

## **DECLARATION OF MARTIN L. KNOTT**

Declaration of Martin L. Knott Regarding  
Authentication and Public Accessibility of Publication

I, Martin L. Knott, declare as follows:

1. I am a librarian and Metadata and Linked Data Strategist within the University of Michigan Library's Technical Services Department, located at 913 S. University, Ann Arbor, MI 48109-1190. I hold a Master of Science in Information from the University of Michigan, where I studied library and information science. I joined the University Library in August of 1992. Through the course of my employment and based on the University Library's business records, I have personal knowledge of the University Library's normal business practices, including during the time period starting in the early 1990s. The University Library's normal business practices, which follows standard library practices, are described in further detail below.

2. This Declaration relates to the dates of receipt and public availability of the following:

**ten Kate, W. et al. (1997). *trigg&link : A new dimension in television program making. In Multimedia applications, services and techniques : ECMAST '97 : second European conference, Milan, Italy, May 21-23, 1997 proceedings (Lecture Notes in Computer Science, v. 1242). Berlin ; New York : Springer.***

3. Standard operating procedures for materials at the University of Michigan Libraries. During the late 1980s and through 2007, when a journal volume or other publication was or is received by the University Library, it would be checked in, stamped or inscribed with the date of receipt, added to library holdings records, and made available to library patrons or visitors (*i.e.*, the general public) for review,

Declaration of Martin L. Knott Regarding  
Authentication and Public Accessibility of Publication

photocopying, and/or borrowing as soon after its arrival as possible. This procedure normally took and still takes a few days or at most 2 to 3 weeks.

4. The image attached to this Declaration is a true and accurate copy of pages from *Multimedia applications, services and techniques* from the University of Michigan Library collection containing **trigg&link : A new dimension in television program making**. The acquisitions inscription indicating when this copy of *Multimedia applications, services and techniques* was received by the University of Michigan Library is located in the gutter of the page following the title as was standard when the book was acquired.

5. Based on the information in the attached image, it is clear that this copy of *Multimedia applications, services and techniques* was received by the University of Michigan Library on or before September 8, 1997, and catalogued and available to the public within a few days or at most 2 to 3 weeks after September 8, 1997, after which the public could search for it by at least subject matter, conference proceeding title, editor, year, and/or topic in the University of Michigan Library's online catalog, for example, by alphabetical or numerical year order in the physical catalogues or through word-searching the online catalog.

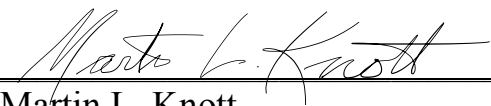
I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like

Declaration of Martin L. Knott Regarding  
Authentication and Public Accessibility of Publication

so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18  
of the United States Code.

Date: November 13, 2019

University of Michigan Library  
913 S. University  
Ann Arbor, MI 48109-1190

  
\_\_\_\_\_  
Martin L. Knott  
Metadata and Linked Data Strategist

## **NOTICE CONCERNING COPYRIGHT RESTRICTIONS**

The material copied here may be protected by copyright law in the United States and/or in other jurisdictions. This copy was made in compliance with U.S. copyright law and is provided to you for the purposes of private study, scholarship, or research.

If you use the copy for a different purpose, such as posting on a course website, the copyright analysis that supported making the copy does not apply. It is your responsibility to address copyright for any other uses. For assistance, you may wish to consult the library's guides to [Copyright Basics](#) and [Copyright and Course Websites](#). You can also contact the University of Michigan Library Copyright Office at [copyright@umich.edu](mailto:copyright@umich.edu).

Serge Fdida Michele Morganti (Eds.)

# Multimedia Applications, Services and Techniques – ECMAST '97

Second European Conference  
Milan, Italy, May 21-23, 1997  
Proceedings



Springer

ummu

QA

76.575

Series Editors

Gerhard Goos, Karlsruhe University, Germany

.E25

Juris Hartmanis, Cornell University, NY, USA

1997

Jan van Leeuwen, Utrecht University, The Netherlands

bks

Volume Editors

Serge Fdida

Laboratoire MASI/CNRS, Université Pierre et Marie Curie

4, Place Jussieu, F-75252 Paris Cedex 05, France

E-mail: serge.fdida@masi.ibp.fr

Michele Morganti

Italtel Spa

I-20019 Settimo Milanese (MI), Italy

E-mail: michele.morganti@italtel.it

Cataloging-in-Publication data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

**Multimedia applications, services and techniques : second European conference ; proceedings / ECMAST '97, Milan, Italy, May 21 - 23, 1997 / Serge Fdida ; Michele Morganti (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Budapest ; Hong Kong ; London ; Milan ; Paris ; Santa Clara ; Singapore ; Tokyo : Springer, 1997**

(Lecture notes in computer science ; Vol. 1242)

ISBN 3-540-63078-3

CR Subject Classification (1991): C.2, H.3, H.4, H.5, E.4

ISSN 0302-9743

ISBN 3-540-63078-3 Springer-Verlag Berlin Heidelberg New York

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1997

Printed in Germany

Typesetting: Camera-ready by author

SPIN 10550366 06/3142 - 5 4 3 2 1 0 Printed on acid-free paper

Samba Ex-1013

IPR2020-00216

Page 7 of 27

1077621  
9/8/97

3 9015 04136 5407

## Preface

ECMAST, the European Conference on Multimedia Applications, Services and Techniques, comes to its second edition at a turning point for the future of this whole sector. Trials throughout Europe, many of them organized within the context of the ACTS Programme, are beginning to deliver valuable results in terms of viable technologies, promising applications and, most of all, user responsiveness. Standardization bodies all over the world are now in the process of finalizing their baseline documents on reference architectures, delivery platforms and key interfaces, while national regulators are actively discussing and experimenting the rules that will condition the evolution and the future asset of this whole new business sector. Established operators, service and content providers, as well as newcomers, are busy trying to identify new business opportunities and to gain new market shares, while equipment manufacturers are working hard to provide them with the necessary technical solutions.

The ECMAST '97 Technical Program very much reflects this rapidly evolving situation and the main themes of debate that accompany it: the never-ending search for killer applications; the role of broadcast services and service providers; the overwhelming presence of the Internet. The number of proposed contributions exceeded 120: once more a confirmation of the heat that today exists around these topics, but also a formidable task for the Program Committee who had to select the 48 technical papers that, arranged in 15 sessions along two parallel streams, offered to the participants an exciting 3-day journey across the many facets and the many challenges of Multimedia. A key note speech on "Nomadic Computing" by Prof. L. Kleinrock completed the program, while a choice of technical visits on the second day and a full Tutorial Day on the preceding day complemented it.

ECMAST '97 is intended as an open forum where delegates from all key players can meet and discuss recent developments and emerging trends in multimedia technologies, services, and applications with an emphasis on practical results and field trials involving real users. It is also intended as a timely milestone for a comprehensive state-of-the-art assessment of the main outcomes and achievements of the 4th EU Framework Programme in view of the definition of the content and the objectives of the 5th.

We, as the Programme Committee co-chairmen, would like to thank all the authors for their contribution in assuring an excellent technical level for the conference. We would like to thank equally all the reviewers for the hard work spent meeting the tight schedule and a number of people for their efforts and commitment to making ECMAST '97 a success: the members of the Programme Committee, the members of the Steering Committee, and the members of the Organizing Committee, amongst whom an extra special vote of thanks is due to Paola Vaccari.

# Table of Contents

## 1. Multimedia Networks Evolution

An ATM-based Demonstration Model for Multimedia Services Using Different Access Networks <i>K. Achtmann, K.-H. Döring, R. Herber, G. Komp</i> .....	1
A Transnational IN/B-ISDN Integrated Network for the Provision of Multimedia Services <i>H. Hussmann, F. J. Herrera, R. Pasquali, P. Todorova, I. Venieris, F. Zizza</i> .....	19
Divide Your Systems to Conquer the Market <i>B.-E. Johansson, M. Andréasson, H. Flinck, M. Kalervo, O. Vuorenmaa, P. Hoepner, R. DaSilva</i> .....	37

## 2. Production of Multimedia Content

<i>trigg&amp;link</i> - A New Dimension in Television Program Making <i>W. ten Kate, A. Schoenmakers, N. de Jong, H. Charman, P. Matthews</i> .....	51
The ATLANTIC News Studio: Reference Model and Field Trial <i>R. Storey, A. Alves, J. Ruela, L. Teixeira, T. Andrade</i> .....	67
The Design and Implementation of a Multimedia System for the Interactive and Time-Synchronised Analysis of Vehicle Crash Tests <i>A. Cole, J. Robinson, C. Athwal</i> .....	79

## 3. Multimedia Networks and Protocols - Part I

Resource Management for Distributed Multimedia Applications <i>D. Waddington, C. Edwards, D. Hutchison</i> .....	95
A Multicast Network Architecture for Large Scale Collaborative Virtual Environments <i>C. Greenhalgh, S. Benford</i> .....	113
Consensus Making Activities in Europe: The Example of Multimedia in ACTS <i>E. De Hert, R. Guarneri, S. Malmros, K. Start</i> .....	129

## 4. Content Creation and Integration - Part I

Low Cost Watermarking Based on a Human Visual Model <i>J. F. Delaigle, C. De Vleeschouwer, F. Goffin, B. Macq, J.-J. Quisquater</i> .....	153
Image Database Indexing and Retrieval Using the Fractal Transform <i>J. M. Marie-Julie, H. Essafi</i> .....	169
DIANE: A Multimedia Annotation System <i>S. Bessler, M. Hager, H. Benz, R. Mecklenburg, S. Fischer</i> .....	183

## 5. Multimedia Networks and Protocols - Part II

Connectionless ATM Using an ATM Switch Router <i>M. Veeraraghavan, P. Pancha, G. Dommety</i> .....	199
Engineering Aspects of an Architecture for Non-Real-Time VBR Video Services <i>G. Meempat, A. Erramilli, W. Willinger</i> .....	213
Video on Demand Distribution Over ATM Virtual Private Networks <i>C. M. D. Pazos, E. M. Silva, M. Gerla, J. A. S. Monteiro, L. Fratta</i> .....	229

## 6. Content Creation and Integration - Part II

An Authoring and Run-Time Environment for Interactive Multimedia Services <i>S. Antoniazzi, C. Ievoli, E. Marcozzi, R. Penzo, M. Sturlesi</i> .....	245
Tools for Multimedia Content Creation, Manipulation and Management: The ACTS Perspective <i>E. Badiqué, A. Barbagli</i> .....	261

## 7. Multimedia Delivery

Interaction with Digital Broadcast Services Through a Terrestrial Return Channel <i>R. Allan, C. Taylor</i> .....	277
Dynamic Multiplexing for Digital TV Broadcasting <i>L. Teixeira, V. Teixeira, T. Andrade</i> .....	293
The Work of ACTS in Interactive Distribution and Transmission: Towards Interoperable Interactive Multimedia Services <i>F. Guirao, L. Van Noorden</i> .....	309
User Interfaces for Interactive TV - A Case Study with End Users <i>F. Koller, M. Burmester, A. Wöhr</i> .....	327

## 8. Coded Representation

Use of Object Articulation and Motion Estimation for Video Production <i>I. Kompatsiaris, D. Tzovaras, M. G. Strintzis</i> .....	343
A Multi-Site Teleconferencing System Using V.R. Paradigms <i>S. Valente, J.-L. Dugelay</i> .....	359
Object Encapsulation of Multiscale Image Region Representations <i>M. Brelot, G. Privat</i> .....	375
Subjective Assessment of a Multimedia System for Distance Learning <i>A. Kokotopoulos</i> .....	395

## 9. Multimedia Services

The Impact of Service Competition on Navigation <i>G. Schapeler, K.-H. Jerke, G. Grasshoff</i> .....	409
---	-----

Copyright Protection in Video Delivery Networks by Watermarking of Pre-compressed Video	
<i>F. Hartung, B. Girod</i> .....	423

A Fully Configurable Secure Environment for Multimedia Applications	
<i>J.-M. Mas Ribés, T. Delmot, B. Macq</i> .....	437

## 10. Multimedia Servers

Temporal and Interactive Relations in a Multimedia Database System	
<i>C. Djeraba, H. Briand</i> .....	457

Validation of Video Retrieval Systems	
<i>I. Krishnamurthi, S. Raman</i> .....	475

The KYDONIA Multimedia Information Server	
<i>S. Christodoulakis, N. Pappas, G. Kyriakaki, Y. Maragoudakis, Y. Mavraganis, C. Tsinaraki</i> .....	491

## 11. Internet and Multimedia

A Critique of Modern Internet Protocols: The Issue of Support for Multimedia	
<i>D. Hutchison, R. El-Marakby, L. Mathy</i> .....	507

A Congestion Control Scheme for Multimedia Traffic in Packet Switching 'Best-Effort' Networks	
<i>R. Bolla, M. Marchese, S. Zappatore</i> .....	523

User Requirements and Resource Control for Cooperative Multimedia Applications	
<i>M. Alfano</i> .....	537

Multimedia Multicast Routing	
<i>L. Rajesh Kumar, D. Janaki Ram</i> .....	553

## 12. Trials I

Swiss TopVision, the Trial With Interactive Content	
<i>D. de Lang, P. Balsiger, H. Eggenhuisen, P. Gardien, J. Jansen</i> .....	571

Consumer Interactivity in Cambridge	
<i>N. Harper</i> .....	581

Using DAB and GSM to Provide Interactive Multimedia Services to Portable and Mobile Terminals	
<i>Th. Lauterbach, M. Unbehaun, D. Angebaud, A. Bache, Th. Groult, R. P. Knott, P. Luff, G. Lebourhis, M. Bourdeau, P. Karlsson, R. Rebhan, N. Sundström</i> .....	593

ISIS Project - Demonstration System and Pilot Trials	
<i>F. Carducci, R. Giubilei</i> .....	609

### 13. Terminal Architecture

- An Open Software Architecture for Multimedia Consumer Terminals  
*S. Antoniazzi, G. Schapeler* ..... 621
- Using an Asset Model for Integration of Agents and Multimedia to Provide an  
 Open Service Architecture  
*P. Charlton, F. Espinoza, E. Mamdani, O. Olsson, J. Pitt, F. Somers, A. Waern*..... 635
- Definition and Implementation of a TINA Based Terminal Architecture  
*H. Vanderstraeten, J. Vanhoutte, V. Savin, P. Palavos, J.-M. Reynders, G. Bilsen*... 651

### 14. Applications

- Integrated Multi-Media Project: A Case Study in Lesson Sharing Using Video-  
 Conferencing Technology  
*P. Marsden, J. Ashworth, L. Griffiths, M. Taylor*..... 669
- Telelearning: New Trends in Education Through Global Multimedia Networks  
*Th. Zahariadis, A. Dede, I. Maffett, G. Stassinopoulos*..... 681
- The BONAPARTE Telemedicine ATM Multimedia Applications  
*E. J. Gómez, P. Cano, F. del Pozo, H. Rahms, L. Molina, N. Malpica, J. A. Quiles,  
 J. M. Alfonso* ..... 693

### 15. Trials II

- InfoCity NRW - A Phased Approach to Multimedia  
*A. Lindner, P. Trinkl, P. Walford, H. Westbrock*..... 709
- DIGISAT: A Technological Solution via Satellite for Interactive SMATV  
 Networks in the DVB Environment  
*J. Seseña, A. Molina, H. Prieto* ..... 723
- Multimedia Service Provisioning in the Munich Trial of the AMUSE Project  
*H. Elbert, J. Enssle, M. Frank, H. Hessenmüller, E. T. Hvannberg, T. Theimer* ..... 739
- VIDAS Workshop on Synthetic Natural Hybrid Coding  
*F. Lavagetto* ..... 755

**Author Index** ..... 771

# *trigg&link*

## A New Dimension in Television Program Making

Warner ten Kate<sup>1</sup>, Arno Schoenmakers<sup>2</sup>, Nick de Jong<sup>1</sup>,  
Helen Charman<sup>3</sup>, Pete Matthews<sup>3</sup>

(1) Philips Research Laboratories,  
Prof. Holstlaan 4 (WY21), 5656 AA EINDHOVEN, The Netherlands;  
(2) Philips Digital Videocommunication Systems;  
(3) Philips Corporate Design

**Abstract.** The merge of internet and television broadcast is discussed at application level: how can internet contribute to television other than Web-surfing? Two main service types were identified. Both relate to television program making. The first refers to the hyperlinking nature of the internet. It led to the concept of *trigg&link* where a linear, non-interactive television program is enhanced into a linear (parallel), interactive program. The second refers to using internet services within the television program, where the internet services are on a higher level than plain Web-surfing. The enhancement they provide is found in the additional information, additional service, and enhanced programming available through the *trigg&link* principle. Basic services are combined into packaged services.

The system principles are outlined to support such services. A scheme is proposed to extend URLs so as to support Web-to-Broadcast linking. The protocol stack to run interactive applications is presented. It is the scheme according to the MHEG and DSM-CC standards, compliant with the DVB and DAVIC specifications.

The *trigg&link* concept is used in *CleverCast*®, Philips' DAVIC-compliant end-to-end system for enhanced broadcast services.

### 1. Introduction

This paper reports on the results of some prototyping studies where it was aimed to enhance the television broadcast service by incorporating "internet". Internet has been placed between quotes as its appearance as a service rather than its technology is meant as the subject of study. Internet is supporting more and more entertainment-type of services, while the broadcast networks extend into an information medium through offering more and more data services. It can be expected that internet and broadcast networks will merge into a "single" net. Because the paper concentrates on this internet-broadcast issue, the telecommunication networks are not mentioned, but they clearly are part in this merge.

The current architectures and transmission protocols in both nets are optimized for their primarily goal. RTP, RSVP and RTSP at the internet side [1-3] and DSM-CC and MHEG at the broadcast side [5,6] are examples of technology to enable the new services. Being disjunct protocols, for a complete merge of the internet and broadcast networks, the use of gateways seems unavoidable. In case of data-broadcasting purposes, bridge techniques like IP-tunneling can be used to let the internet

applications benefit from the physical characteristics of the broadcast link (larger bandwidth; point-to-multipoint connections). Internet and broadcast, however, are not really merged.

The prototyping studies conducted to the appealing concept of so-called *trigg&link*. The appeal stems from the way the available technologies are used to offer the service. The service concept relates to television program making and can be split in two main areas. One refers to the use of internet, the other to the television program itself. Both are discussed in the subsequent sections. Some system aspects are discussed in sections 4 and 5. Section 6 presents the results from the first built prototype. The paper concludes with summarizing.

## 2. The Service Concept

Two major service types are apparent which enhance TV-broadcast by incorporating the internet. The first is Web-surfing, including email-like services. It is already widespread operational, e.g. [14]. The second refers to *trigg&link* and is based upon the hypermedia characteristic of the Web. In a first design the service is a program referring to some Web-site (e.g. displaying the URL), which can be visited by the viewer by a simple acknowledgement (e.g. clicking the URL). At the site the service carries on as an usual Web-surfing session, where after termination the original broadcast resumes (possibly, the audio continues all the time). Whereas Web-surfing is a service standing on its own, *trigg&link* gives it a relation with the TV program.

As the referred page is already known, it is obvious to insert that page in the broadcast stream along with the so-called trigger displaying the URL, so as to enable fast access. In a more general approach the *trigg&link* service then becomes: The program provider inserts triggers in the broadcast stream; they are related to the program's content and provide entrance to additional information (links). That information is located

- in another part in the broadcast stream (e.g. instant replay)
- on local storage (e.g. a subscribed DVD)
- at the internet (e.g. starting a Web-surfing session)

Downloading and caching information is a combination of the first two items.

In this set-up the added value is in providing additional information. A further step is to design the service so as to create added value in the domain of entertainment. An alternative further step is to benefit from the internet at service level. Both direct the art of television program making and are a step towards interactive television. They are discussed in the next two sections.

When speaking about merging internet and broadcast, it seems that most people think in terms of broadcasting on the internet, or using the broadcast channel to improve quality of (internet) service. In comparison, the combined use of TV-watching and Web-surfing has received little attention. The best known in this area is probably InterCast [15], although other schemes are also available [16,17]. In our view, *trigg&link* is part of this service family; the focus of *trigg&link* is to the TV- rather

than to the PC-environment. This translates, a.o., to the service approach: unified (single, main attention focus) versus multi-window (no hierarchy) presentation. Fig.1 illustrates. Another difference refers to the used technology, which in the case of *trigg&link* is entirely based upon digital television, being compliant with the (international) standards and specifications by DAVIC, DVB, MPEG, and MHEG [4-6,8].

Broadcast as it is known today is a linear, non-interactive service. The events succeed one after another, the viewer has no participation in it. In contrast, Web-surfing is a non-linear, interactive service. The viewer is in full command on the flow order of the Web-pages. "The" content provider has no contribution in the programming. *trigg&link* constitutes an intermediate as it provides a still linear, though interactive service. The viewer is involved in the actual display flow. The art of program making is challenged as next to creating a default route, an interesting palet of choices is to be programmed, such that the offered interactivity enriches the program.

### 3. Television Program Making

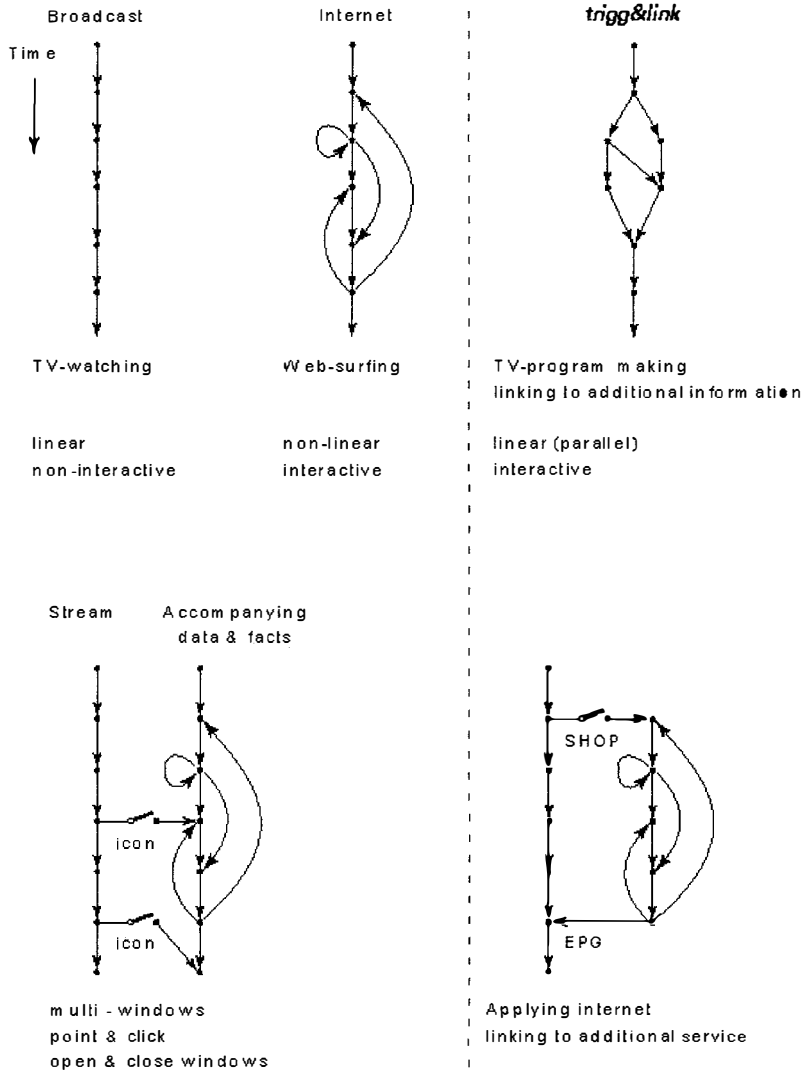
Current TV-programs are linear and non-interactive. The use of *trigg&link* should invite and guide the viewer to more entertaining value. In this paper it is assumed that the triggers and links appear visually. Clearly, other, or a combination of, modalities can be used as well. Three types of triggers are identified:

1. static
2. dynamic
3. living

Static triggers are present during the complete program. They relate to the program as a whole. An example is the EPG kind of information (Electronic Program Guide) having more detail than provided through the EPG itself (about the cast in a movie, etc.). Static triggers can be designed as part of a logo or being a dedicated button on the remote control.

Dynamic triggers are present during a part of the program. They relate to an actual event in the program. An example is to select an instant replay upon a highlight in a match (while the main stream continues displaying the match). The tasteful design of dynamic triggers is believed to enhance television watching.

Living triggers are the combination of a static trigger and a dynamic link. The trigger visualized on the screen remains identical, while the actual link adapts to the action in the program. The same database is entered at another node. Examples are the actual score in a match, the exact moment in a program, or a summary of the already passed parts. Living triggers should make the screen less flashing; the actual content determines the link.



**Figure 1. Approaches to program making**

The fourth variation would be that the trigger changes in its appearance (other than being an animation), while the link remains identical. This way of presentation is confusion rather than helpful.

It is obvious that multiple triggers can be presented at the same time and that the presentation of the triggers, i.e. the linked information they suggest, should be consistent.

There are three main ways to display the linked information: replacement, picture-in-picture, and overlay. In the first, the original video is completely lost and this option is only useful if the context allows such. Picture-in-picture can be in both directions (the linked information or the original video in the subscreen). It is a kind of windows approach. From the point of program making, it requires careful design and use. In that sense, overlay offers the best integration possibilities. Here, intelligibility is not always guaranteed.

The appropriate use of these link types depends on, a.o., the class of program: static or dynamic. In a static program the flow of events is slow allowing to drift away (replacement). In a dynamic program there is much action and additional information is preferred in a subscreen; the viewer decides where to focus his attention.

As Fig.1 illustrates, *trigg&link* is still linear programming, but has parallel instead of only sequential streams. A drawback of this linear character is that the viewer does not know in advance which triggers he can expect, and to what additional information they will alert. Also, after a link-offer has been passed he might want to (re)inspect that information, still in the context of the running program.

A way out is to provide the program with a kind of Table-of-Contents (TOC), summarizing the program's triggers. This TOC is accessible during the full length of the program (static trigger). Next to listing the triggers, it can also be implemented as a means for direct access to (some of) those listed links. That access might be along another path than the access during the alerting period in which the trigger is displayed (e.g., a path to local disc or internet against a path to the broadcast stream). As a consequence, the TOC is a non-linear program part.

Being a static trigger the TOC can be combined with other static trigger functions, e.g., the detailed EPG-like information. The TOC can also offer links to information and services of which the viewer will not be alerted dynamically.

#### **4. Applying Internet in TV-program making**

In the previous section the main benefit of the internet is its (possible) use as a database, saving in the preparation and design of links in a *trigg&link* program. (Vice versa, designed pages can be added to the Web.) This section concentrates on the explicit use of internet as a provider of additional service.

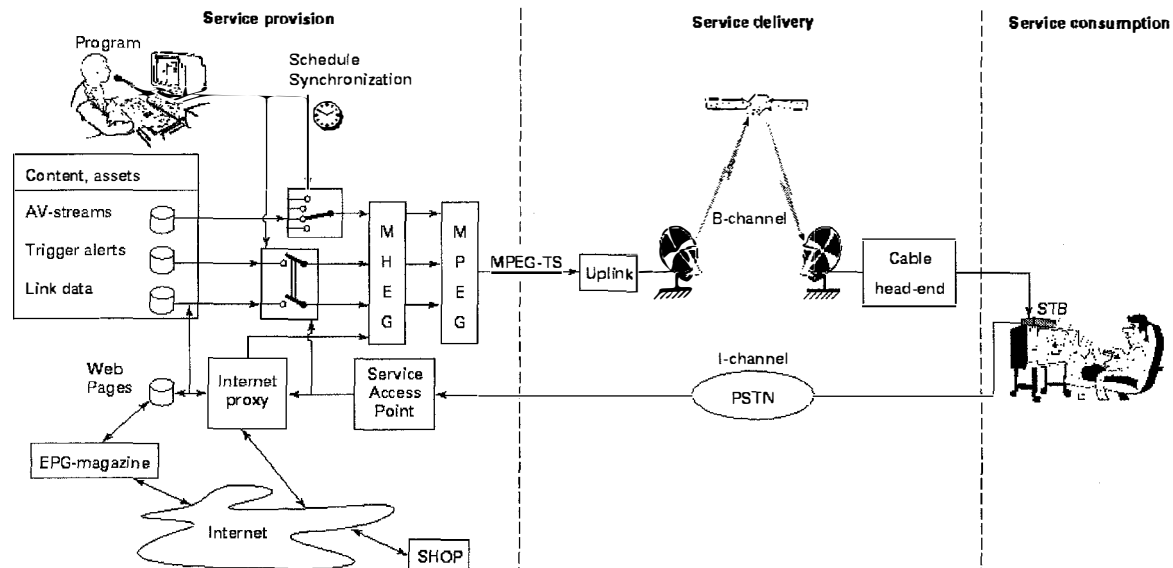


Figure 2. The enhanced broadcast model to run trigger&link

Fig.2 depicts the general model for enhanced broadcast [11]. The service provision part is connected with a service consumption part through a service delivery part. The main component in the service consumption is the set-top box (STB). Service delivery consists of a broadcast channel (B-channel), drawn as a satellite connection, and an interaction channel (I-channel), annotated as a telephone connection. The service provision part is drawn with a little more detail.

Centrally in the service provision stands the broadcaster, who provides the programs which are extended with the *trigg&link* functionality as described. The triggers and links are stored beforehand in a database and multiplexed with the program upon broadcast (could also be executed beforehand). The broadcaster programs the interrelation between the different content and assets using MHEG [6], the material plus the MHEG-application are multiplexed into a MPEG Transport Stream [4]. The proxy server fetches Web-pages from the internet, and stores them for later broadcast or forwards them for immediate broadcast. The fetching request is issued by either the broadcaster or by the user. Two cases are shown where the user connects to the internet in the context of a broadcast program.

The first case refers to a home-shopping site (SHOP). Some event in the program has a relation with the offered products by the SHOP. Through the *trigg&link* functionality the viewer is alerted for the possibility of sale and is invited to link to the SHOP's home page. That home page is still typically located in the broadcast stream. However, if the viewer wishes to do some home-shopping, the application connects to the internet, and, using the internet home-shopping application, the sale is settled. After the session, the viewer returns to his original program.

In this paradigm the viewer moves from broadcast to internet. The broadcast provides a service by piggy-backing on the internet. In the second paradigm the viewer moves from the internet to the broadcast. The shown case is the site of the broadcaster himself. At the site an extensive EPG is offered; next to schedule lists, the EPG also offers more magazine-like features such as critic's choice and program backgrounds, (or *trigg&link* pages!). *trigg&link* enables to link directly from the EPG to a program in the broadcast stream.

The URL identifying the particular program needs to include information about the broadcast stream in which the program is located. In the European Digital Video Broadcasting project (DVB) such ID has been defined and standardized in the Service Information (SI) definition [9,10]. In DVB all channels (called service in DVB) are uniquely identified through a triplet of identifiers named *original\_network\_id*, *transport\_stream\_id*, and *service\_id*. A program in such a channel (called event in DVB) is identified through the so-called *event\_id*. Clearly, the URL should contain at least the triplet information. The "Web-browser" is extended with the STB's navigation software, combining the link information with the SI-data.

To assist the browsing communication, it is helpful if the URL is extended with some scheduling information (*event\_id* or begin/end-like timing; the *event\_id* provides the entry to the timing information listed in the SI-data). Note, that this information is different from a command suite controlling the play back (play, pause, stop, etc.). It specifies the scheduling information as pushed by the broadcaster, whereas the latter

is about scheduling through pulling by the user. The URL serves to identify the object, its play-out can be through protocols like DSM-CC [5]. Other sub-information in the URL could be to select a particular stream out of a program or channel (e.g., only the audio component) or a particular data-object in case of data broadcast. This schedule and sub-information is not always needed, for example, if the URL is a general link to a broadcast channel.

In conclusion, an URL linking to a DVB-broadcast program could look like:

dvb://<triplet>:<time-window>/<sub-selection>/

where dvb: indicates the broadcast protocol, <triplet> contains the channel information, <time-window> directs the program's availability, and <sub-selection> specifies further sub-information. At least the dvb: and <triplet> fields should be mandatory, the <time-window> and <sub-selection> fields are optional and have different formats (detail and scope of information).

Aside from the discussed Web-example, other appearances of the URL can be on a disc (multimedia magazine containing an EPG) and in email-like messages sent to a TV-watcher (chat about, including a link to, a program).

## 5. Service Architecture

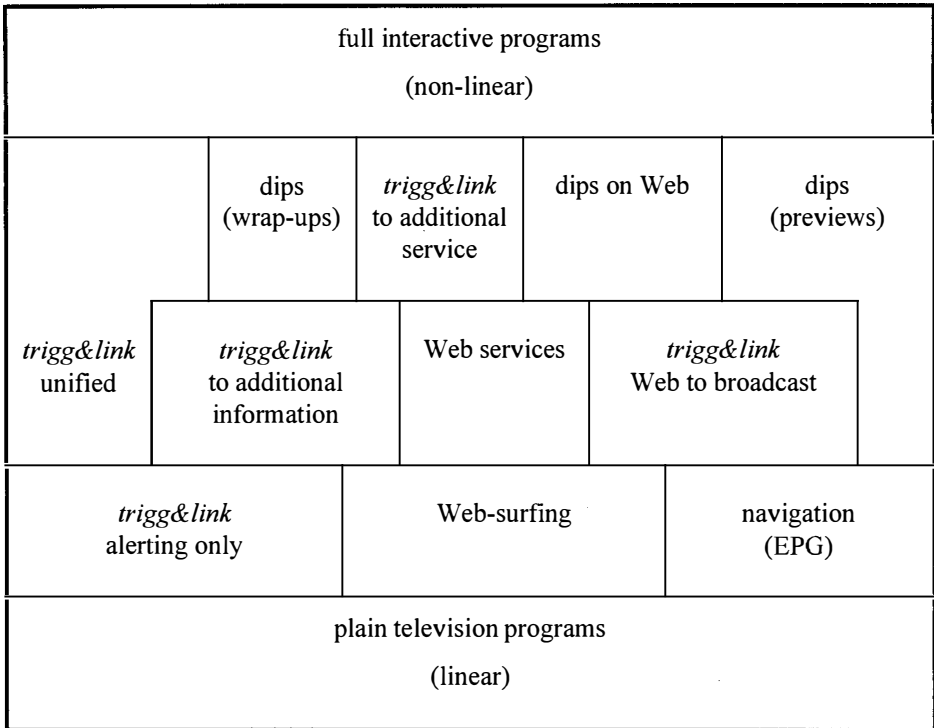
Publications on services enabled by multimedia-associated technologies quite commonly report the services themselves and their realization/implementation. Instead we are challenged to set up a service-architectural framework within which services could be decomposed, enabling for their referencing and comparison and leading to functional interfaces designed for reusability in future extensions. In this section a proposal is done in that direction. Some system aspects are discussed as well.

The previous sections discussed how the concept of *trigg&link* can be used in television program making. It is an intermediate between current linear television programs and future full-interactive programs. The various services can be organized in a layered hierarchy as depicted in Fig.3. The idea is that each higher layer extents on the services provided in its layer below. From this the contours of required system tools can be indicated. The hierarchy is not complete. Multi-user aspects, including communication, are left out, for example. More layers are involved before full interactive programs are reached.

The bottom and upper layer represent the two extreme types of television program making. The second layer shows three services as currently being introduced. They are the alerting function (e.g., advertising the URL of some Web-site), Web-surfing (on your TV), and navigation (EPG). The next two layers represent some service additions to enable more integration with the television programs using the *trigg&link* concept (the Web-services block is still separated from the television program).

The vertical direction has an evolutionary meaning. Horizontally, the left-hand side refers to interaction within the program, i.e. the control of program flow, while the

right-hand side refers to interaction about the program, i.e. the selection of programs. The left-hand side focusses on dynamic triggers, the right-hand side on static triggers.



**Figure 3. The service hierarchy of television program making around *trigg&link***

Having the several services organized, it might be wondered how they relate to the application layer of the OSI reference model (ISO) [13]. The OSI-model organizes the hierarchy of communication protocols in a distributed (computer) system. It defines 7 layers, which range from physical layer to application layer. One of the principles of the OSI-model is that, within each layer of the protocol stack, the distributed entities have a peer-to-peer communication. Actual communication is through using the services offered by the next lower layer.

Borrowing this principle to structure the services in the hierarchy, leads to the following concept. The services offered to a user of a system operate in a peer-to-peer way between user and service provider, actual communication is through the applications running on the system. Two types of services are identified: basic and packaged. Basic services are the familiar single-entity applications like TV-watching and Web-surfing. Packaged services are the applications which combine basic services, offering ease-of-use. Examples are *trigg&link* or tools to navigate through and to organize (basic) services. Roughly, the services in the first and second layer in

Fig.3 belong to the basic services, those in the next two layers belong to the packaged services.

The concept is illustrated in Fig.4. The lower three layers reflect the OSI-model. According to the identification of basic and packaged services, a division is made into application and package layer. The first contains the group of basic application operations, whereas the second contains the packaging of these operations. The package layer delivers its “service” to the user. The latter layer is an abstraction, of course. It contains psychological instead of system entities. The user perceives the service in a peer-to-peer way, i.e. system independent, however, the quality-of-service he experiences does depend on the used system.

Layer	Example			
user (content layer)	entertainment	information	communication	operational control
package layer (application layer)	navigation	<i>trigg&amp;link</i>	program related communication	GUI
application layer	select and display TV-program	request and display Web-page	compose and mail message	download and execute script
presentation layer	content format	data format	message format	script binaries
transport and network layers	broadcast	internet	telephone	local storage

**Figure 4. Identifying a package layer between user and application layer**

Current applications are designed to interact directly with the user; they offer their service to the user (one of the reasons impeding ease-of-use). The packaging-type applications are designed similarly, communicating with the user and presentation layer (and lower) in parallel with the stand-alone applications. The presented model organizes the two types of applications in a serial way, in which the stand-alone applications are redesigned into building blocks to interchange with the package layer, and in which the packaging applications take these building-block services to communicate with the user. As a consequence, the package layer might be idle (the end-service is a single-entity one).

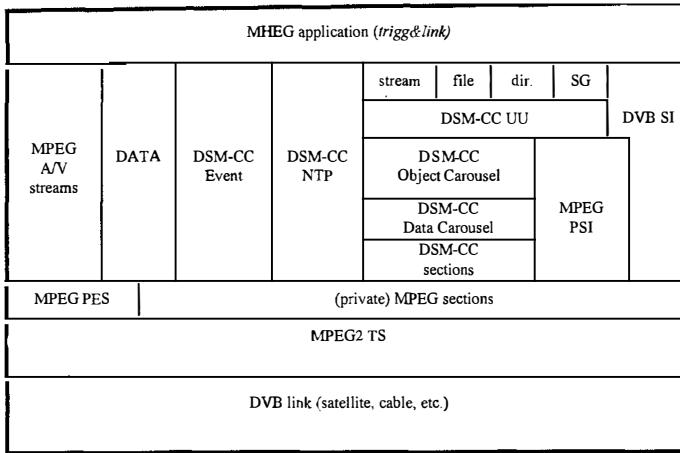
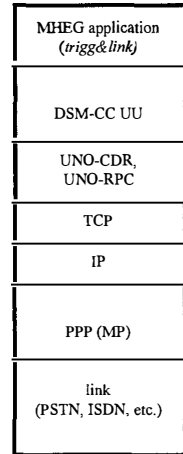
The model of Fig.4 reflects that basic services can operate on their own protocol stack and the packaged services take care of the change over to another stack, if required. Instead of running different protocol stacks, bridges and alike can be used to transform between stacks. The dashing of the vertical lines in Fig.4 expresses both transitions (the listed entries are examples; the stacks they form are not necessarily the only and preferred ones).

In preparing for full interactive systems which have their roots in different networks, this model suggests that the basic services forming a coherent group should be supported on a single stack optimized for that set of services. The full system's functionality will be obtained through a gateway. The layer where this gateway will apply as well as its position in the system's architecture are points for further optimization.

As an example consider the addition of internet to television broadcast. The relevant services are Web-surfing, *trigg&link*-to-additional-information, and *trigg&link*-to-additional-service, Fig.3. Web-surfing is a basic service and might have its own implementation. Web-services are rapidly developing, but it is not yet clear what their final structure will be (e.g., there is no clear security mechanism). Therefore, it is too early to anticipate the proper system to support *trigg&link*-to-additional-service.

Sec.2 shows that *trigg&link*-to-additional-information merely operates within the broadcast environment: the additional information is likely to be transmitted along with the broadcast program. The service fits on the broadcast protocol stack; excursions to the internet are realized at the package layer, e.g., using the I-channel and proxy server as sketched in Fig.2.

Using today's technology *trigg&link* can be implemented by using MHEG [6]. The MPEG-4 standardization work might come up with interesting alternatives [7]. In the digital television environment the DVB-project is completing a standard for the protocol stacks to support such services [11,12]. The standard is in line with the DAVIC specifications [8]. Based on these stacks the *trigg&link* services could be implemented as depicted in Fig.5. The application is supplied as a MHEG script, which is found as a file object in the DSM-CC UU carousel [5]. The particular place to identify the carousel is indicated in the Program Map Table (PMT) describing the program associated with the *trigg&link* service. The PMT is part of the MPEG PSI (Program Specific Information) [4]. The audio and video streams of the program are transported in the multiplex as usual [4]. Their positions in the multiplex are also indicated in the PMT. The DVB SI extends the PSI, a.o. to support easy navigation [9,10]. The MHEG-application can use the SI, for example, to support an EPG-service. Finally, the *trigg&link* data (triggers and links) are transported as file- or stream-objects in the DSM-CC UU carousel.

**B-channel:****I-channel:****Figure 5. The system protocol stack to run trigg&link.**

Interactivity in the MHEG-application is driven by the broadcasted events or by the user's actions. The broadcasted events are transported through DSM-CC as well, using the NPT (Normal Play Time) as time base. User actions either react on a broadcasted event or represent a request to the service provider. The user communicates with the MHEG-application, which either executes the reaction or forwards the request. A user's reaction can also be an answer to a broadcasted question. In that case the reaction is also forwarded. The return messages are transported along the I-channel using the stack depicted in Fig.5. As the I-channel can be bi-directional, the messages to the user can also be transmitted along that (point-to-point) channel.

## 6. Prototype

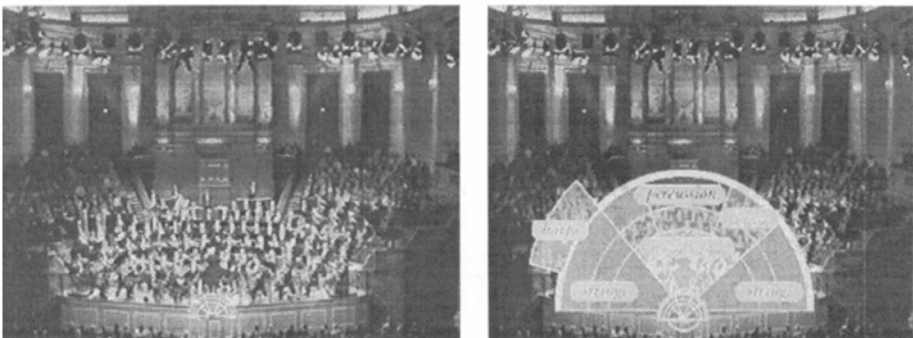
Several prototypes have been built to experience the service concepts described. One such prototype is presented in this section. A release from a classical concert was taken as base program. It was enhanced with five different triggers and links. A TOC of these triggers was designed as well, providing direct entrance to the five links plus an entrance to an additional link for purchasing the CD of the concert, see Fig.6. This purchase could be performed on the internet, in that sense being an example of using internet services within the broadcast. Another such example in this paradigm is the ticket ordering for an upcoming concert.



**Figure 6. The Table of Contents listing the triggers and links offered in the program**

An example of switching from internet to broadcast would be the switching from the hall's Web-site to the (live) broadcast, through clicking on the site's announcement of the concert. It is the same site as where the ticket ordering can be arranged.

The three ways to present links were designed (replacement, picture-in-picture, and overlay). Extra information about the composer was provided as a slide-show, information about the conductor kept the main video in a subscreen, and information about the music was displayed in overlay. The composer trigger is an example of a static trigger; the information can be accessed during the complete concert. The conductor trigger is an example of a dynamic trigger: the trigger is available if the program displays the conductor. The music-style trigger is an example of a living trigger: the trigger remains identical, however, the linked information depends on the particular movement in the concert. Fig.7 shows another example of a dynamic trigger: upon the full-orchestra views the orchestral layout can be inspected. Subpages list the particular instruments in each instrumental group.



**Figure 7. Example of a dynamic trigger offering information about the orchestra:  
Left the trigger, right the link explaining the orchestral layout**

The prototype was evaluated through a questionnaire. The outcome was that most people appreciated this new way of program making. All answers indicated that triggers and links should be designed for optimal fit to the video material such that a true integration results. The triggers should be non-intrusive, still clearly indicating that additional information is available and what that information will be about. The latter can be relaxed somewhat, as some noted that it can also be fun to discover the content of the linked information. Offering different levels of information depth, e.g. through slider-like triggers, is seen as a way to tailor programs to personal needs and thus to broaden the audience scope. The idea of receiving context specific information was considered more convenient and direct in comparison with using the internet or teletext. When handling detailed information or conducting detailed searches a regular browser may be more suited.

## 7. Conclusion

The results were presented of a study on enhancing television broadcast by incorporating “internet”. Two main service types were identified. Both relate to television program making. The first refers to the hyperlinking nature of the internet. It led to the concept of *trigg&link* where a linear, non-interactive program is enhanced into a linear (parallel), interactive program. The second refers to using internet services within the television program, where the internet services are on a higher level than plain Web-surfing. The enhancement is found in the additional information, additional service, and enhanced programming available through the *trigg&link* principle. Basic services are combined into packaged services.

The system principles were outlined to support such services. A scheme is proposed to extend URLs so as to support Web-to-Broadcast linking. The protocol stack to run interactive applications is presented. It is the scheme according to the MHEG and DSM-CC standards, compliant with the DVB and DAVIC specifications.

The *trigg&link* concept is used in *CleverCast*<sup>®</sup>, Philips’ DAVIC-compliant end-to-end system for enhanced broadcast services.

## 8. Acknowledgement

Many people contributed in developing the concepts and in realizing the prototypes presented in this paper. The authors wish to express their gratitude especially to Patrick Deunhouwer and Gé van Lier of Philips Research and Astrid Dobbelaar, Mark Hartevelt, Sandra Nicholson, Judith Rattle, Guy Roberts, Ingrid van der Zon of Philips Corporate Design.

## 9. References

- [1] Real Time Protocol (RTP), Audio/video transport (avt) charter, <http://www.ietf.org/html.charters/avt-charter.html>

- [2] Resource Reservation Setup Protocol (RSVP), RSVP-charter, <http://www.ietf.org/html.charters/rsvp-charter.html>
- [3] Real-Time Streaming Protocol (RTSP), W3C activity: Real-time multimedia, <http://www.w3.org/pub/WWW/AudioVideo/Activity-new.html#RTSP>
- [4] ISO/IEC International Standard IS 13818-1 (MPEG-2), Information technology - Generic coding of moving pictures and associated audio information, Part 1: Systems.
- [5] ISO/IEC International Standard IS 13818-6, Information technology - Generic coding of moving pictures and associated audio information, Part 6: Digital Storage Media - Command and Control (DSM-CC).
- [6] ISO/IEC International Standard IS 13522-5 (MHEG), Information technology - Coding of multimedia and hypermedia information, Part 5: Support for base-level interactive applications.
- [7] ISO/IEC 14496 (MPEG-4), International Standard scheduled November 1998, [http://drogo.cselt.stet.it/mpeg/mpeg-4\\_description.htm](http://drogo.cselt.stet.it/mpeg/mpeg-4_description.htm)
- [8] Digital Audio Visual Council, DAVIC 1.x specifications, <http://www.davic.org/WORKPLAN.htm>
- [9] European Telecommunications Standards Institute (ETSI), Digital broadcasting systems for television, sound and data services; Specification for Service Information (SI) in Digital Video Broadcasting (DVB) systems, ETS 300 468, 1996.
- [10] European Telecommunications Standards Institute (ETSI), Digital broadcasting systems for television; Implementation guidelines for the use of MPEG-2 systems; Guidelines on implementation and usage of service information, ETR 211, 1996.
- [11] Digital Video Broadcasting, Draft Specification - Network Independent Protocols for Interactive Services, 1996.
- [12] Digital Video Broadcasting, Guidelines for Use of DVB-SIS Specification - Network Independent Protocols for Interactive Services, 1996.
- [13] A.S. Tanenbaum, Computer networks, Prentice Hall, 1988.
- [14] WebTV, The Internet on your TV, <http://www.webtv.net/>
- [15] InterCast Industry Group, Linking television and the internet on the PC, <http://www.intercast.org/>
- [16] Wink, <http://www.wink.com/>
- [17] HyperTV, <http://www.hypertv.com/>