



# LINKEDTV



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**Deliverable 9.1.1** Annual Project Scientific Report

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## PROJECT PERIODIC REPORT

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<sup>1</sup> • PU = Public

- PP = Restricted to other programme participants (including the Commission Services)
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# **1 Publishable summary**



## Television Linked To The Web

### What is LinkedTV?

LinkedTV is an integrated and practical approach towards experiencing Networked Media in the Future Internet.

Networked Media will be a central element of the Next Generation Internet. Online multimedia content is rapidly increasing in scale and ubiquity, yet today it remains largely still unstructured and unconnected from related media of other forms or from other sources. This cannot be clearer than in the current state of the Digital TV market. The full promise and potential of Web and TV convergence is not reflected in offerings which place the viewer into an Internet closed garden, or expect PC-like browsing on a full screen Web, or offer interesting new functionalities which however lack any relation to the current TV programme.

Our vision of future Television Linked To The Web (LinkedTV) is of a ubiquitously online cloud of Networked Audio-Visual Content decoupled from place, device or source. Accessing audio-visual programming will be “TV” regardless whether it is seen on a TV set, smartphone, tablet or personal computing device, regardless of whether it is coming from a traditional or new media broadcaster, a Web video portal or a user-sourced media platform. Television existing in the same ecosystem as the Web means that television content and Web content should and can be seamlessly connected, and browsing TV and Web content should be so smooth and interrelated that in the end even “surfing the Web” or “watching TV” will become as meaningless a distinction as whether the film is coming live from your local broadcaster, as VOD from another broadcaster, or from an online video streaming service like Netflix.

As a result, not only commercial opportunities but also opportunities for education, exploration and strengthening European society and cultural heritage arise. Imagine browsing from your local news to Open Government Data about the referenced location to see voting patterns or crime statistics, or learning more about animals and plants shown in the currently viewed nature documentary without leaving that show, or jumping from the fictional film to the painting the character just mentioned to virtually visiting the museum when it can be seen, or seamlessly accessing additional information that has been

automatically aggregated from multiple sources in order to get better informed on an important event that was just mentioned in the news.

Technologically, this vision requires systems to be able to provide networked audio-video information usable in the same way as text based information is used today in the original Web: interlinked with each other at different granularities, with any other kind of information, searchable, and accessible everywhere and at every time. Ultimately, this means creating hypermedia at the level of the Web. The Web's original success was the underlying hypertext paradigm built into HTML. Hypermedia has been pursued for quite a while as an extension of the hypertext approach towards video information. But it needs complex video analysis algorithms and is still an issue of research. LinkedTV provides a novel practical approach to Future Networked Media.

The result will make Networked Media more useful and valuable, and it will open completely new areas of application for Multimedia information on the Web.

## How to solve the interlinking of Web and TV

To enable a new generation of online applications which can interweave TV and the Web several research challenges need to be overcome. These are the subject of the collaborative research in the LinkedTV project. Manually connecting TV and Web content is costly both to create and maintain, and it does not scale. A key goal of LinkedTV is to develop tools and approaches to better automate the preparation of content via shared annotations, and the creation of links between content based on those shared annotations. Firstly, **intelligent video analysis** can identify concepts of interest in the spatial and temporal segments of video. Hybrid approaches combining textual, audio and visual feature extraction maximize the accuracy of automated analysis, lowering the overall cost of generating annotations of large scales of video material.

The concepts in the analysis results are mapped into shared Web based vocabularies, using Linked Data sources such as DBpedia or GeoNames. This Linked Data based annotation is the basis for the **hyperlinking to Web content**, which has been subject to annotation with the same concept vocabularies. As a result, video is enriched at a fragment level with Web based content.

HTML5 and HbbTV based hypervideo players will enable the LinkedTV experience across different devices including SmartTVs and tablets. Those **presentation engines** will be implemented for both single and dual screen usage, providing an **intuitive interface** to the LinkedTV scenario enrichments in a **contextualized and personalized** way. Three **scenarios** guide and inform LinkedTV in terms of the content to use and the experience to offer. With public broadcaster RBB the regional news can be enriched with topical content addressing different viewers' interests. With cultural heritage archive Sound and Vision, Europe's rich heritage is brought closer by linking to it from TV programming. Finally, more explorative usage of interactive TV will be performed by the University of Mons, for example by making use of the possibilities of gesture control and behavioural tracking in front of TV.

A **LinkedTV platform** will provide access to the functionalities of the LinkedTV experience: annotation, linking and playout. Therefore it encapsulates a set of components into an end-to-end workflow, which cover the research challenges of the project: media analysis, annotation, hyperlinking, enrichment personalization and integrated playout.

## Work performed and achievements in Period 1

In our first year the consortium concentrated the work on the topics presented in the following. We also highlight first achievements of this Period 1.

### **State of the art and requirements analysis for hypervideo**

To start the research on hypervideo analysis an in-depth state of the art and requirements analysis for hypervideo was conducted and reported (D1.1). Based on those findings, a number of pre-existing hypervideo analysis techniques were evaluated. In addition first new techniques going well beyond the state of the art were developed and already tested on LinkedTV content or by participating at international benchmarking activities (TRECVID Multimedia Event Detection Task).

### **Introduction and standardization of Media Fragments URI**

Media Fragments URIs are the basis of the LinkedTV vision since they will enable to enrich seed video program at the fragment level. We have continued to work with the W3C Media Fragments Working Group in order to push the existing specification to the final W3C recommendation stage. In addition the first version of the LinkedTV ontology for representing multimedia metadata was designed and modelled and a framework for enriching seed video program with multimedia content and encyclopaedia knowledge was set up.

### **Design and implementation of first user interface mock-ups**

Before designing a user interface, it is important to investigate the user needs. Therefore, categories of user goals and functional requirements were derived from a review of literature on hypermedia and interactive television. First user interface mock-ups for the LinkedTV system were designed and some of them were already implemented in first basic prototypes.

### **Creation of a first version of the LinkedTV Use Model Ontology**

In LinkedTV with its rich content it is essential for the users to get support in finding the kind of content they are interested in and to make use of the rich relations between multimedia items on the Web. Therefore user models to represent the different kinds of interests people may have in multimedia content are needed. A first version of the LinkedTV Use Model Ontology (LUMO) has been created for this purpose.

### **Development of a basic LinkedTV platform architecture**

For the integration of hyperlinks in videos for an interactive, seamless usage of video on the Web a platform is required. The platform has to deal with the automatic identification of media fragments, their metadata annotations and with connections to the Linked Open Data

Cloud. A platform architecture was designed which covers the server and client side based on the requirements derived from the LinkedTV scenarios.

### **Specification of LinkedTV scenarios**

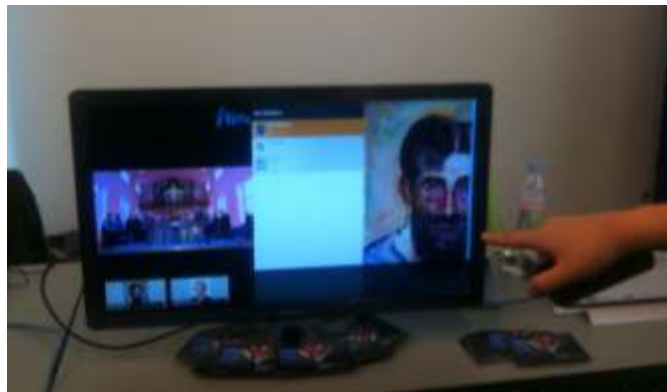
A news and a documentary scenario were specified on the basis of professional requirements (production workflow, regulation and strategy) and user interests (market research). The two scenarios give a background and motivation for the research and development work and define relevant media and content for annotation and enrichment (LinkedTV content). Accordingly, related content was provided.

### **LinkedTV workshop on Future Television**

LinkedTV held on the pre-conference day of the EuroITV 2012 the 3<sup>rd</sup> edition of the Future Television workshop. After a full program of talks, we finished with an interesting demo and a group discussion around what Future TV would be like.

### **First LinkedTV demonstration**

Besides the creation of a considerable number of scientific publications, which can be found on our website, LinkedTV already showed a first technology demonstration at the EuroITV 2012 conference in Berlin. The demonstrator is based on the documentary scenario and uses as its seed content the Dutch TV programme 'Antiques Roadshow'.



Via a TV and simple remote control interaction the viewer can select concepts of interest in the programme and access a set of Web based contents such as images, wikipedia pages or websites.

## **Contact**

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**Duration:** 42 months

**Funding Scheme:** FP7-ICT collaborative project

**Project number:** 287911

**Project Coordination:** Joachim Köhler, Fraunhofer IAIS

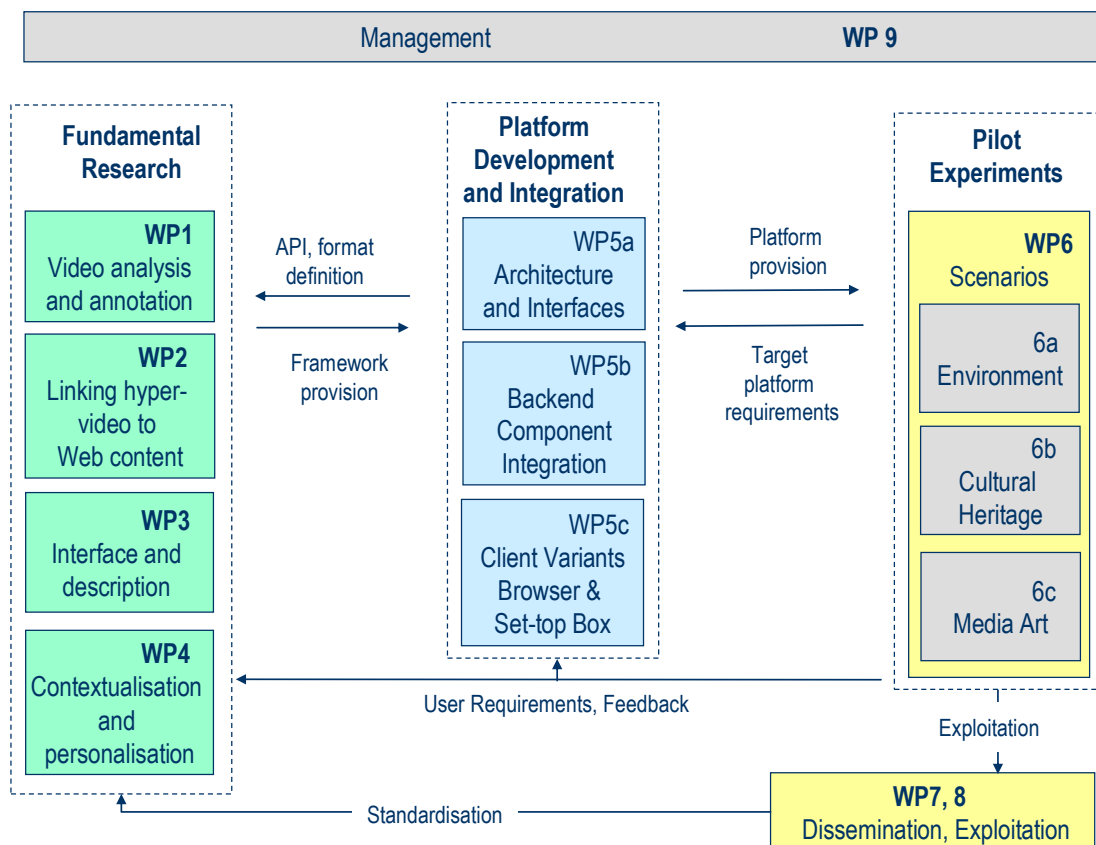
**Project Scientific Coordination:** Lyndon Nixon, STI

For more information, please visit our website: <http://www.linkedtv.eu>



## 2 Project objectives for the period

The overall goal of LinkedTV is to demonstrate “Television linked to the Web”. This is represented by a set of **scenarios** (WP6) which correspond to the benefits of seamlessly interweaving Web and TV content into an integrated experience. The scenarios will be made possible by a **LinkedTV platform** (WP5) and (client side) video player which can support this interweaving of TV and Web content. These technologies will be enabled by and built upon innovative research results in the areas of **video analysis, annotation** (WP1) and **hyperlinking** (WP2), **user interfaces** (WP3) and interaction, and **personalization** (WP4). The results are widely made public through a concerted **dissemination action** (WP7), as well as prepared for potential transfer of technology and industry uptake (**commercialization**) by a dedicated exploitation focus (WP8). The project itself runs smoothly through a professional and competent approach to management (WP9). These different aspects are managed within the EU project by a clear division into work packages and tasks with respective responsible partners for the completion of each distinct activity:



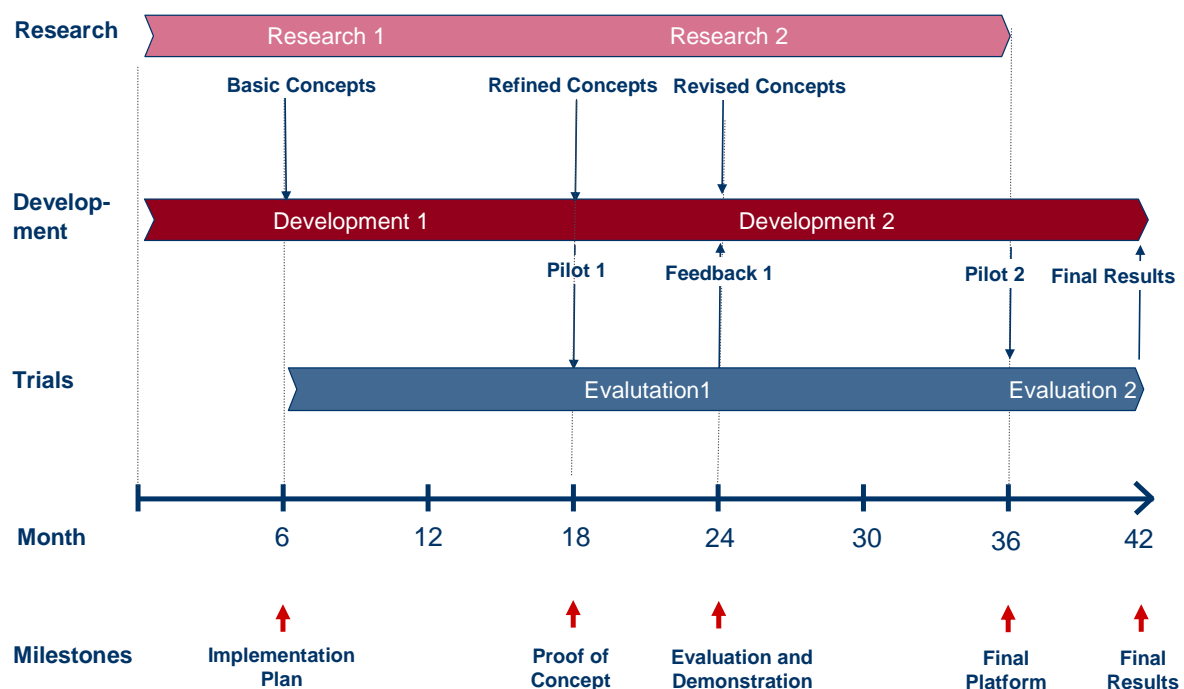
The work packages are in line with our project objectives as introduced in table 2 of the Description of Work and as listed below:

- Apply and improve media analysis approaches for the semantic analysis and linking of audiovisual information (WP1)

- Enable Web-scale hypervideo through the conceptual annotation of media (WP2)
- Develop intuitive interfaces for Web and IPTV-based concept browsing and content presentation in video (WP3)
- Personalise selected concepts and content presentations to the user's profile and context (WP4)
- Create an end-to-end platform for LinkedTV services (WP5)
- Realize the scenarios where LinkedTV services are used to enhance the TV/video experience (WP6)
- Disseminate project results in the community (WP7)
- Exploit project results commercially (WP8)

The achievements of each work package are reflected in the work package reporting, in the following section. From this, we highlight how the initial planning for LinkedTV has been completed, and first concrete steps have been made towards the realization of the scenarios in an end-to-end workflow (LinkedTV platform, delivery to player) which integrates first outputs of the R&D work packages, and where already these achievements are being presented at conferences and events, reflecting the scientific contributions of the project and raising its visibility in the academic and industry communities.

The project objectives over its 42 month duration are summarized in the below diagram from the Description of Work:



These are made concrete in the milestones set for the individual work packages, which for the first 12 months of LinkedTV have been focused on ensuring sufficient preparation of the research and development work:

- analysis of current state of the art (Milestones MS1, MS5),
- scenario requirements (Milestone MS9),
- technology specifications (Milestones MS20, MS16),
- initial technology selection and development of LinkedTV platform (Milestone MS21), preparation and testing,
- as well as establishing the LinkedTV vision in its scenarios and management (scenario data and content preparation (Milestones MS27, MS28)),
- storyboards and mock-ups (Milestones MS11, MS12),
- LinkedTV online presentation and dissemination (Milestones MS34),
- establishing first events and exploitation actions (Milestones MS40, MS41).

At the end of the first year of LinkedTV, as is also reflected in the following work package reports, the milestone at month 6 to have an integrated **Implementation Plan** can be seen to have been achieved (with a set of basic concepts coming from the research) as well as that the project partners are now progressing well towards the first **Proof of Concept** of LinkedTV planned for month 18.

### 3 Work progress and achievements during the period

#### 3.1 Concise overview of progress at project level

The LinkedTV project had a successful start. All work packages took up their work and a strong collaboration between the partners was established. Already in this first reporting period a considerable number of scientific publications were produced, including papers that were jointly authored by several LinkedTV partners and work packages. At the end of this first year all work packages are on schedule and have performed their tasks with only minor deviations from plan. The project is well on track towards the achievement of its ambitious goals as presented in Chapter 2.

WP6 (Scenarios) specified a News and a Documentary scenario on the basis of professional requirements and user interests. The two scenarios give a background and motivation for the work of the technical work package (WP1-5) and define relevant media and content for annotation and enrichment (**LinkedTV content**). In close collaboration with WP3 a **first LinkedTV demonstration** of the Documentary scenario was created and presented during the EuroITV conference.

WP1 (Intelligent hypervideo analysis) started its work with an in-depth state of the art and requirements analysis for hypervideo, documented in D1.1. Based on those findings, a number of pre-existing **hypervideo analysis** techniques were evaluated. First new techniques going well beyond the state of the art were developed and already tested on LinkedTV content or by participating at international benchmarking activities.

WP2 (Linking hypervideo to web content) concentrated on the introduction and standardization of **Media Fragments URI** as a media-format independent, standard means of addressing media resources using URIs. Media Fragments URIs are the basis of the LinkedTV vision since they will enable to enrich seed video program at the fragment level.

Research in WP3 (LinkedTV interface and presentation engine) was dedicated to the design and implementation of first **user interface** mock-ups taking into account a set of functional requirements derived from a review of literature. The work resulted in the demonstration at the EuroITV conference mentioned afore.

The work in WP4 (Contextualisation and personalisation) was focused on the specification of the means and methodology for **implicit user profiling**. This involved the creation of a first version of the LinkedTV Use Model Ontology and determining the methods for capturing, understanding and learning user preferences, as well as the definition of the user model schema. The user model enables efficient concept and content filtering within the LinkedTV platform.

In WP5 (LinkedTV platform) the project partners have developed a **basic platform architecture**, which connects the new components provided by all other technical WPs 1-4. The platform offers an interface to implement the scenarios defined by WP6 using LinkedTV

content in German and Dutch. An initial end-to-end prototype has been implemented for demonstration of the main results of the first year at the review.

Despite the first LinkedTV demonstration the project run the first **LinkedTV workshop on Future Television** at the EuroITV conference. WP7 (Dissemination) took care of this event, which might be established as an annual event to build up a research and industry community interested in the topics of LinkedTV. Other dissemination activities comprise the set up and maintenance of the LinkedTV website and the creation of first LinkedTV information materials.

WP8 (Markets, Business Models and Exploitation Strategies) concentrated within the first year on the definition of an **exploitation plan** for the project and on the performance of an initial market analysis.

## 3.2 Progress and achievements at work package level

### 3.2.1 WP1 Intelligent hypervideo analysis

#### Summary of Progress Towards Objectives

WP1 focuses on intelligent hypervideo analysis. Ultimate objective of the WP is to support the (semi-)automatic hyperlinking of video and multimedia content, so as to generate hypervideo. This will be achieved by developing within WP1 and delivering to the project a set of analysis tools that will facilitate the further processing of it towards hypervideo creation. The categories of analysis tools that are considered in WP1 include tools and techniques for the (semi-)automatic decomposition of the audiovisual content (e.g. temporal-spatial segmentation), the association of content segments with object and/or scene labels, text and audio information analysis, and event and instance-based labelling of content segments. All these techniques will be integrated in an annotation tool for hypervideo, which will aggregate their results and provide them in an appropriate format to subsequent WPs of LinkedTV. Furthermore, within the objectives of WP1 is also the evaluation of the above analysis techniques, both internally and by participation to international benchmarking activities.

A first result of WP1 is the preparation and delivery of D1.1 “State of the art and requirements analysis for hypervideo”, where the state of the art on a number of analysis topics that are of interest to LinkedTV is detailed and requirements for the analysis-related work within LinkedTV are discussed, on the basis of an initial set of scenarios that were defined in the project. D1.1 is a joint output of all tasks of WP1, as indicated by the main sections of it, which address the following topics: Scenarios overview and main user-side requirements; Visual Information Pre-processing and Representation; Visual Object and Scene Labelling; Complementary Text and Audio Analysis; Event and Instance-based Labelling of Visual Information; and, User Assisted Annotation. D1.1 also reports briefly on the first results of experiments with such techniques on LinkedTV content.

More specifically within **task T1.1**, the focus of the first year was in the review of the state of the art and the testing of techniques for the meaningful decomposition of the content. Following the review of the SoA, we experimented with a shot segmentation technique that detects both abrupt and gradual transitions. Our preliminary evaluation based on the LinkedTV News Show and the Documentary scenarios indicated that it performs remarkably well (~90% correct detection), with errors primarily in the presence of significant instantaneous luminance variations caused by photographer’s flashes. To correct this, we augmented the above technique with a baseline approach to flash detection; approximately 78% of erroneous detections caused by flashes are corrected by this extension. Going beyond shot segmentation, we experimented with a scene segmentation technique, and techniques for spatial and spatio-temporal video segmentation as well as content description.

In **task T1.2**, the emphasis is on the labelling of content segments; we focus on both generic concept detection techniques and techniques specifically for face detection, clustering and recognition. For concept detection, we initially experimented with a baseline method based

on SURF descriptors and one SVM classifier, using the 346 concepts of TRECVID SIN as concept labels. Then, we started to explore is the use of multiple combinations of features (e.g. SIFT, RGB-SIFT, Opponent-SIFT), interest point detectors (e.g. Harris-Laplace, dense sampling) and codebook definition strategies (hard / soft assignment) together with multiple SVMs per concept, whose outputs are combined to provide the final result. The incorporation of more elaborate SVM classifiers, such as the Linear Subclass SVMs that we developed in this year is also in our plans. In terms of faces, initial experiments with the face.com API showed significant potential; but, due to newly-introduced usage restrictions to the face.com API, the development of an OpenCV-based solution is in our plans for the second year.

**Task T1.3** deals with text and audio analysis. In terms of text analysis, following the review of the SoA, we experimented with a statistical approach to keyword extraction. Our preliminary experiments on LinkedTV content (RBB News videos) showed promising results. We further developed a testing framework with a basic web interface on top of our aforementioned statistical approach, in order to facilitate evaluation, and a demo of this is available online. In terms of audio analysis, we worked on automatic speech recognition for German, which showed good results on a variety of content items, but also revealed issues with local dialect, spontaneous speech, and background noise. We also worked on speaker identification, using a GMM-HMM model; this we tested on German parliament speeches (253 speaker total) and produced good preliminary results (8,0% Equal Error Rate). Finally, we did some work on extracting non-speech audio features, for supporting the audio-visual event detection discussed in the following section (Task 1.4).

In **task T1.4** we started to work on event- and instance-based labelling. In terms of event detection, we used the non-speech audio features extracted in T1.3 for combining them with concepts detection results (T1.2). We used a first version of our technique for participating to the Multimedia Event Detection (MED) Task of TRECVID (this was a joint participation with GLOCAL). Concerning object re-detection, we should start by specifying that object re-detection refers to the automatic detection of all appearances of a specific object within a video, where the sought object is initially demarcated manually on a video frame. This effectively addresses the problem of instance-based labeling, where e.g. a specific painting that the user is interested in can be detected throughout the video. For this, we implemented and tested a baseline technique based on SURF and RANSAC, which we plan to improve.

**Task T1.5** aims at the development of a user-assisted annotation tool that will integrate the results of the analysis techniques developed in tasks T1.1 to T1.4 and provide them in an appropriate format to subsequent WPs of LinkedTV, according to the defined workflows. Although this task only started in M7 and is expected to release a first version of its annotation tool in M24, we have already developed a first incomplete version of an annotation tool based on the EXMARaLDA toolkit. Our preliminary annotation tool can aggregate the results of techniques such as shot segmentation, ASR, speaker recognition, etc., and supports basic interaction with the user, allowing the manual correction of automatically-generated analysis results.

Finally, the evaluation task of WP1 (**Task T1.6**) was not active during year 1 (it officially starts in M13 of the project). Nevertheless, during the first year we worked on evaluating the results of both SoA techniques and extensions that we developed, as part of our activities in tasks T1.1 to T1.4, and some results of these evaluations are outlined in the “technical requirements” sections of D1.1. We also participated to an external evaluation (the TRECVID benchmarking activity), with our initial event detection approach. We plan to continue such evaluation activities within T1.6 in the second year.

### **Achievements**

Main achievements of WP1 in the first year include:

- The delivery of D1.1 “State of the art and requirements analysis for hypervideo”
- Tested and evaluated a number of pre-existing analysis techniques on LinkedTV content (e.g. shot segmentation, keyword extraction, speech recognition)
- Started developing new analysis techniques that extend the state of the art (e.g. camera flash detection for improved shot segmentation, audio-visual event detection)
- Tested first versions of new LinkedTV analysis techniques either on LinkedTV content or by participating to international benchmarking activities (TRECVID)
- Produced a number of scientific publications, including papers that were jointly authored by several WP1 partners



### 3.2.2 WP2 Linking hypervideo to web content

#### Summary of Progress Towards Objectives

The overall goal of WP2 is to represent formally metadata provided by multimedia analysis processes over a LinkedTV seed video program and to analyze textual resources in order to provide either structural information or related multimedia content that could be used for enriching this seed video. The work carried out within WP2 is therefore structured around two axis:

- Converting both the legacy metadata and the results of the automatic multimedia analysis performed in WP1 (serialized in the eXmaralda format) into RDF that are stored in a triple store (WP5). Named entity recognition is made in parallel on either the transcripts provided by the broadcaster or the automatic ASR performed by WP1. The named entities extracted are themselves used in additional RDF annotations.
- Mining, retrieving and discovering additional content that enriches specific media fragments of the seed video program being watched by the LinkedTV user. This additional content is looked up from a curated list of web sites using different methods ranging from structured queries or search APIs to focused crawl and offline indexing and analysis processes.

This additional content is provided to WP4 which aims to apply a personalization layer on top of these suggestions, and to WP3 which will practically display the additional information in the rich hypervideo LinkedTV player.

The first major contribution of this work package is the introduction of Media Fragments URI as a media-format independent, standard means of addressing media resources using URIs. Media Fragments URIs are the basis of the LinkedTV vision since they will enable to enrich seed video program at the fragment level. During the first 6 months, we have continued to work with the W3C Media Fragments Working Group in order to push the existing specification to the final W3C recommendation stage, in particular, providing test cases. In the deliverable D2.1, we explain how the HTTP protocol can be used and extended to serve Media Fragments and what the impact is for current Web-enabled media formats. We present early implementations of this technology and in particular how the LinkedTV player will handle media fragments URI.

The second major contribution of this work package is the design and modeling of the first version of the LinkedTV ontology for representing multimedia metadata. The starting point of this work are the results of the analysis performed by WP1 on seed videos together with other metadata (legacy, subtitles) provided by content providers. We have first performed a thorough state-of-art review in order to extract requirements for the LinkedTV metadata model. More precisely, we have first provided a comprehensive overview of numerous multimedia metadata formats and standards that have been proposed by various communities: broadcast industry, multimedia analysis industry, news and photo industry, web community, etc. Then, we have derived a number of requirements for a LinkedTV metadata model. Next, we have presented what will be the LinkedTV metadata ontology, a set of built-

in classes and properties added to a number of well-used vocabularies for representing the different metadata dimensions used in LinkedTV, namely: legacy metadata covering both broadcast information in the wide sense and content metadata and multimedia analysis results at a very fine grained level. We have finally provided a set of useful SPARQL queries that have been evaluated in order to show the usefulness and expressivity of our proposed ontology. This work has been reported in D2.2. The ontology is available at <http://data.linkedtv.eu/ontology/>.

The third major contribution of this work package is the framework we have setup for enriching the seed video program with multimedia content and encyclopaedia knowledge. The first step of our approach is to extract named entities, associate them types or categories and disambiguate them with unique identifiers which are generally linked data resources. This will complement the annotations performed by WP1 and will generate new annotated video fragments. Technically, we have released the NERD platform and we have integrated a number of new named entity extractors to deal with the German and Dutch languages. The platform has been released at <http://nerd.eurecom.fr>. The second step aims at providing additional content in relation with the seed video fragments. Annotations available in the LinkedTV platform can be the source of queries for retrieval of this additional content (e.g. directly from existing structured LOD datasets or generated by mining white lists of unstructured web sites). This work has just started and will be the core of WP2 activities in year 2.

### **Achievements**

The main achievements for WP2 in year 1 are:

- The specification Media Fragments URI 1.0 (basic) is a W3C Recommendation, <http://www.w3.org/TR/media-frags/>
- The LinkedTV ontology is available at <http://data.linkedtv.eu/ontology/>
- The NERD platform is available at <http://nerd.eurecom.fr>

### 3.2.3 WP3 LinkedTV interface and presentation engine

#### Summary of Progress Towards Objectives

##### *Designing user interface*

The goal of WP3 is to design a user interface for the LinkedTV system in such a way that it gives users effortless access to information. A main concern that we want to tackle is to not disturb the user while they are watching a program, but to enrich the experience of watching a programme with easily accessible information.

Before designing a user interface, it is important to investigate the user needs. In deliverable D3.1, categories of user goals were derived from a review of literature on hypermedia and interactive television. Interactive systems (including demos of systems) that are currently available on the Internet were also reviewed. Furthermore, in the literature and state-of-the-art analyses, particular attention was given to newest development in the context of Social TV and the current developments in this area. In this context, special focus was given to inclusion of input from Social Media in user interfaces. Several concrete concepts and proposals have been provided for consideration. Even though Social Media are not in the focus in the first year of the project, the goal was to assess potential impact early enough and to design current developments in such manner that social media aspects can be integrated later on easily. After reviewing the literature and the systems, we listed all the functions and tasks that were described in the literature of interactive television or that could be performed by the systems online. We grouped this list into four categories: Information, Communication, Manipulation and Transaction. We reviewed the scenarios and listed all the functions that were mentioned in the scenarios in the corresponding categories. Since the core of the LinkedTV is the information need of users, we focused on the Information user goal category. More specifically we decided to focus the user need of “getting additional information”.

For this particular user need we created a list of different functional requirements: When the user is watching a programme s/he indicates that s/he wants additional information about an item that is present in the programme. The system needs an overview of all the items presented in the programme and it needs to present those to the user. The user should then be able to select about which item s/he would like to receive more information. When the user has specified the item on which s/he would like to receive additional information, the system needs to collect different information sources about that particular item and give the user the opportunity to select the information source that s/he would like to consult to satisfy her/his information need. When the user has selected an information source, the system should be able to present the information of that particular information source and enable the user to switch to other information sources. When the information need of the user is satisfied, the user should be able to indicate that s/he wants to exit the additional information sources and resume the programme. The system then needs to fulfil this request by resuming the programme.

The goal of deliverable D3.2 was to propose different user interfaces for the LinkedTV system and taking into account the functional requirements that were just listed. Before mocking-up different user interfaces, a literature review was carried out and we also investigated systems that are currently available on the Internet. The core of that deliverable was the presentation of hand drawn mock-ups for getting additional information for the LinkedTV system. The mock-ups were accompanied by critical analyses.

These mock-ups and other existing systems were presented to the scenario partners and they expressed their opinions about these interfaces. Based on this feedback and the content of the different scenarios, separate interfaces are designed for the news scenario (of the scenario partner RBB) and the cultural heritage scenario (of the scenario partner Beeld en Geluid). For both scenarios, two interfaces were designed for a television screen with a remote control and two interfaces for a television screen with a secondary screen. These interfaces are described in deliverable D3.3. We presented these mock-ups to the scenario partners and their feedback will be taken into account for future mock-ups.

The general plan for the development of the user interface in the coming year of the LinkedTV project is to include users in the design of the interfaces. We will carry out user tests that are focused on the usability of the mock-ups. The users that will take part in the tests will be selected to make sure that they are familiar with the shows that are used in the scenarios.

In the coming year of the LinkedTV project, we will also discuss the user interfaces with several other work packages of the project. Since the user interfaces depend on the additional information that can be presented to the user, we will collaborate with the work package that automatically generating these links (WP2) and the work package that is responsible for the personalization of these links (WP4). We will also discuss the interfaces with the technical partners that are responsible for implementing the system.

#### *Implementation of the system*

Another important goal is to implement the system for the LinkedTV media player. A challenge is the implementation of the system for different platforms.

We started with a number of meetings and discussion with WP3 members, evaluating existing and new tools, available knowledge and potential LinkedTV scenarios, subsequently reflecting these with software developers. We also investigated technical restrictions with respect to potential future LinkedTV player interfaces.

We examined player behaviour options and its technical dependence with WP5. We started developing first basic prototypes related to LinkedTV which were shown during the Mons meeting (March 2012), including dynamic playlisting, annotations and chaptering of content in relation to interaction models that might be of use for LinkedTV scenario's.

We continued working on the first HTML-5 compliant demo, using TV content from Beeld en Geluid (AVRO) Kunst & Kitch. This TV format is derived from BBC Antiques Roadshow, a British television show in which antiques appraisers travel to various regions of the United Kingdom (and occasionally abroad) to appraise antiques brought in by local people. The

demo was finalized and submitted to the EuroITV 2012, Berlin, showing the first scenario case and providing a first technical interface and interaction reference model for the project, see deliverable D3.4.

Following this we engaged with RBB to learn how the prototype application could be used for RBB scenarios too. In addition, we have been working on the definitions for the players interface to The Media Player Canvas API (described in deliverable D5.2). This relies on the distributed NIC architecture, the traffic cop component that handles all interactive calls between player and back end.

### **Achievements**

- Detailed overview of literature, existing systems and developments in interactive TV (in particular socialTV) and potential impact on user interfaces
- Design of different mock-ups for Beeld en Geluid & RBB scenarios
- First prototype of LinkedTV media player (interface demonstrated at EuroITV 2012, Berlin)

### 3.2.4 WP4 Contextualisation and personalisation

#### Summary of Progress Towards Objectives

The overall goal of WP4 is to personalise selected concepts and content presentations to the user's profile and context. This means in LinkedTV with its rich content it is essential for the users to get support in finding the kind of content they are interested in and to make use of the rich relations between multimedia items on the Web. We need user models to represent the different kinds of interests people may have in multimedia content. And we filter the rich multimedia content according to the preferences and interests of a user expressed in these user models.

Therefore the requirements for personalising and contextualising concepts and content for the users of LinkedTV were investigated and defined in D4.1, based on a study of the state-of-the-art. Subsequently, the personalisation and contextualisation task in LinkedTV focused on unobtrusively capturing implicit user preferences, while at the same time being able to factor in explicit information provided by the users. The profiling and contextualisation methodologies will exploit the structural advantages of formal semantics in both the background knowledge and the user model and focus on rendering the user model as lightweight but at the same time as meaningful as possible to enable advanced predictive inference for concept and content filtering, with respect to safeguarding user privacy.

In WP4 we comprehensively investigated existing LOD ontologies as basis for our user models. Though they provide valuable input of different kinds none of them is really appropriate for user modelling. Typically they are not sufficiently well structured (like DBPedia), too restricted (like schema.org or the IMDB ontology) or too much oriented towards "high level" ontology modelling (like SUMO or CYC).

As a consequence of this assessment we decided to create the LinkedTV User Model Ontology (LUMO). It combines two main issues: it allows us to represent the mental model of the user as needed in a widespread multimedia domain, with respect to contextual aspects of the user, such as his spatio-temporal information or information defined by sensor-extracted data, and it provides the ontological bridge to existing LOD ontologies as used in WP2 for multimedia fragment annotations.

Concrete user models will be built using the LinkedTV User Model Ontology. The methods to implicitly capture, understand, update and formulate semantic user models have been specified in D4.2. Six user models have been created manually following our use case examples in WP6 (as a first proof of concept and as input for the LinkedTV Semantic Filtering). The different topics the users are interested in are represented according to LUMO, and the different degrees of interest these users have as weights associated with each item in these models.

A user model can be created from scratch (e.g. by the user through an appropriate editor who provides a starting model with his preferences – similar to Social Networks preference lists or by implicit user feedback). It is also very important to keep the user model up to date

with the user's media consumption. We have defined the needs and the means to unobtrusively create and learn the user model implicitly, through observing user behaviour on the LinkedTV, esp. his media consumption.

The user model will encompass semantic user preferences (interests and disinterests) based on the observations of his transactional and reactional behaviour as well as his social interactions through time in his consumption history. The preferences will be expressed as primitive and complex concepts (abstract concepts or specific individuals) from the reference LUMO ontology, while the observations will also determine the degree of preference a user has to a specific concept, formulated as weighted concepts in the user profile.

UEP has been working on tracking user behaviour through their interaction with the browser. Tracking data are enriched with semantic information by the General Analytics INterceptor (GAIN) using the WP2 NERD ontology. GAIN was integrated with a proof-of-concept video player. Preference learning methods can be applied to modify the user model from user decisions. UEP contributed to the development of the I:ZI Miner system, which is now able to mine user preferences from the semantically enriched GAIN output.

UMONS concentrated their activities in WP4 on user physical behaviour tracking. The Kinect sensor (which is also used in other home setups like the Microsoft xbox games) watches the users and extract features helping to evaluate the user context (is he alone or not, are there children in the room, how is the light in the room). In a first step, the number of people and their location (sofa or not) are computed in real time. User behaviour observations may also help to evaluate a user's interest in the content on the TV (does he suddenly look to the TV while he was not looking there before?). In a first step, UMONS determined the face direction with respect to the TV.

The semantic annotation process in LinkedTV enables fine grained annotations of media *fragments* (see the LinkedTV deliverables D2.2 and D2.3). A video as a whole as well as scenes in it or even single shots can be annotated. The multimedia fragments are annotated with elements from LOD ontologies (URI) like DBPedia, music ontology, etc. They are interlinked to other entities on the Web.

These multimedia fragment annotations and the user models allow us to filter content according to a user's preferences. The first methods of concept and content filtering based on the semantic user models have been defined in D4.3. We use two related filters: the LinkedTV Semantic Filtering LSF (developed by Fraunhofer), and f-PocketKRHyper (by CERTH). The LSF content filtering is based on weighted semantic matching. It can be used in different ways: enriching information about an object shown in a video scene or frame with linked information from the Web in a user specific way; ranking annotation elements occurring in a frame according to the user's special interest; or determining semantic similarity between media fragments and providing user recommendations. A first version of the LinkedTV semantic filter LSF has been implemented. It takes semantic user models and semantically enriched media fragment annotations to compute rankings of media content w.r.t. specific user interests.

CERTH's logical reasoner f-PocketKRHyper will take advantage of complex user preferences, i.e. associations between concepts in the user profile, to post-process the initial filtering results by means of fuzzy logical reasoning.

### **Achievements**

- Specification of the methodologies to implicitly capture, understand, learn and serialize a user model based on user transaction and consumption history on the LinkedTV platform (D4.1, D4.2).
- Definition of requirements and first version of a lightweight, user-pertinent ontology for the networked media domain and mappings creation between the ontology and the LOD vocabularies used to annotate the LinkedTV content (D4.1, D4.2).
- The LUMO lightweight ontology was created as basis for user models. It encompasses the contextual and domain-specific attributes of the LinkedTV users, along with mappings to the different semantic vocabularies used in WP2 to characterize seed and related content.
- A user model editor has been implemented allowing us to create and manage complex user models based on the LUMO ontology and related LOD ontologies.
- Preference learning and user observations have been investigated as basis for user model adaptations.
- A first version of the LSF filtering was implemented and tested with example user models from WP6 and annotated multimedia fragments from WP2.
- The Beancounter preference mining from social interactions and the f-pocketKRhyper reasoner were investigated for integration into user modelling.



### 3.2.5 WP5 LinkedTV platform

WP5 has begun with a set up of the team mainly from Noterik and Condat with the temporarily participation of partners from Fraunhofer, EURECOM, CWI and RBB. The communication was scheduled periodically by phone conferences (each 3 weeks) and longer on-place workshops at each consortium meeting. Reporting has been provided for the project management, the project-meetings and plenary phone conferences.

#### Summary of Progress Towards Objectives

##### *Objectives*

The objective of WP5 is to provide a platform for the integration of hyperlinks in videos for an interactive, seamless usage of video on the Web. This requires a platform for the automatic identification of media fragments, their metadata annotations and connection with the Linked Open Data Cloud, which enables to develop applications for the search for objects, persons or events in videos and retrieval of more detailed related information.

The design of the platform architecture, which is documented in D5.1, covers the server and client side based on the requirements derived from the scenarios defined in WP6 and technical needs from WPs 1-4. The main design criteria covered openness, distribution of platform components, separate development of components, scalability, multi-user, load balancing, support of multi-lingualism, exchange of existing platform components, and flexible connection to existing standard media platforms. The document defines workflows, components, data structures and tools. Flexible interfaces and an efficient communications infrastructure allow for a seamless deployment of the system in heterogeneous, distributed environments.

The resulting design builds the basis for the distributed development of all components in WP1-4 and their integration into a platform enabling for the efficient development of hypervideo applications.

##### *Prototype*

The realization of the platform will be carried out in several steps and iterations. An initial end-to-end prototype is implemented for demonstration of the first year results at the review, which:

- supports the defined scenarios from RBB and Beeld en Geluid
- includes these features of W1 to WP5:
  - WP1 mainly provides input from subtitles, natural language and graphical object analysis.
  - WP2 concentrates on classification of annotations without semantic enrichment by external web materials.

- WP3 provides a first version of the Hypervideo player documented in D5.2 showing the videos of the scenario and allowing end users to select and show additions to objects shown in the videos (e.g. name of a person).
- WP5 provides a first version of the LinkedTV platform to store and retrieve videos and their metadata.
- uses video materials from Beeld en Geluid and RBB using different languages (Dutch and German).

It is intended to evaluate use cases which use mainly automatically generated Media Fragments and annotations as well as scenarios where a human editor has manually adjusted the information discovered by WP1 and WP2.

The demonstration of the prototype requires a stepwise manual start of the tools from each WP to overtake and process the results from the preceding WPs. An automatic workflow will be implemented in the next phases of the project.

#### *Implementation*

In WP5 a first version of an Administration Tool has been implemented, which allows to select videos for analysis and to show all materials available in the platform.

The platform has been set up on Linux with JBoss, the JBOSS-ESB (Enterprise Service Bus) and Open Link Virtuoso providing a relational data base and a Triple Store. All employed software is free open source so that no license fees are required.

A first version of the platform has been implemented covering the Linked Media Layer (LML) to store Media Fragments and annotations by WP2 and retrieve them for play-out by WP3. The API is implemented as REST services for a flexible remote access to the LML by all other WPs.

The Hypervideo Player for the client has been implemented by Noterik in WP3 and WP5 with the basic functions to display annotations. The player shows the videos of the scenarios and retrieves the corresponding Media Fragments and annotations via the REST API. The end user uses the player to select and view the annotations related to the running video.

#### *HTML5 and HbbTV Client variant*

For the first phase of the project the plan foresees a HTML5 variant for the browser, because this is the most appropriate front end for interactive TV by offering a two-way communication and clickable video. For the second phase of the project a HbbTV variant is planned. This variant requires a more detailed feasibility analysis, because the envisioned interactive features of LinkedTV need to regard the constraints of HbbTV such as the missing pointing device and use of CE-HTML provided by HbbTV instead of HTML5.

#### *Privacy constraints*

Since privacy is a crucial point for the system acceptance by the users, the following measures will be undertaken to avoid violating people intimacy: i) No rough confidential data will be stored anywhere ii) The features extracted from the rough data will be stored in a

temporary location on the server and after some minutes deleted iii) The personalized content decision will be done on the client to avoid transfer iv) If data are sent to the server, they will be first aggregated and anonymized.

#### *Next steps*

The next phase of the project will focus on the following issues:

- Extension of the Administration Tool to cover the full range of features to add, update and delete AV materials
- Implementation of an automatic workflow between the WPs
- Display of media fragments for the end user
- Extension of the prototype to handle annotations with links to external web resources
- Implementation of a HbbTV client
- Development of a refined concept for the storage of personal data and
- Definition of methods to handle different languages (Dutch, German, French, English).

#### **Achievements**

The main achievements of WP5 in the first year include:

- Gathering of all requirements to be fulfilled for the scenarios defined in WP6, the development of the technical WPs 1-4 and general needs such as scalability, performance and flexibility
- Delivery of D5.1 LinkedTV platform and architecture
- Delivery of D5.2 LinkedTV front-end: video player and MediaCanvas API
- Implementation of the first end-to-end demonstrator showing the main results of WP1, 2, 3, 5 and 6 on the basis of materials and use cases of the Beeld en Geluid and RBB scenarios

### 3.2.6 WP6 Scenarios

#### Summary of Progress Towards Objectives

In the first year of WP6, our objectives were to identify and collect media and content for the scenarios (T6.1.1) and perform storyboarding of each scenario (T6.2.1).

To begin with, we fixed the overall direction of the partner scenarios based on their organizational goals and available video materials. From this basis, particularly analysis of typical “seed contents”, we could generate examples of relevant media and content for annotating and enriching scenario video, and thus also a first whitelist of both metadata sources and content sources. Based on a number of identified personas (typical viewer types of the chosen scenario video) and the aforementioned examples of media and content, storyboards were drawn up using the Balsamiq collaborative online storyboarding tool to map out the whole foreseen process of a typical viewer accessing the LinkedTV system while watching scenario-chosen video material, being interested in specific objects/concepts in the programme and browsing to relevant additional information and services around that object/concept (the enrichment). These storyboards already made use of the UI proposals coming out of WP3 for the LinkedTV player.

Despite the original intention to create a Hyperlinked Environmental Infotainment Show, RBB specified a scenario for a LinkedTV News Show. This decision was based on several different aspects, such as the availability of content but also on technical aspects like the availability of subtitle files which largely improve the analysis results for the seed content (WP1). As both seed content (including metadata) and enrichment content are more easily available for a daily news programme than for a monthly life science programme – which may even be stopped completely before the end of this project – RBB decided to change the strategy for a scenario with more relevance and feasibility for both end users and the technical partners of the project. A first version of this News Scenario was then specified in all aspects, from feasibility to metadata handling, from usability to interaction design, and sample content (seed content, related enrichment content and metadata) were provided and evaluated – all in close collaboration with WPs 1, 2, 3 and 4.

The Documentary Scenario that was developed by Beeld en Geluid is focused on cultural heritage. Therefore, the choice was made to use the program Tussen Kunst & Kitsch (Antiques Roadshow) as the basis for the scenario. In the show, people take art objects with them to be assessed by an expert. The objects brought in provide the possibility to add relevant information on questions like Who, When, What, Where and Subject, all related to art history and cultural heritage. In order for WP1 and WP2 to extract relevant information (e.g. concept detection, scene detection, shot detection, links), Beeld en Geluid has provided input such as subtitle files, legacy metadata and the content itself. Furthermore, a white list was drafted of URLs that contain both content and metadata relevant for hyperlinking. Examples are websites with rich content like Rijksmuseum collection, Artcyclopedia, vocabularies like VIAF and the Tussen Kunst & Kitsch website itself. A first demo was developed, which was showcased among others at the EuroITV, ACM Multimedia and ICT

Delta conferences, and on other occasions and meetings as well. All work has been carried out in close collaboration with WP1, 2, 3, 4 and 5.

The initial task of UMONS was in creating and providing content for an artistic scenario. After a lot of discussions on this topic it appears that an artistic scenario definitely needs media artist participation which is too early within the project timeline. By this first year, the real potential of the LinkedTV platform cannot be fully demonstrated yet and the artists do not have enough information to create a scenario to be able to use this potential.

Thus, at the Berlin meeting, the UMONS task was re-oriented towards providing innovative interfaces for the other two scenarios (RBB and Beeld en Geluid). Research and development were performed along two axes: hand-based gestures and interaction using real objects. For the hand-based interaction a system based on the widely available Kinect sensor was developed and provides 3D hands positions and clicks. For the second real object-based interaction system, a second Kinect-based approach extracts the 3D position of real objects on the table in front of the TV.

### **Achievements**

- Specification of the LinkedTV News Scenario and the LinkedTV Documentary Scenario on the basis of professional requirements (partner's production workflow, regulation and strategy) and user interests (market research and experience from similar projects)
- Preparation of content, resulting in a first live demonstrator (Beeld en Geluid)
- Preparation of content for first mock-ups and demonstrator (RBB)
- Storyboarding for three personas (personalized user scenarios) for each of the partner scenarios
- Initial specification of reusable metadata sources (largely based on the Linked Open Data cloud)
- Specification of a Whitelist for sources of preferred/trusted Enrichment Content in each scenario
- Intensive collaboration with WP3 on mock-ups of the LinkedTV player UI in both single screen and second screen situations, taking into account both usability aspects from the scenario perspective and using as a basis samples of enrichments of the chosen scenario "seed videos"
- Proposals on user profiling aspects, in collaboration with WP4
- Hand-based interaction system development by UMONS
- Real object-based interaction system demonstration by UMONS
- Proposals of innovative user interactions for the two scenarios based on the above systems and the goals and requirements of the scenario partners.

### 3.2.7 WP7 Dissemination

#### Summary of Progress Towards Objectives

In the first year of WP7, we created the LinkedTV website and newsletter, and we started in line with our dissemination and standardization plan to publish our work, present at academic and industry events, produce online and printed material, and contribute in standardization activities.

To begin with, we created the dissemination and standardization plan which outlines our intentions and goals for the dissemination and standardization tasks throughout the LinkedTV project. We also set up early the LinkedTV website at [www.linkedtv.eu](http://www.linkedtv.eu) based on the well known Wordpress blogging software and filled in the website sections as well as generating news items.

We created a LinkedTV presentation which is both online<sup>2</sup> and has been used at public events (SemTech 2012, EuroITV 2012). We also created a LinkedTV newsletter<sup>3</sup> which is both online and printed. We have all public LinkedTV deliverables on the website and in the next phase will include partners presentations on project work as well as online demos and links to partner tools.

A key metric for the scientific work in the project is academic publication, here in the first year we can point to 15 publications at various international events. We also were accepted to make project presentations at highly visible community events such as SemTech 2012 (semantic technology industry) and others taking place after the end of the reporting period. Detailed information on publications, events and other dissemination activities and results can be found in Chapter 4.

With respect to standardization, we identified within the consortium the primary standardization bodies and activities to consider, and in the next phase will identify project results which potentially can form a basis for contribution to an activity or proposal for a new activity.

#### Achievements

- LinkedTV website at [www.linkedtv.eu](http://www.linkedtv.eu)
- Delivery of the dissemination and standardization plan
- LinkedTV accounts at Twitter, YouTube, Slideshare
- Regular news items and website updates
- Project presentation online
- Project newsletter online
- Project deliverables online

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<sup>2</sup> <http://www.slideshare.net/linkedtv/linked-tv-introduction>

<sup>3</sup> <http://www.linkedtv.eu/newsletter>

- 11 academic publications
- Presentations at events giving us visibility, such as SemTech 2012 and EuroITV 2012

### 3.2.8 WP8 Markets, Business Models and Exploitation Strategies

#### Summary of Progress Towards Objectives

##### *Objectives*

According to the Description of Work (DoW), the main objectives for WP8 in year 1 of the project can be summarized as follows:

1. To define an exploitation plan that identifies exploitation activities during the project and to summarize them in D8.1.
2. To complete an initial market analyses and to summarize the results of the analyses in D8.2.

##### *Achievements*

The objectives of WP8 for year 1 have been fully achieved. With regards to the first objective – “Exploitation Plan”, the following results were achieved:

First of all general exploitation principles and directions were defined together with key performance indicators for measuring exploitation activities during and after the project. In order to set a sound foundation for exploitation activities, potential exploitable products resulting from LinkedTV innovation and development were identified. The potential LinkedTV products range from specific and specialized software modules as for example software for intelligent video analyses and automatic video annotation, to a LinkedTV platform providing the same functionalities as a service and accompanied with a broad range of specific applications and consulting services. Each partner defined a detailed exploitation plan. In a joint effort of all partners and two workshops a possible common product portfolio for LinkedTV innovations and developments were identified. Promising opportunities for common exploitation are for example: A LinkedTV platform including also support and solutions for second screen applications, development of specific applications for broadcasters, content providers and other potential customers. Based on the acquired knowledge within the project also common consulting and teaching activities involving the competences of several partners have high potential. By considering individual and common exploitation preferences and priorities, clusters of interested partners for common exploitations have been identified. As it could be expected, the industrial partners and institutions of applied research are mainly interested in exploiting technology and consulting, while academic partners focus on teaching executive education and consulting. The individual and potential common exploitation plans have been summarized in D8.1.

With respect to the second goal – “Market Analyses”, two activities were performed:

1. A state-of-the art analyses of both user preferences for innovative TV concepts and of user attitudes towards TV. A particular focus was given to Social TV. The report shows that social media are becoming increasingly important for TV. On the one hand they are becoming part of various TV formats, on the other they push also the acceptance and adoption of the second screen in form of smartphones and tablets by users. They also push the acceptance and the adoption of interactivity as well as



sharing and exchanging of additional information and content while watching TV. Both of these are important future developments on the market showing the high potential of LinkedTV innovations. The results of the market analysis were used for defining the scope of social media inclusion into various developments of the project, as for example personalization in WP4 and user interfaces in WP3.

2. A state-of-the-art analyses of the B-to-B IPTV market. An overview of current and future developments as well as existing and emerging players and emerging IPTV ecosystems were identified. Based on that, planned LinkedTV innovations and developments were positioned into the market and benchmarked with current and future developments. The planned LinkedTV innovations and developments were particularly compared with existing market developments with respect to: 1) Hypervideo analyses; 2) Linking TV with Web content; 3) Recommendation and personalization approaches; 4) Existing approaches for user interfaces in particular with respect to second screens; 5) Contextualization; and 6) Content provided. The analyses revealed that LinkedTV developments have high potentials for creating products with unique selling propositions. The results of these analyses were summarized in D8.2. D8.2 was published and made available to a broad public.

#### *Future Activities:*

Based on the results achieved in the 1<sup>st</sup> year of the project, the following activities are planned for the next reporting period:

1. Tracking of the exploitation initiatives from the various partners during the projects and also creating additional exploitation initiatives and opportunities.
2. Based on the results of the market analyses and other results achieved in the project in the first year, LinkedTV partners articulated the need to develop not only common exploitation ideas where most or all partners will be involved, but also exploitation strategies which actually tackle different modules and where two or only few partners can be involved.
3. Evaluation of exploitation impact and recommendation of exploitation actions.
4. Based on the results of year 1 also first concepts of LinkedTV business modules will be developed together with detailed descriptions of potential and possible end to end LinkedTV value chains.

#### **Achievements**

- The analysis of the IPTV market was broadly published.
- Overview of changing attitude of users towards TV.
- Overview of current trends, in particular Social TV.
- Detailed overview of current developments in the b to be TV market.
- Detailed individual exploitation plans for each partner.
- Overview of potential product portfolio and potential common exploitation approaches as well as interest class tours of partners that might have common exploitation interests.

### **3.2.9 WP9 Management**

Management activities of the LinkedTV project are reported in Chapter 4.

## 4 Project management during the period

### 4.1 Management activities

#### Coordination

Management activities accomplished by WP9 consisted of coordination tasks mainly. The project was coordinated within the reporting period by its project coordinator Dr. Joachim Köhler and its scientific director Dr. Lyndon Nixon in conjunction with LinkedTVs technical board. The technical board comprises all work packages represented by their WP leader.

Current activities and general topics were discussed during four face-to-face meetings and regular plenary conference calls in-between. In addition work package specific or topic related meetings and conference calls were organised in parallel on an as-needed basis, in order to speed up research and dissemination activities within the project.

#### Quality Assurance

Already at the beginning of the project, WP9 initiated and implemented a quality assurance process to ensure the highest quality of the projects contractual deliverables. Each deliverable is reviewed internally by one project team member not involved in the creation process with regards to content and finally checked in WP9 regarding structure and other formal criteria before it is submitted to the EC. Internal reviewers are chosen on the quarterly plenary meetings and published on the project wiki.

#### Collaboration

To support the collaboration within the consortium a number of collaborative tools have been installed and made available to all project team members. Beyond face-to-face meetings and conference calls, collaboration on a daily basis takes place mainly through mailing lists and a Wiki. 13 mailing lists are maintained to allow for consortium wide as well as for intra and inter work package communication. The Wiki stores general project information as well as work package related topics. It is actively used for example for preparing joint publications or for planning the agenda of plenary meetings. Within the reporting period 90 content pages were created.

AV material and other large documents are stored and distributed via a FTP server. In addition for software and document versioning a SVN infrastructure is installed.

## 4.2 Dissemination

### 4.2.1 Project website

The project website is online at <http://www.linkedtv.eu> and uses the well known Wordpress software to manage its content. The frontpage is regularly updated with news items and there is easy access to project information via search, sections for navigation, and on the right hand column the project introduction slides, Social Web channels, news categories, archive, tag cloud and latest tweets.

In the first year of the project we published 26 news stories. This is since January 2012, when the website went live. So for the first 9 months, we received over 2 500 unique visitors and over 10 500 page impressions. We believe in the next year we will grow website visitors. Interestingly, 40% of visitors came via search to the webpage, and approx 6% of visitors came via Twitter shortened URLs (t.co).

### 4.2.2 Branding

Several Social Web channels are used by LinkedTV to share its content and news more widely in the Web ecosystem. In particular, we find Slideshare and Twitter the most valuable channels for content sharing and news distribution, respectively.

The project introduction slides achieved over 3 700 views in just over 3 months after being published in Slideshare and embedded on the LinkedTV front page. Slideshare is also being used for the project deliverables and the presentations by LinkedTV partners.

Every news item is tweeted. The LinkedTV Twitter account made 22 tweets in the first year and gathered 58 followers. It is also a member of 1 list with 67 followers. While these numbers are still small, we believe Twitter has potential to grow and since all tweets are public and sometimes use hashtags or mentions to link to other events or users, there is wider visibility of Twitter content than one's own followers.

### 4.2.3 Promotional Material

We have produced LinkedTV postcards and a newsletter (for the first year of the project) (<http://www.linkedtv.eu/newsletter>) as well as a specific leaflet (in Dutch) for events attended by the partner CWI.

### 4.2.4 Events and Conferences

We organized the FutureTV workshop at EuroITV 2012, for the 3<sup>rd</sup> year in a row (the previous 2 editions were organized by an earlier project NoTube) thus establishing this event as part of the conference.

We also co-organized the Social Event Detection task at MediaEval 2012 and participated in the Multimedia Event Detection task at TRECVID 2012.

LinkedTV partners were on the organizing committee of the International Conference on Multimedia Retrieval (ICMR 2012).

We have attended and shown our demo at EuroITV 2012 and at the CWI Information Day.

LinkedTV representatives were present at and presented the project at the events SemTech Berlin 2012, STUBA Workshop (organized by project hbbNEXT), the Cross Media Conference and a W3C workshop on HTML5 at the XInnovations 2012.

#### 4.2.5 Publications

A large number of scientific papers have been published by the consortium in reporting period 1, fully or partially based on the research funded by the LinkedTV project.

1. N. Gkalelis, V. Mezaris, I. Kompatsiaris, T. Stathaki, "Mixture subclass discriminant analysis link to restricted Gaussian model and other generalizations", IEEE Transactions on Neural Networks and Learning Systems, 2012, accepted for publication.
2. Dorothea Tsatsou, Vasileios Mezaris and Ioannis Kompatsiaris. **Semantic personalisation in networked media: determining the background knowledge**. In *7th International Workshop on Semantic and Social Media Adaptation and Personalization (SMAP 2012)*, December 3-4, 2012, Luxembourg. 6 pages. [paper](#)
3. Yunjia Li, Giuseppe Rizzo, Raphaël Troncy, Mike Wald and Gary Wills. **Creating Enriched YouTube Media Fragments With NERD Using Timed-Text**. In *Proc. 11th International Semantic Web Conference (ISWC'12), Demo Session*, November 11-15, 2012, Boston, USA. 4 pages. [paper](#)
4. L. Baltussen and J. Oomen. **Antiques Interactive**. in PATCH'12: Workshop on Personalized Access to Cultural Heritage, Nara, Japan, 2 November 2012. 4 pages. [paper](#)
5. Giuseppe Rizzo, Thomas Steiner, Raphaël Troncy, Ruben Verborgh, José Luis Redondo Garcia and Rik Van de Walle. **What Fresh Media Are You Looking For? Extracting Media Items from Multiple Social Networks**. In *Proc. International Workshop on Socially-Aware Multimedia (SAM'12)*, October 29-November 2, 2012, Nara, Japan. 6 pages. [paper](#)
6. Sven Buschbeck, Anthony Jameson, Raphaël Troncy, Houda Khrouf, Osma Suominen and Adrian Spireescu. **A Demonstrator for Parallel Faceted Browsing**. In *Proc. Intelligent Exploration of Semantic Data Workshop (IESD'12)*, October 8-12, 2012, Galway, Ireland. 4 pages. [paper](#) ... **Winner of the IESD challenge**
7. Symeon Papadopoulos, Emmanouil Schinas, Vasileios Mezaris, Raphaël Troncy and Ioannis Kompatsiaris. **Social Event Detection at MediaEval 2012: Challenges, Dataset and Evaluation**. In *Proc. MediaEval Benchmarking Initiative for Multimedia Evaluation*, October 4-5, 2012, Pisa, Italy. 2 pages. [paper](#).
8. R. Bardeli, J. Schwenninger, and D. Stein. **Audio Fingerprinting for Media Synchronisation and Duplicate Detection**. In *Proc. Media Synchronisation Workshop*, Berlin, Germany, October 2012. 4 pages accepted. [paper](#)
9. D. Stein, E. Apostolidis, V. Mezaris, N. de Abreu Pereira, J. Müller, M. Sahuguet, B. Huet, I. Lasek. **Enrichment of News Show Videos with Multimodal Semi-Automatic Analysis**, *NEM-Summit*, October 2012, Istanbul, Turkey. 6 pages. [paper](#)
10. Radek Škrabal, Milan Šimůnek, Stanislav Vojtíš, Andrej Hazucha, Tomáš Marek, David Chudán, Tomáš Kliegr. **Association Rule Mining Following the Web Search Paradigm**. In *Proc. of European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD 2012)*, Bristol, UK, 24-28 September 2012. Springer-Verlag
11. N. Gkalelis, V. Mezaris, I. Kompatsiaris, T. Stathaki, "Linear subclass support vector machines", IEEE Signal Processing Letters, vol. 19, no. 9, pp. 575-578, September 2012.

12. Dorothea Tsatsou, Lyndon Nixon, Matei Mancas, Miroslav Vacura, Rüdiger Klein, Julien Leroy, Jaroslav Kuchar, Tomáš Kliegr, Manuel Kober, Maria Loli, Vasileios Mezaris. **Contextualised user profiling in networked media environments**. In *Proc. 2nd International Workshop on Augmented User Modeling in conjunction with [20th Conference on User Modeling, Adaptation and Personalization \(UMAP 2012\)](#)*, Montreal, Canada, 16 - 20 July 2012. [paper](#)
13. D. Stein, E. Apostolidis, V. Mezaris, N. de Abreu Pereira, and J. Müller. **Semi-Automatic Video Analysis for Linking Television to the Web**. In *Proc. FutureTV Workshop*, June 2012, Berlin, Germany. 8 pages. [paper](#)
14. Lotte Belice Baltussen, Mieke H.R. Leysen, Jacco van Ossenbruggen, Johan Oomen, Jaap Blom, Pieter van Leeuwen and Lynda Hardman. **Antiques Interactive**. In *Proc. EuroITV demo session*, June 2012, Berlin, Germany. 4 pages. [paper](#)
15. Giuseppe Rizzo, Raphaël Troncy, Sebastian Hellmann and Martin Bruemmer. **NERD meets NIF: Lifting NLP Extraction Results to the Linked Data Cloud**. In *Proc. [5th Workshop on Linked Data on the Web \(LDOW'12\)](#)*, April 16, 2012, Lyon, France. 10 pages. [paper](#)

#### 4.2.6 Co-operation

There is a close contact between the LinkedTV project and hbbNEXT, especially through the partner RBB, and an intention as tools and technologies mature in both projects to examine possibilities for collaboration, co-ordinated activities and technology transfer.

We are also aware of the following potential projects for co-operation:

- CERTH is present in several projects including [CUBRIK](#) and [SocialSensor](#).
- CWI is also involved in Vconnect which seems very close to some objectives of LinkedTV (social TV aspect).
- STI knows VUA, BBC and U Zurich, who are all in a new STREP called ViSTA-TV, doing data analytics on IPTV viewing data.