

FP6- 027685 MESH

D1.3

Third MESH Public Annual Report

Contractual Date of Delivery:	M36 (February 2009)
Actual Date of Delivery:	21 April 2009
Workpackage:	<i>WP1 Management</i>
Dissemination Level:	Public
Nature:	Report
Approval Status:	MC approved
Version:	1.0
Total Number of Pages:	12
Distribution List:	All project participants, MC members, European Commission
Filename:	mesh-wp1-d1.3-final_public_report.doc
Keyword list:	

Abstract

This document presents all the achievements of the MESH project, including details on the different modules integrated in the MESH news portal, the publicly available results, and the academic dissemination, as well as the main events in the media sector.

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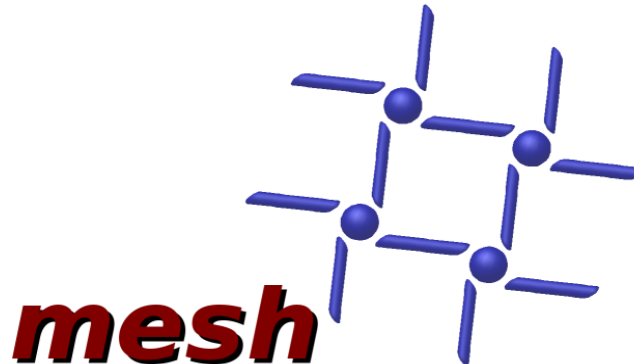
History

Version	Date	Reason	Revised by
0.1	16 April 2009	Draft	Pedro Concejero
0.9	20 April 2009	Incorporates comments from MC	Paulo Villegas Pedro Concejero
1.0	21 April 2009	Printed and saved as pdf for submission	Pedro Concejero

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Multimedia Semantic Syndication for Enhanced News Services



www.mesh-ip.eu

Final Public Report – Executive Summary

MESH is an Integrated Project in the Sixth Framework Programme. Its main objectives are to extract, compare and combine multimedia content from multiple news sources, automatically create advanced personalised multimedia summaries, syndicate summaries and content based on the extracted semantic information, and provide end users with a personalised *multimedia mesh* news navigation system.

The MESH project has successfully developed and integrated a MESH integrated news portal. A prototype deployed for demonstration purposes is available in the internet at the address

<http://mesh.tid.es:8080/MeshGUI>

This development and integration work has been carried out in an iterative fashion, by means of technical and user validation of the different modules included in the integrated portal.

The multimedia analysis tools in MESH automatically extract annotations from different media and integrate them into the MESH Knowledge Base. This is precisely a key part of the advances made by the project, since it integrates in a single package video segmentation, content representation, person detection, visual classification, text detection and application of OCR techniques to video data, automatic speech recognition, linguistic analysis of textual data, and event and highlight detection, all of them conforming a multimodal analysis infrastructure for multimedia content.

However, this analysis is generally based on algorithms which can produce errors. The MESH Manual Annotation Tool (MAT) addresses this problem by allowing the user to correct the automatic annotation in a quick, easy, and efficient way.

Additionally a hybrid reasoning framework combines reasoners of different types, and the personalisation subsystem tracks and analyzes both long-term interests and instant preferences to filter and recommend the most relevant news content to the user.

Once this automatic analysis is performed, the prototype allows for semantic search based on the mentioned multimodal ontology-driven analysis of content, and additional MESH modules perform video transcoding, automatic media summarisation according to different policies, and finally streaming and hyperlinking of the video content to the user through a GUI integrated in a web browser.

With this prototype, MESH has achieved to:

- Provide a significant contribution to emerging multimedia content markets with innovative semantic technologies and new business models.
- Facilitate the discovery and exploitation of multimedia content, with special focus in the area of News (although the main developed technologies are applicable to many other domains).

During 2008 MESH has organized a large-scale event, the Summer School on Multimedia Semantics (SSMS 2008). A notable novel aspect of this year programme was the objective to connect multimedia semantics researchers with the media sector professionals. MESH organized a 5-day programme centred on state-of-the-art technologies and research issues; and a co-located 3-day programme explaining the application of semantic technologies for media sector professionals. SSMS 2008 was attended by 74 students and 30 media professionals.

Finally, we consider worth mentioning the participation of MESH in the TRECVID 2008 international video evaluation framework (www-nlpir.nist.gov/projects/trecvid/), both as individual partners (in the HLF and Summarisation tasks) and as a joint MESH team (in the HLF task), which enlarged further the co-operation within the consortium and opened up an additional avenue for improvement of the techniques developed within MESH.

1. The MESH News Portal

MESH has developed a rich vision for optimizing how we use news in the information age, based on several complementary sides: understanding news, by providing automatic and semi-automatic tools to annotate and provide knowledge on multimedia news content; delivering news in novel formats, with emphasis on the production of personalised summaries; and understanding the users, by providing mechanisms to personalize the content according to different user profiles, and to the different usage the users make of the system. This ambitious vision has produced the planned results in the form of a complete prototype, a news portal, with a demonstration instance publicly available in the internet, and whose home page can be seen in Figure 1 below.

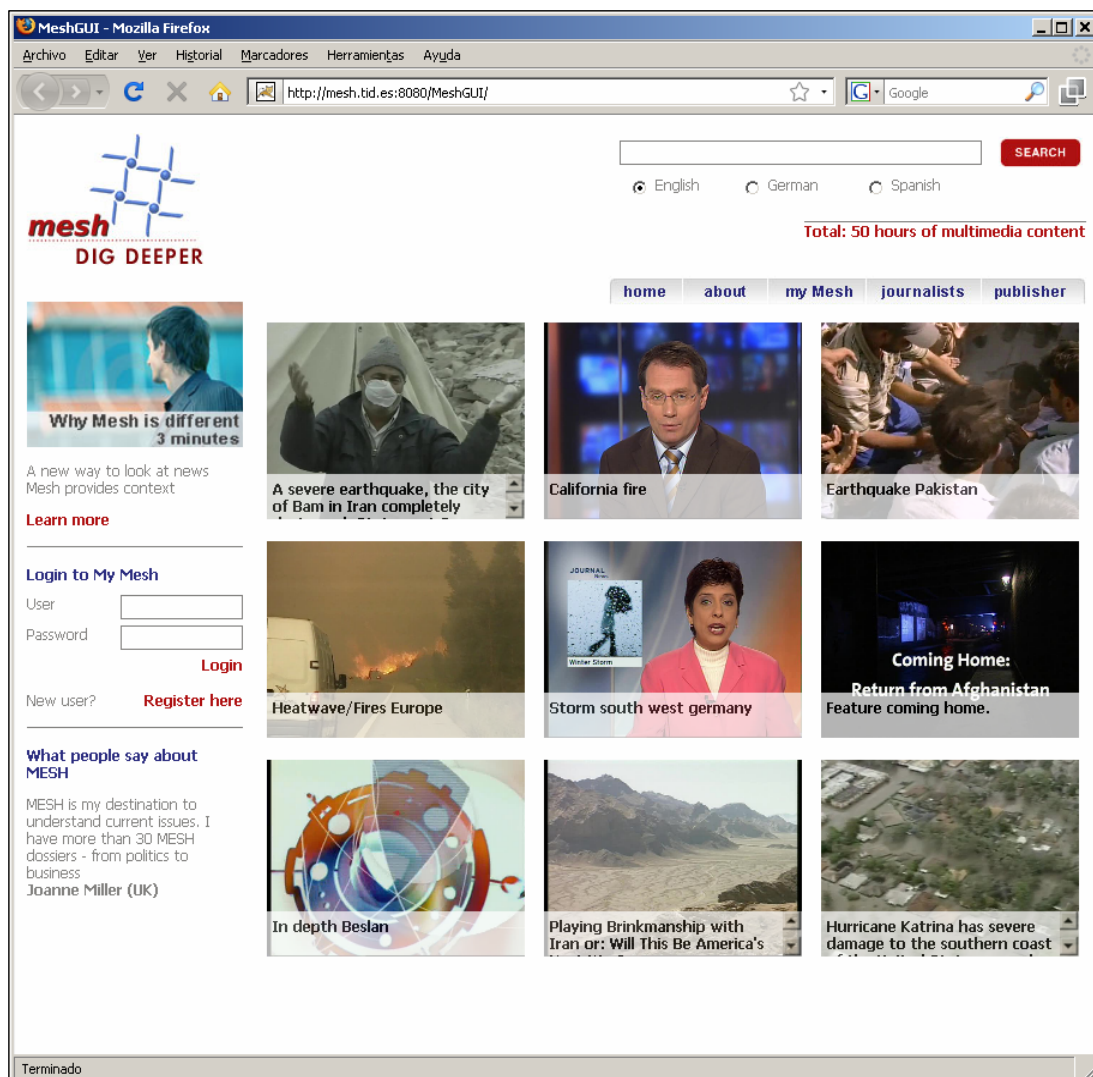


Figure 1: MESH Login and Search Page

The MESH integrated prototype is openly available at <http://mesh.tid.es:8080/MeshGUI>.

A brief illustration of the platform showing some basic functionalities is given in Figure 1. In the Login/Search page a vertical panel on the left allows the users to Login or Register to the Mesh platform. A search horizontal pane is always available, at the top, where users enter queries and receive sorted lists of the results below. Every news item which involves video content is viewable by streaming in an embedded rectangular window.

Based on the developed MESH ontology a results filter is also available on the left side, allowing further filtering of results according to concepts found in the resulting content

items. Under every video the “play”, “play summary” and “order personalised summary” buttons are always displayed.

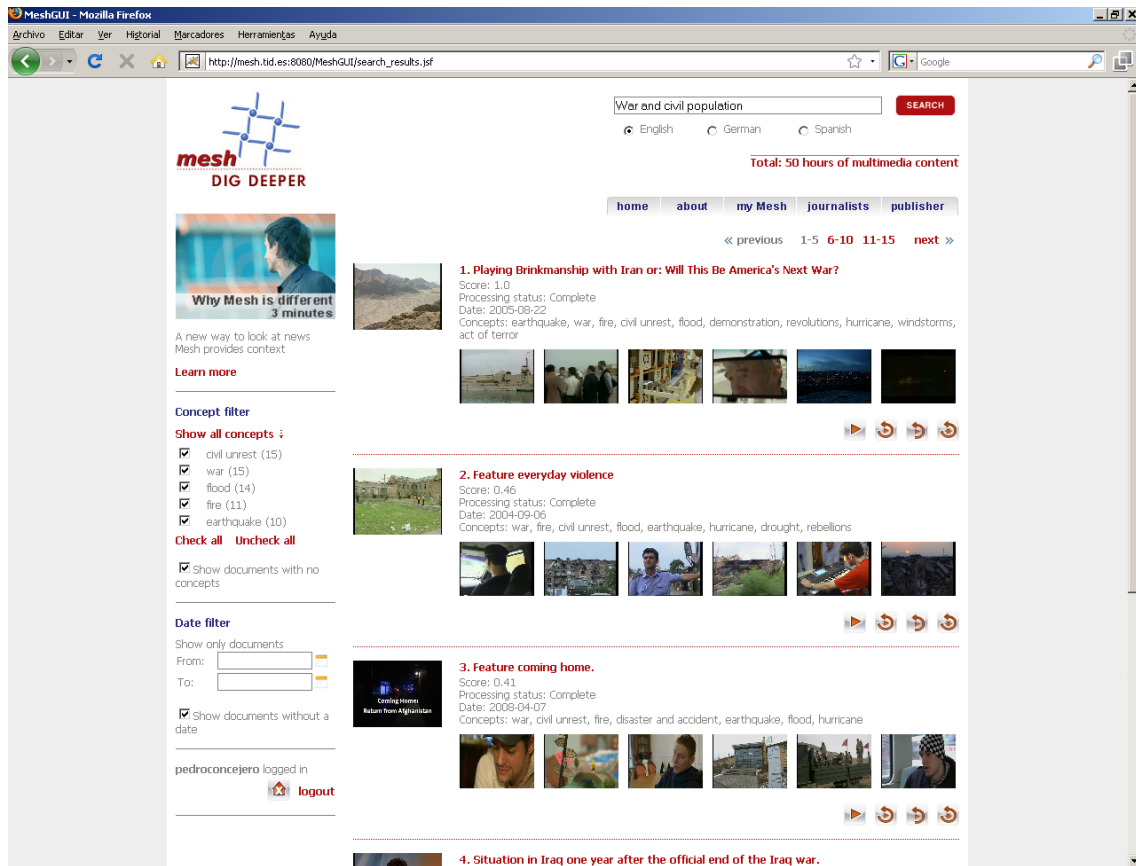


Figure 2: Search Results page

While viewing the summary of a news video the user can choose between following the link of the video that only includes the shots that involve the anchorman (‘Anchor’ button in Figure 3); or watching the actual shots of the event reported (‘News’ button in Figure 3). By default the summarised version is composed by the event shots with the video and voice of the anchorman played in an embedded video at the top left of the main video window, in a picture-in-picture style.

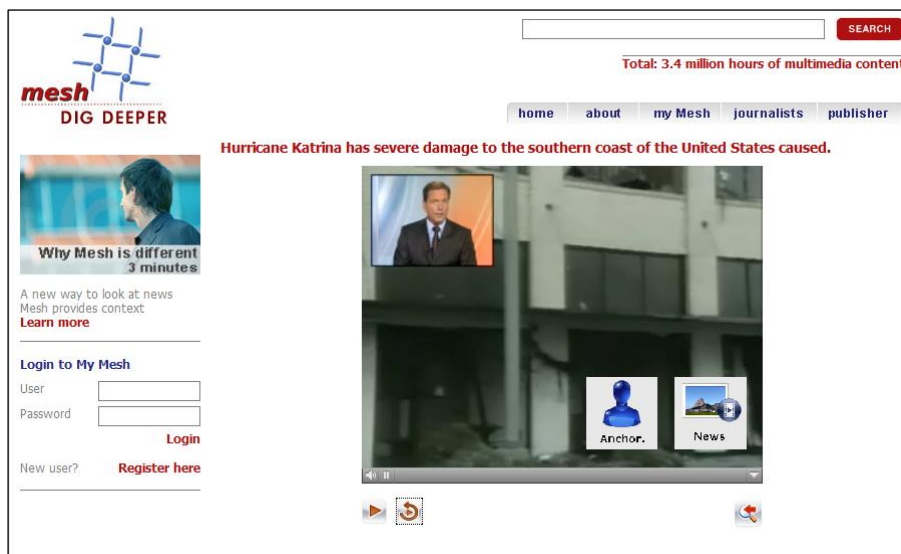


Figure 3: Choice between news shots and anchorman shots

The user can also order a summary that will be created according to his/her personal preferences and profile. Once the personalised summary is ready, a notification is displayed in a notifications pane under the MyMesh tab. In addition to the video news items the MESH system is able to update its Knowledge Base with articles from RSS feeds as they become available, and hence provide more complementary results.

The demonstration content set available in this news portal prototype includes pre-recorded video news broadcasts by Deutsche Welle in English, German and Spanish.

2. Multimedia Analysis in MESH

The role of multimedia analysis in MESH is to automatically extract meaningful semantic-level metadata from multimedia content. This involves both the processing of the different modalities of multimedia content independently, to take advantage of the particular characteristics of each, and the combination of analysis results across modalities, to enable reliable extraction of rich semantics from the content.

On individual modality analysis, MESH provides modules for video segmentation, content representation, person detection (an example of which can be seen in Figure 4), visual classification, text detection and application of OCR techniques on video data, automatic speech recognition, linguistic analysis of textual data, and event and highlight detection.

In order to produce final multimedia analysis results beyond a simple concatenation of the individual modality results outlined above, and to serve as an error-correction mechanism that discards conflicting annotations on the basis of various criteria, MESH includes cross-media analysis and reasoning. A cross-media analysis technique was developed to this end, based on examining the particular characteristics of the news multimedia content and using the MESH Knowledge Structures.

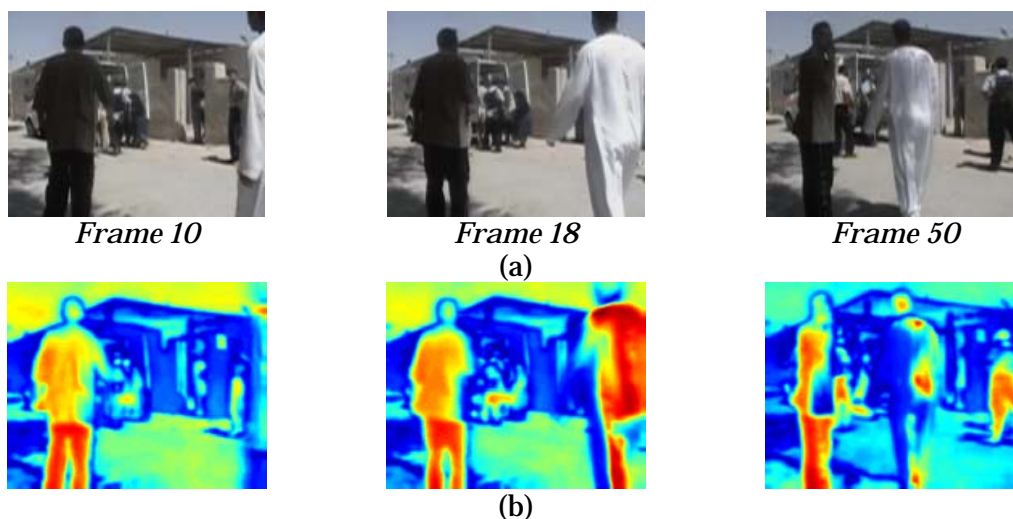


Figure 4 (a) Selected frames from a video depicting two men entering the scene; (b) Corresponding saliency frames. Notice how saliency changes when those two events occur. Initially, the standing man is the most salient region. The second man becomes more salient when he enters the scene, while the same happens at the third selected frame.

2.1. Knowledge Structures – The MESH ontologies

MESH has produced ontologies in two news domains: *natural disasters and accidents*, and *conflict, war and civil unrest*. The MESH consortium has released these ontologies under a Creative Commons Attribution-Share Alike 3.0 Unported License, and are available for download from the project website:

<http://www.mesh-ip.eu/upload/MESH%20Ontologies.zip>

2.2. MESH participation to TRECVID-2008 HLFE

Individual partners from the MESH consortium participated in the TRECVID 2008 Video Retrieval Evaluation series of the TREC conference sponsored by the National Institute of Standards and Technology (NIST) of the U.S.A., in the summarisation and in the High Level Feature Extraction (HLFE) tracks. But in addition to these single-partner participations, MESH also orchestrated a joint collaboration into the HLFE task, in which a group of four organizations from the MESH consortium developed a common infrastructure for joint submission., We submitted a total of 6 runs, using different variations and configurations over a common model.

With this purpose the MESH project developed a common visual analysis infrastructure to detect high level concepts in visual scenes; though the set of concepts was only partially coincident with those of TRECVID 2008 (in MESH it is tuned to news content). In the course of the development, a few new techniques, not originally present in the MESH system, were also tried.

2.3. MESH Manual Annotation Tool

The multimedia analysis in MESH (speech recognition, textual analysis, visual classification, and cross-media analysis) extracts automatically the annotations from different media and makes them available to the end user. However, this analysis is generally based on algorithms that can produce errors. The human intervention in the annotation process becomes then essential. The MESH Manual Annotation Tool (MAT) addresses this problem by allowing the user to correct the automatic annotation quickly, easily, and efficiently.

With MAT the annotator can quickly correct the automatic annotations by propagating the same individuals among similar shots. MAT visualizes all decompositions: textual and linguistic analysis, and cross-media decomposition, and the user can compare the intermediate annotations with the final result (cross-media) and correct or complete this later. To reach these objectives, the MAT tool communicates with other Mesh components, in particular, with the relevance feedback component (Figure 5). With this integration we aim to propagate the same annotation among similar shots inside the video. The similarity should be based on multiple criteria: visual, semantic and face similarity.

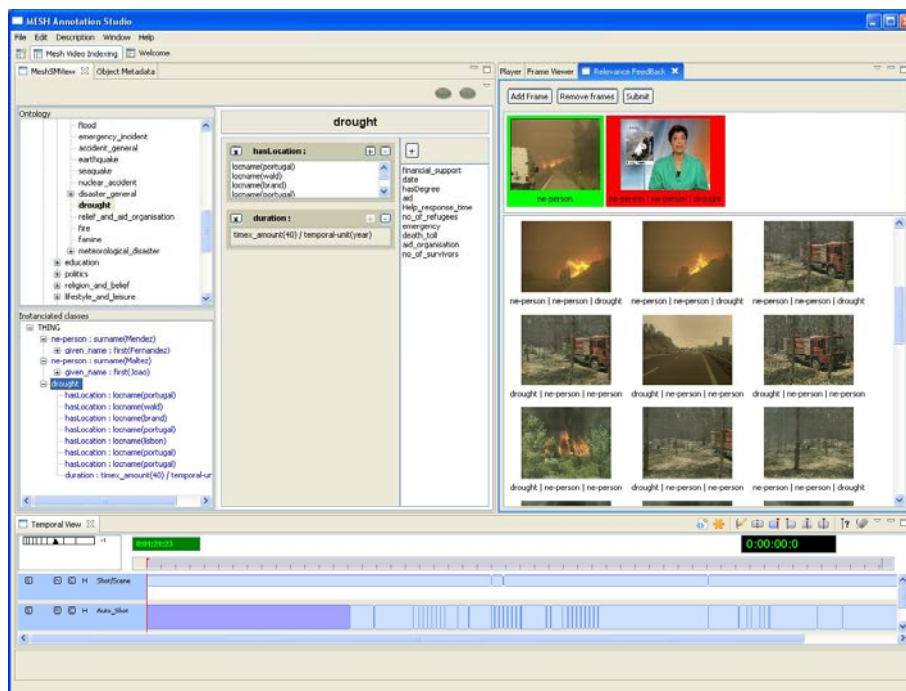


Figure 5 MESH Manual Annotation Tool and Relevance Feedback functionality

3. Reasoning in the MESH system

In order to make intelligent use of the semantic content acquired through the multimedia analysis of news items, strong reasoning capabilities are required. Reasoning is necessary to detect semantic relationships between related information items, to integrate background knowledge (e.g. which country a location belongs to) and to validate the consistency of the information sets. Reasoning enables the system to bring out information only implicit in the explicitly given information for retrieval and query answering. During the project's lifetime a hybrid reasoning framework was developed that allows for combining and integrating reasoners of different types, such as general reasoners based on First-Order Logic or Description Logic with special purpose reasoners that focus on efficient handling of specific types of information. The reasoners all operate on the same OWL knowledge base representing the semantic repository of the MESH system.

The reasoning system combines a general *monotonic rule based reasoner*, a special *identity reasoner* for managing sets of entities referring to the same object and a *temporal reasoner* for managing temporal relationships among the entities, e.g. events. A rule set for the application domain was created to derive relationships among news and events from different sources.

4. Search and ranking of results in MESH

Query processing in MESH features a simple interface, but a complex system processing the query is used to return personalized results. The aim is to determine which news items or fragments are more important for a specific user in a given situation, and which news should be highlighted or left in the background, depending on the particular context, or which pieces of content best convey a story or meet a specific user request.

A combination of ontology-based search and full text query processing for multiple languages is a novel technology provided by MESH. The Ontology-driven technologies have been introduced in the retrieval model as an enhanced ground for representing and processing the semantics (e.g. the meaning of content, user interests, contextual conditions, etc.) involved in the retrieval process. Ontologies enable finer, very specific search and retrieval tasks in the retrieval system, by supporting the expression of complex semantic queries (e.g. involving conditions between the search terms), finding accurate conceptual answers, and retrieving the content related to such answers, by exploiting the semantic annotations produced by the corresponding MESH modules.

The integration of multiple criteria for the final ranking of search results (or recommended content) has been also addressed, resulting in a rank fusion module where advanced dynamic combination strategies are applied, leading to a hybrid retrieval approach.

5. Personalisation in MESH

One key aspect of MESH is that news consumers have to be understood (i.e. profiled) so that news items can be matched against the reader's interests and requests. MESH addresses this objective by providing user preference learning techniques by the analysis of implicit user feedback, and the definition of gradual forgetting functions in tracking user actions.

Additionally, the MESH system incorporates a content filtering module, whose main novel aspects are the use of the ontology-based representation of user interests, and a mechanism to filter long-term user preferences according to their semantic relation to the short-term user actions.

The personalisation engine itself is composed of a collaborative recommender module, based on the detection of implicit communities of interest.

6. User Involvement, Promotion and Awareness

The integration of knowledge, semantics and low-level multimedia processing for the purpose of automatic semantics extraction from multimedia content is still the subject of active research in academia and industry. The MESH consortium has made a considerable effort in dissemination and training in the multimedia research and on media publication fields. This is only a summary of all the activities carried out by the project during its whole life.

6.1. *The Summer School on Multimedia Semantics 2008*



The Summer School on Multimedia Semantics was established to bring the relevant academic and media professional societies closer to the latest research and commercial developments providing the opportunity to gain deeper insight into the related research challenges and the ever increasing number of new applications.

SSMS has been held on two previous occasions and SSMS2008 built upon the success of these events. A notable novel aspect of 2008 programme was the objective to connect multimedia semantics researchers with the professional media sector. To this end, two groups of attendees were catered for: postgraduate students and researchers attending a 5-day programme centred around state-of-the-art technologies and research issues; and professionals attending a 3-day programme explaining the application of semantic technologies to their day-to-day activities. The fourth day of the event brought both groups together attending a series of lectures from representatives of world renowned organisations.

SSMS 2008 was attended by 74 students and 30 media professionals. The programme for researchers included the following lectures:

- Multimedia Signal Processing, by Prof Noel O'Connor
- Machine Learning, Pattern Recognition, Cross-modal analysis and fusion, by Dr Alexander Hauptmann
- Semantic Web and Multimedia, by Prof Steffen Staab
- Multimedia Ontologies for Reasoning and Analysis, by Prof Ralf Moeller
- Multimedia Information Indexing and Retrieval, by Prof Alan Smeaton
- Flexible Interfaces for Semantically Annotated Multimedia, by Prof Lynda Hardman
- Semantics and 3D media, by Dr Michela Spagnuolo
- Social Networks and Multimedia Semantics, by Dr Peter Mika

The programme for professionals included the following presentations:

- Calais - the media and the semantic web, by Barak Pridor, CEO, ClearForest, a division of Thomson Reuters

- A News Agency in Transition, by Meinolf Ellers, Managing Director dpa-infocom GmbH, Hamburg, Germany
- Mobile Services and Mobile Devices, by Paola Hobson, Motorola UK Research Lab, Basingstoke
- Newsgaming, by Julian Kuecklich, Press Association, London
- A newspaper goes multimedia, by Robert Freeman, Head of video, Guardian, UK
- Content Management, Data Mining, CRM, by Frank Poerschmann, IBM Global Business Services, Lead Media & Entertainment GB, Lead CRM Strategy, IBM Deutschland GmbH
- Concerns on Privacy and Innovation in ICT and Media Industries, by Rainer Boehme, Faculty of Computer Science, TU Dresden
- Talking about Networked Journalism, Search, Privacy, Filtering, Personalisation. Panel including:
 - Clancy Childs, Sales Engineer, Partner Services, Google, London, UK
 - Willi Ruetten, Director European Journalism Centre, Maastricht
 - Robert Freeman, Head of video, Guardian, UK
 - Andreas Neus, IBM Germany / Karlsruhe Service Research Institute, Karlsruhe University

The video recordings of the SSMS 2008 lectures are publicly available at http://videlectures.net/ssms08_chania.

Also, under the SSMS08 home page the slides for most lectures are also available as pdf files: <http://www.mesh-ip.eu/ssms08.aspx?Page=ssms08>

6.2. Publications in academic journals and conferences

MESH consortium has made extraordinary effort in publishing the developed methods and results in academic conferences and journals. The whole list of publications comprise no less than 86 papers and presentations, with at least 51 of them public, which can be consulted at the project website: <http://www.mesh-ip.eu/?Page=results>

6.3. MESH dissemination in the media sector

MESH was present in the 59th World Newspaper Congress in Moscow (2006) and in the 61st World Newspaper Congress (2008), and organized a full Industry Day co-located with the SAMT Conference (1st International Conference on Semantics and Digital Media Technology), in December 2006 in Athens. The SAMT Industry Day was created to enable media professionals, content providers, broadcasters, professional content users, and related industrial practitioners to gain first hand experience of relevant multimedia semantic analysis technologies and associated commercial applications.

On standardization activities, MESH has been interacting with the International Press Telecommunication Council (IPTC), as one very relevant international body for metadata standards in the news domain. MESH representatives participated in IPTC meetings in Vienna and Madrid, presenting MESH activities and purpose and getting feedback from IPTC representatives.

6.4. Exploitation of MESH results

Apart from the publication of the MESH prototype on the internet, there are several important public exploitation achievements in the project:

- A MESH partner, Universidad Autónoma de Madrid, has released CAIN21, the framework on which the MESH MAC (Media Adaptation Components) is based, under a dual-license model at <http://cain21.sourceforge.net>. CAIN-21 is freely available for non-commercial use under the terms of the GNU General Public License version 2 (GPLv2). A proprietary version of CAIN-21 for no GPLv2 or commercial use can be also made available under a different license scheme; professional and commercial users who do not want to share their source code under the GPLv2 conditions can use CAIN-21 by prior reaching a license agreement. (<http://cain21.sourceforge.net/licence.pdf>).
- The MESH ontologies have been licensed under a Creative Commons Attribution-Share Alike 3.0 Unported License, and are available for download from the project website: <http://www.mesh-ip.eu/upload/MESH%20Ontologies.zip>
- In the same way, the MESH User Ontology is available under the same license in the <http://www.mesh-ip.eu/?Page=Results> project web page.

7. Further Information

The MESH consortium is formed by: [Telefónica I+D](#), [Informatics and Telematics Institute](#), [Athens Technology Center](#), [Motorola](#), [Queen Mary University of London](#), [Institut National de l'Audiovisuel](#), [Noterik](#), [Universiteit Twente](#), [Deutsche Welle](#), [Deutsches Forschungszentrum für Künstliche Intelligenz](#), [Universidad Autónoma de Madrid](#) and [DIAS Publishing](#).

Additional resources can be found at the MESH website, available at www.mesh-ip.eu. It contains more in-depth information about the project, downloadable brochures and posters, documents produced and a series of MESH-related news items and events.