatory TV program formats which currently use parallel platforms.

In summary, the result of this step was an analysis of existing work. The lack of linkage mechanisms and reference architectures in broadcasting, and the prevailing usage of linear content became the starting point.

3.1.2 *Step 1.b - Scenario Building*

Based on these results, concrete story scenarios were built and in a next step classified and abstracted to deduce functional and non-functional requirements. The focal issues in the classification of these scenarios are, on the collaboration between the viewers (consumers side), and, on linking television medium / content and collaborative services (producer's or broadcaster's side). Summarizing, the consumer scenarios were classified and abstracted into a-/synchronous influence and non-influence of the medium and content as shown in Figure 1. The producer and broadcaster scenarios into enhancement and real-time change of the medium and content. This work focuses on synchronous scenarios.

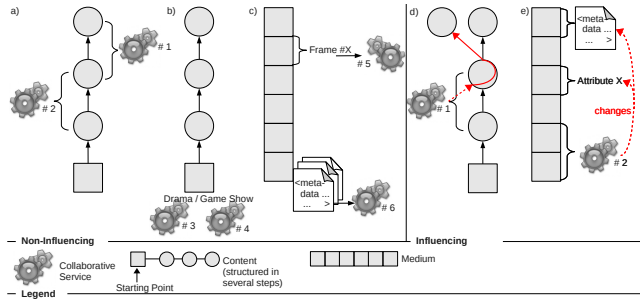

Figure 1: Schematic representation of collaborative services without influence (left side) and influence (right side) on medium and content

Consumer scenario: Non-influencing collaboration does not affect the characteristics of the linked medium (e.g., Figure 1c) or course and characteristics of the linked content (e.g., Figure 1a and b). An example would be to enable participation by providing a collaborative quiz service in conjunction with a broadcast quiz show. The quiz service is linked, for instance, to the genre, which is a characteristic of the content, and it is linked to the medium as it is, for example, initiated and terminated by metadata or by a certain attribute of the medium.

Consumer scenario: Influencing collaboration affects the characteristics of the linked medium (e.g., Figure 1e) or course and the characteristics of the content (e.g., Figure 1d). One example would be to provide a 60-second chat as a joker in "Who wants to be a millionaire". This service is linked to the content and influences its course, and it is linked to the medium, as it is provided for a specified time interval. Influencing the medium means for example, adapting the duration of the interval depending on the intensity of the collaborative activity.

Producer, broadcaster scenario: Enhancing content Prepare medium and content before broadcast for (non-) influencing collaboration by enhancing selected collaborative services and linkage.

Broadcaster scenario: Changing content Doing synchronized changes on the medium and content automatically and in real-time during the broadcast.

By abstracting and classifying story scenarios, functional and non-functional requirements were identified. Functional requirements include the enhancement and update of medium and content, provision of private and open groups, session management, notification of opportunity to participate, medium and content analysis.

3.2 Step 2 - Engineering Research

In the engineering research phase, the reference architecture (artifact) is modeled, developed and evaluated.

3.2.1 *Step 2.a - Model Construction (using UML)*

UML use cases are designed for the
1.) Producer's and broadcaster's view:
- Define and provide the collaborative services used.
- Enhance medium and content with selected collaborative services (by using MPEG-J).
- Provide methods and interfaces to define hooks in (a) the medium and content and (b) in the collaboration.
- Link hooks (a) and (b) by using the linkage mechanisms provided.

2.) Consumer's perspective (client):
- Provide a player that receives the incoming media stream and displays the decompressed video content. To enable participation, the player must analyze the characteristics of the received and decompressed medium and its content. Available collaborative services must be indicated to the viewer.
- Connect participants on the one hand, and provide a back channel to the broadcaster (server) on the other hand.
- Measure, analyze and quantify collaborative activity. Send results to the broadcaster (server).
- Provide support and exception handling.

3.) Broadcaster's perspective (server):
- Receive and analyze incoming quantified data from the consumers.
- Change medium and content with respect to the received data and their analysis.
- Compress and broadcast the modified media stream.

Each step of the model construction includes the determination and analysis of characteristics and requirements that are necessary on the medium and content, the collaboration and the linkage. This step will lead in answering the research questions *Q1* to *Q4* in a theoretical manner.

3.2.2 Step 2.b - Construction of an artifact

Based on the previously defined model, a layered reference architecture (Figure 2) will be developed in this phase. The

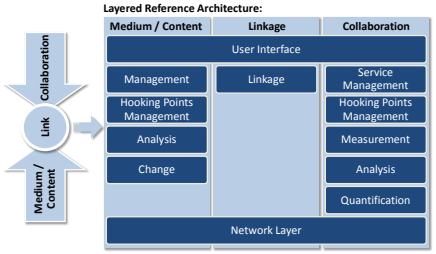

Figure 2: Schematic Representation of the Reference Architecture

reference architecture processes an MPEG-2 / MPEG-4 video stream delivered via IPTV and enables the implementation of a prototypical collaborative broadcasting scenario, as described in the previous sections and in step 1.b.
This step will lead in answering the research questions *Q1* to *Q4* in a practical manner.

3.2.3 Step 2.c - Destruction of an artifact

Destruction of the artifact includes testing and evaluation. Testing of this reference architecture will be conducted by building working prototypes of the defined collaborative broadcast scenarios. Due to a lack of time and money, the prototypes will use existing (and maybe linear) video content and consider the consumer's and the producer's, broadcaster's perspectives, as mentioned before. By building prototypes from this reference architecture, its functionality is proven. The prototypes in turn are examined by measuring the previously specified essential and desirable functional and non-functional requirements.
This step will lead in testifying the research questions *Q1* to *Q4* and answering *Q5*.

4. PROSPECTS AND FUTURE WORK

Having finished descriptive and non-empirical research and step a) of the engineering research, I have recently started constructing the artifact. During the next months I will develop a reference architecture as illustrated in Figure 2. Before developing the basic packages (*Medium / Content*, *Linkage* and *Collaboration*), an analysis of broadcast content (of medium and content) and of existing collaborative services will be done.

The reference architecture will be evaluated by realizing the already defined story scenarios (mentioned in step 1.b) prototypic. The prototypes will in turn be evaluated in terms of the previously elaborated essential and desirable functional and non-functional requirements. Since the design and production of a participatory broadcasting content format is beyond the scope of this work, the prototypes will be tested with existing broadcast video content. However to address the "big picture" and to give a complete example scenario, I will create a storyboard of a participatory TV program format. Its purpose is to illustrate the role of participatory content in any activity beyond passive watching of TV.

5. REFERENCES

[1] J. Abreu, P. Almeida, and V. Branco. 2beon: interactive television supporting interpersonal communication. In *Proceedings of the 6th Eurographics workshop on Multimedia 2001*, pages 199–208. Springer New York, 2002.

[2] S. Bachmayer, A. Lugmayr, and G. Kotsis. Convergence of collaborative web approaches and interactive tv program formats. *International Journal of Web Information Systems*, 6(1):74 – 94, 2010.

[3] E. Boertjes. Connectv: Share the experience. In *Proceedings of the 5th international conference on Interactive TV: a Shared Experience*, volume 4471 of *Lecture Notes in Computer Science*, pages 139–140. Springer, 2007.

[4] U. Borghoff and J. Schlichter. *Computer-Supported Cooperative Work - Introduction to Distributed Applications*. Springer Berlin, 2000.

[5] T. Coppens, L. Trappeniers, and M. Godon. Amigotv: A social tv experience through triple-play convergence. In *Proceedings of the 2nd international conference on interactive TV*, Brighton, UK, 2004.

[6] F. de Oliveira, C. Batista, and G. de Souza Filho. A3tv: anytime, anywhere and by anyone tv. In *Proceedings of the 12th international conference on Entertainment and media in the ubiquitous era*, pages 109–113. ACM, 2008.

[7] S. Grünvogel et al. A novel system for interactive live tv. In *Proceedings of the 6th international conference on Entertainment Computing*, pages 193–204. Springer Berlin / Heidelberg, 2007.

[8] ISO / IEC. *International Standard 14496: Information technology — Coding of audio-visual objects, Part 5: Reference software*, 2001.

[9] M. López-Nores et al. Technologies to support collaborative learning over the multimedia home platform. In W. Liu, Y. Shi, and Q. Li, editors, *ICWL*, volume 3143 of *Lecture Notes in Computer Science*, pages 83–90. Springer, 2004.

[10] M. López-Nores et al. Formal specification applied to multiuser distributed services: experiences in collaborative t-learning. *Journal of Systems and Software*, 79:1141–1155, August 2006.

[11] K. Luyten et al. Telebuddies: social stitching with interactive television. In *Proceedings of the 1st international conference on Human factors in computing systems*, pages 1049–1054. ACM, 2006.

[12] M. Nathan et al. Collaboratv: making television viewing social again. In *Proceeding of the 1st international conference on Designing interactive user experiences for TV and video*, pages 85–94. ACM, 2008.

[13] P. Tuomi. Sms-based human-hosted interactive tv in finland. In *Proceedings of the 1st international conference on Designing interactive user experiences for TV and video*, pages 67–70. ACM, 2008.

[14] M. Ursu et al. Interactive tv narratives: Opportunities, progress, and challenges. *ACM TOMCCAP*, 4(4):1–39, 2008.

All links were checked in April 2011.