Second BRIDGET Workshop and Use Scenarios – Version B

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Reply to	leonardo@cedeo.net
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Author(s)	Leonardo Chiariglione, Ingo Feldmann, Adrian Gabrielli, Diego Gibellino, Traian Lavric, Gianmatteo Perrone, Alberto Messina.
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Abstract	This deliverable reports on the 2nd BRIDGET workshop and defines the scenarios that will be the target of investigations and experimentations in the 3rd project year.
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Ver0.3	2015-11-16	Revision by BRIDGET meeting
Ver0.4	2015-11-17	LC – parts of competence completed
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Ver1.0	2015-11-27	GP – revised final version
Ver1.1	2015-12-01	LC – new content added after discussion

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1 Executive summary

The present deliverable D2.4, published 25 months after the start of the project, includes a report of the interviews carried out at the 2nd (on-line) workshop, an assessment of the value of the BRIDGET solution in the current technology and service context and a description of the use scenarios that will be implemented in the 3rd project year.

The 2nd workshop has been held as a sequence of independent online interviews with individuals in different industries and at different positions in their organisations. As a large number of professional content producers were already engaged in the user trials in summer 2015, all efforts of the 2nd workshop were directed towards other broadcast and media typologies.

The interviews were organised as follows:

1. Skype was used because of the ease of sharing the presenter's screen;
2. A brief (10-slide) presentation of the notion of bridget and of its possible uses was made;
3. The BRIDGET Authoring Tool was demonstrated in its main functionalities;
4. A concise (10-question) questionnaire was filled out by the presenter in front of the interviewee.

The summary conclusions of the 2nd workshop is that the BRIDGET AT is relevant to broadcasters and media companies for many reasons:

- It appears in a timely fashion and has no known competition;
- It provides a large number of interesting features;
- Real time AT is important and other features would be relevant;
- Integration of AT in existing processes and workflows does not pose significant problems;
- There is a good level of readiness to buy;
- 2nd screen content is relevant (but with a broad range of opinions).

Partly as a result of the workshop, the following additional use scenarios were selected for support during the 3rd year: giving user the ability to enjoy 3D reconstruction of objects and use of bridgets in live broadcasts.

This deliverable also reports about the project's assessment of the positioning of the BRIDGET solution in the current technology and service context.

2 Terminology

This chapter includes terminology applicable to the entire project and not just to this deliverable. It is work in progress and will be updated as the project evolves.

Table 1 - Terms and Definitions

Term	Acronym	Definition
3D model		(3D graphics) a numerical representation of three-dimensional surfaces. In BRIDGET both sparse descriptions (e.g. point clouds) and dense approximations (e.g. through polygonal meshes) of 3D models will be studied.
3D scene reconstruction		Method for generating a 3D model starting from a number of representations of the same object/scene. Input to a 3D scene reconstruction algorithm can be a number of images, a video sequence, or a video sequence with corresponding depth information.
Annotation		Additional information about a media item, such as an image or video, said information being provided manually by a human examining the media item, automatically by computer analysis methods, or by a combination of manual and automatic processes. Example annotations include relevant textual keywords, provided by a human, and the dominant colours in an image or video, provided by automatic analysis of the content.
Application Information Table	AIT	A DVB Service Information Table that can be included in a MPEG-2 Transport Stream to allow applications signalling and identification through a broadcast channel. AIT data can also be represented as a file, either binary or using XML syntax, found at a URL. Applications data can be carried as data broadcast (through a carousel) or can be downloaded via broadband. It is the mechanism adopted by DVB-based commercial platforms (e.g.: HbbTV and in Italian MHP platform) to provide support for hybrid services (DVB-T/S and IP)
Application Programming Interface	API	A software interface specifying how a program interacts with other programs.
Audio Visual Description Profile	AVDP	(MPEG-7 Profiles) an amendment of MPEG-7 Part 9 which uses a subset of MPEG-7 MDS and the complete set of Visual and Audio tools to define a common format for the exchange of automatically extracted metadata for media production.
Augmented Reality	AR	A live copy of the physical environment in which certain elements are augmented through overlaying synthetic (computer generated) videos, sounds and 3D graphics.
Augmented Reality Application Format	ARAF	An extension of a subset of the MPEG-4 part 11 Scene Description and Application Engine standard, combined with other relevant MPEG standards (MPEG-4, MPEG-V), designed to enable the consumption of 2D/3D multimedia content.
Authoring tool		A software package which developers use to create and package content deliverable to end users.

Term	Acronym	Definition
Auto-calibration algorithm		Algorithms for camera calibration from multiple images of unstructured scenes, without usage of checkerboards or other specific visual patterns typically used in traditional calibration methods.
Bag-of-Words	BoW	A model providing a simplifying representation for Information Retrieval (IR) used in natural language processing and computer vision.
Bridget		Link from a TV programme to an external interactive media element.
Camera calibration		(Multi-camera system) the process of estimating intrinsic and extrinsic camera parameters, obtained through the analysis of several synchronized frames. Intrinsic camera parameters normally describe characteristics of each camera, such as the focal length, the principal point and lens distortion. Extrinsic camera parameters indicate rotation and translation transformations from 3D world coordinates to 3D camera coordinates.
Compact Descriptors for Visual Search	CDVS	An emerging MPEG standard of compact descriptors for efficient visual search applications, including matching of views of objects, landmarks, and printed documents that is robust to partial occlusions as well as changes in vantage point, camera parameters, and lighting conditions.
Companion screen apps		A class of applications that are designed to be complementary to TV watching or radio listening. Companion screens apps usually display content that is contextual and synchronised to what is shown on the main screen.
Companion screen		A secondary device (commonly a tablet or smartphone) which provides an enhanced viewing experience for the main device (commonly a television).
Compressed Histogram of Gradients	CHoG	A low-bitrate, scalable local image descriptor, derived through a specific technique of detecting stable keypoints in an image and computing and compressing histograms of intensity gradients in sub regions of the local region around each keypoint.
Connected TV		A TV set endowed with the ability to access web pages and other web based services.
Content classification		A process aiming to organise unstructured information (e.g. digital image or video content) by analysing the content and adding metadata 'tags' that describe that content (e.g. outdoor, indoor images) or labels classifying the content using a taxonomy of concepts. Automated content classification categorizes and organizes content by combining multiple methods of context-sensitive analysis.
Core Experiment	CE	(MPEG) a methodology to optimise the performance of a standard under development that sequentially optimises a subset of the functionalities assumed to be present in a standard while keeping the others unchanged.

Term	Acronym	Definition
Depth Image Based Rendering	DIBR	Stereo (or multi-view) representation generated by one input view and its corresponding depth information. Input view is warped according to the available depth information, in order to synthesise the view of the scene as captured from other points of observation.
Depth information		Information related to the distance from the camera to objects depicted in the scene. Depth information is usually delivered using a Gray-scale representation in which the luminance value of every pixel of the picture is proportional to the distance from the camera.
Descriptor		Information extracted from audio, image or video that summarizes and represents elementary features of the content. Examples of descriptors are the colour histogram for images and the motion field for video.
Difference of Gaussians	DoG	Difference of two Gaussian-filtered images that approximates a Laplacian or Gaussian image, used to build a scale-space representation of an image that allows to identify stable keypoints.
Digital Living Network Alliance	DLNA	A collaborative organization responsible for the definition of interoperability guidelines to allow sharing of digital media among multimedia devices, in particular in the home network. DLNA provides also an extensive certification programme for devices.
Digital Video Broadcasting	DVB	An industry forum with more than 200 members developing a suite of internationally accepted open standards for digital television, published through ETSI. Some of the most relevant and successful specifications defined by DVB are those related to broadcast data distribution of digital TV through satellite (DVB-S/S2), cable (DVB-C/C2) and terrestrial networks (DVB-T/T2).
Dominant colour descriptor		(MPEG-7) a standard MPEG-7 descriptor which characterizes an image or region by a small number of representative colours, selected by quantizing pixel colours into principal clusters. The dominant colour descriptor consists of the fraction of the image or region represented by each colour cluster and the variance of each one.
Electronic Programme Guide	EPG	Provide users of TV, radio or other media services, updated information on the currently broadcasted or scheduled programmes through a graphical user interface. Users can interact and navigate information and access their favourite content. EPGs can include mechanisms to filter and organize information based on user's preferences or behaviour (recommendation systems).
European Broadcasting Union	EBU	The association of European public broadcasters comprising 74 Active Members in 56 countries and 35 Associate Members from additional 22 countries.
European Telecommunication Standards Institute	ETSI	A European standardization organization in the telecommunications field. Through the Joint Technical Committee (JTC) it publishes DVB specifications.
eXtensible 3D Graphics	X3D	A standard XML dialect for representing 3D computer Graphics.

Term	Acronym	Definition
False alarm		An event (false positive result) that occurs when a test falsely or incorrectly reports a positive result. In visual search context false alarm occurs when a match is found between two images that do not contain matching objects.
False negative		In automated information extraction a false negative occurs when a piece of information actually pertaining to an analysed object is not detected. In Information retrieval it occurs when a result actually relevant to a query is not returned by a search system.
False positive		In automated information extraction a false positive occurs when a piece of information is erroneously associated to an analysed object. In Information retrieval it occurs when a result not relevant to a query is returned by a search system.
First screen		(A.k.a. main screen) is typically the principal TV screen of a household or the main presentation screen where a programme or event is displayed. It is a shared device that could be hierarchically referenced with a companion screen (e.g., a personal portable device).
Free viewpoint		Interaction paradigm enabled by multi-view content representation, allowing users to interactively and freely change the point of view.
Globally Executable MHP	GEM	A set of DVB specifications defining a Java-based middleware for broadcast receivers, IPTV set-top boxes and Blu-ray players. GEM defines the common set of functionalities of the platform in neutral way with respect to the actual transmission network adopted. It is the basis for broader specifications targeting actual devices.
Gradient Location and Orientation Histogram	GLOH	A local image descriptor with applications in computer vision tasks, for example in visual search. It is similar to SIFT descriptor but employs more spatial regions to extract gradient histograms.
Head-Related Transfer Function	HRTF	Transfer function describing how a sound generated from a specific point in space will arrive at the ear (generally at the outer end of the auditory canal).
High-level analysis tool		An automatic image or video processing module which produces semantic information about the image or video, such as whether it depicts an indoors or outdoors scene or whether a specific video shot is important in the narrative. High-level analysis tools usually operate on the information provided by one or more low-level analysis tools.
Homogeneous texture descriptor		(MPEG-7) a standard MPEG-7 descriptor which describes image texture properties in a region of interest. The image is filtered with a bank of orientation and scale sensitive Gabor filters, and the means and the standard deviations of the filtered outputs in the spatial frequency domain (5 scales × 6 orientations per scale) are used as the descriptor components.

Term	Acronym	Definition
Horizontal market		A market in which all the different entities offering services or products are grouped based on the adoption of one technology or platform. A typical example is a set of Service Providers offering their services on receivers compliant with a common set of technical specifications.
Hybrid broadcast broadband TV	HbbTV	An industry forum that defines technical specifications for a platform that seamlessly combines TV services delivered via broadcast with services delivered via broadband. HbbTV specifications rely on other standards or specifications (e.g.: OIPF, CEA, DVB, etc.) and are published as ETSI standards. HbbTV is commercially deployed in different countries in Europe.
Image signature		(MPEG-7) a standard MPEG-7 content-based image descriptor designed specifically for image identification, i.e. designed for the fast and robust identification of instances of the same image, possibly in edited or modified versions, in very large databases or the internet. Such a type of descriptors is also commonly known as a fingerprint or robust hash.
Immersive content		Content that is designed to involve the end-user deeply in the augmented or virtual world by using media and storytelling techniques.
Interactive content		In the context of augmented or virtual worlds, is the content that is designed to respond to the end-user's actions.
International Standard	IS	A standard produced by the International Organisation for Standardisation or the International Electrotechnical Commission.
International Organisation for Standardisation	ISO[1]	An international standards organisation whose members are various national standards organisations. It is organised in Technical Committees, the most important of which, in the context of BRIDGET, is the Joint ISO/IEC Technical Committee on Information Technology (JTC 1).
Key Performance Indicator	KPI	KPIs are sets of metrics that allow to evaluate the achievement of operative goals in a specific domain. KPIs are often collected and evaluated repeatedly to assess the level of performance improvement (or regression) due to changes during an activity or project.
Keypoint		Point in an image showing detection stability under local and global perturbations in the image domain, including perspective transformations, changes in image scale, and illumination variations.
Low-level analysis tool		An automatic image or video processing module which produces basic information about the image or video, such as information related to dominant colours, levels of motion activity, etc.
Main screen		See First Screen.
Maximally Stable Extremal Regions	MSER	Method for detecting stable keypoints from a number of co-variant regions extracted from an image.

[1] ISO is not really meant to be an acronym: see http://www.iso.org/iso/home/about.htm

Term	Acronym	Definition
Mean Opinion Score	MOS	A numerical measure of the (audio, video etc.) quality perceived by human beings.
Media analysis		An analysis of images, audio and videos through automated processes meant to create (or support the creation of) semantic annotations. Examples: segment a video into temporal segments such as shots and scenes, determine whether the depicted scene is indoors or outdoors, etc.
Metadata		Data describing or related to other data. Metadata include information or annotations in textual or graphical form that allow to organize, navigate, and search media content.
Mixed Reality	MR	A mixed representation between the real world and a virtual world, where digital objects co-exist and interact in real time.
Motion activity descriptor		(MPEG-7) a standard MPEG-7 descriptor which captures the intuitive notion of 'intensity of action' or 'pace of action' in a video segment. This descriptor is useful for applications such as video re-purposing, surveillance, fast browsing, dynamic video summarization, content-based querying, etc.
Moving Picture Experts Group	MPEG	A working group of ISO/IEC with the mission to develop standards for coded representation of digital audio and video and related data. Its formal name is ISO/IEC JTC 1/SC 29/WG 11.
MPEG eXtensible Middleware	MXM	(ISO/IEC 23006-2) a collection of multimedia functionalities offered by a collection of MPEG standards exposing standard APIs.
Multi-screen content		A content produced into multiple formats, bitrates and resolutions to allow distribution and consumption on devices such as TV, laptops, tablets, smartphone, game consoles, etc.
Multi-textured mesh		Multiple textures blended together on a single mesh by painting a mask between them.
Multi-view		Synchronized views captured through a multi-camera system.
Multimedia content description interface		MPEG-7 (formally ISO/IEC 15938 Multimedia Content Description Interface) is an international standard for the description of various types of multimedia content, irrespective of their representation format. Unlike standards such as MPEG-2 and MPEG-4 AVC, which aim to represent the content itself, MPEG-7 aims to represent information about the content, known as metadata, so as to allow users to search and browse audio-visual content more effectively.
Multimedia Home Platform	MHP	A DVB specification that defines a Java-based platform based on GEM targeting devices able to access applications (MHP xlets) through DVB networks (DVB-T/S/C).
Object recognition		Process of finding instances of a specific object in images or video through visual analysis. It differs from the object classification process that aims at finding objects belonging to a class, for example "cats".

Term	Acronym	Definition
Open IPTV Forum	OIPF	An industry forum defining technical specifications for IPTV and OTT end to end solutions. The specifications define a common set of media formats, protocols, content protection mechanisms, and a web-based application middleware to implement interoperable devices and network entities. OIPF specifications are adopted by HbbTV.
Over-The-Top	OTT	A way to deliver content or services over the Internet directly to the end user. With this model, Network operators are only involved in the transport of the IP packets from a third party entity to the end user. OTT content and services are consumed in a best effort modality, usually without any guarantee in terms of Quality of Service (bandwidth, latency, etc.).
Quality of Experience	QoE	A measure of the overall user's experience using subjective and objective metrics. It summarizes the level of experience during the entire service fruition. QoE metrics are often dependent on the specific target service.
Receiver Operating Characteristic	ROC	(Signal detection theory) graphically illustrates the performance of a binary classifier system as its discrimination threshold is varied.
Recommendation engine		A system that can predict the preference that one user can have versus a set of items analysing available information about the user (i.e. ratings and habit, social connectivity) and the items (e.g. ratings, text, and physical content).
Scale-Invariant Feature Transform	SIFT	Method for finding stable keypoints in a scale-space representation of the image and for computing descriptors that represent the gradient of the luminance on local areas surrounding the keypoints.
Second screen		A personal and portable device such as a smart phone, a tablet PC or a laptop with broadband connectivity. It can provide an enhanced viewing experience for content on another device, such as a TV set displaying linear content.
Social community		A group of users connected by established or temporary social relationships and able to interact with each other through the Internet. A social community can be focused on a particular topic or more general and can exchange social content with third parties social communities.
Social content		The set of content and information created, shared and exchanged through users' interactions in a social community.
Spatialised audio		Post-processing of the sound aiming at giving the listener the impression of a sound source captured within a three-dimensional environment.
Speed-Up Robust Features	SURF	Method for identifying stable keypoints on an image by means of a fast computation based on integral images and for computing local descriptors that represent the Haar wavelet response around the keypoint.
Structured-light camera		Device capturing 2D sequences and corresponding depth information projecting a known light pattern on a scene: depth is inferred by the deformation of such a pattern onto the existing surface.

Term	Acronym	Definition
Temporal Segmentation		The division of a video into temporal segments, possibly in a hierarchical fashion, e.g. into shots, groups of shots, scenes, etc.
Time-of-flight camera		Range imaging camera system that emits some specifically modulated light and compute distances from the objects in a scene measuring the time-of-flight of such light signal reflected by the objects.
Tracking algorithm		Tracks objects or local regions in video.
Universal Plug and Play	UPnP	A set of network protocols defined by the UPnP Forum that allow devices connected in a network to discover other devices in the same network and announce network services for data sharing, communications, and entertainment.
Use scenario		A formal or informal description of a set of users performing actions on a system. Use scenarios are used for the purpose of explaining, testing or designing the operation of a system.
User Generated Content	UGC	A broad range of media content types created by non-professional users and stored or distributed usually through the Internet. UGC may also be subject to licensing policies defined by the author for its usage and distribution.
Video signature		(MPEG-7) a standard MPEG-7 content-based video descriptor designed specifically for video identification, i.e. designed for the fast and robust identification of instances of the same video or part thereof, possibly in edited or modified versions, in very large databases or the internet. Such a type of descriptor is also commonly known as a fingerprint or robust hash.
Visual Search	VS	The task (or process) of looking for an object in a cluttered visual environment or in a database containing images and/or videos. The item that the observer is searching for is termed the target, while non-target items are termed distractors.
Web3D Consortium	W3C	A industry consortium whose purpose is to define and develop the X3D royalty-free open standards file format and runtime architecture to represent and communicate 3D scenes.
World Coordinates	WCs	The x, y, z coordinates corresponding to the physical world where the user is located. Typically, there is a single, global reference frame for WCs, as opposed to the many, local coordinate systems tied to each camera, or used to model synthetic objects to be “placed inside” the real world in an AR scene.

3 Overview of the BRIDGET solution

The current BRIDGET solution consists of two main applications used for the creation and consumption of bridgets: the authoring tool for professional use and a player. The authoring tool integrates the BRIDGET research which is focused on making service providers' and personal archives more manageable. It enables the authors to enrich their broadcast programmes with external additional content. The player in turn allows consumption of bridgets across multiple different environments.

3.1 Authoring Tool

The professional authors' goal is to present on the second screen content that has semantic connections with the first screen content: additional information about people, places, events, etc. In order to do so, BRIGET allows visual links performed by using visual search technologies developed in WP5: by using an image as query, the professional author obtains a set of similar images from the repository, images that may be already connected to other metadata (text or other media). He can then choose the ones he want to include in the bridget and select what kind of information will be presented (the media itself, metadata that comes with the media, etc.) and how this will be presented (the layout).

All those functionalities are made available through the *professional AT,* implemented as a web tool based on the MyMultimediaWorld[2] platform. This framework, property of IMT, manages multimedia content and the associated descriptions in a cloud-friendly manner.

The AT has access to additional multi-media repositories, according to the architecture depicted in Figure 1: the content of such repositories (*Program storage*) is previously analysed, in order to automatically extract descriptors uniquely representing such content, which are stored on the *Bridget storage*. Therefore, when the media to enrich is uploaded, an automatic processing chain may be started, searching for associations in the repository, collecting the corresponding metadata (*Metadata storage*) and proposing to the content producer several types of enrichments (images, text, videos).

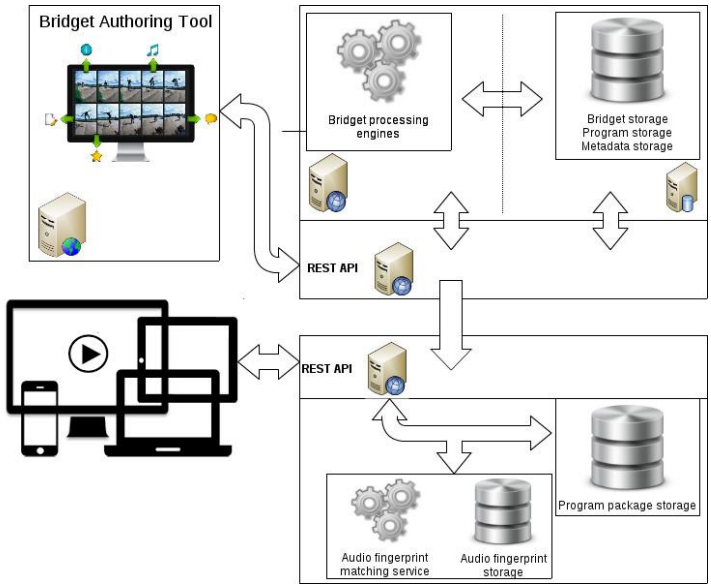


Figure 1: BRIDGET AT frontend and backend architecture.

3.1.1 Authoring Tool Frontend

The AT frontend is a browser-based web application that allows a professional designer (author) to create and store bridgets. It is a true HTML5 application that runs entirely on the browser.

The main Application Components are:

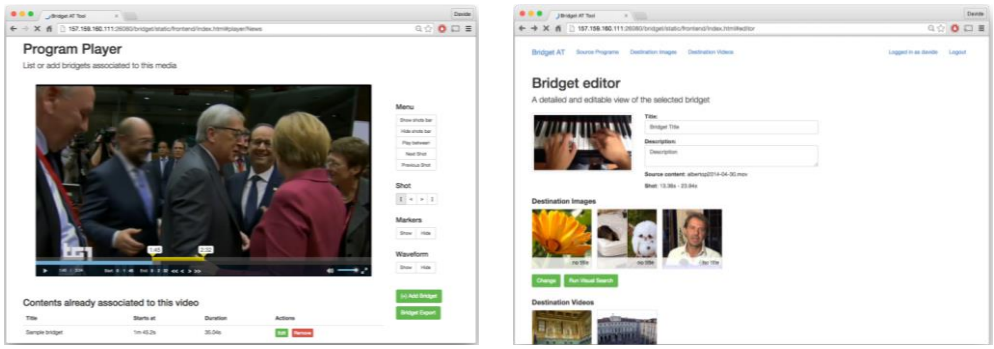
1. *Bridget Client*: A set of cross-browser javascript interfaces used to interact with the Bridget AT Backend APIs. Interaction is based on HTTP AJAX calls. The client also adds a layer of abstraction by automatically issuing multiple calls and aggregating results.
2. *Application Logic*: A javascript layer that models the application logic and state management. This is where the user workflow is implemented.
3. *User Interface*: A set of reusable UI Components built using React.js and JSX declarative language.

The development process carried out so far can be summarized in the following breakdown of activities:

[2] www.mymultimediaworld.com

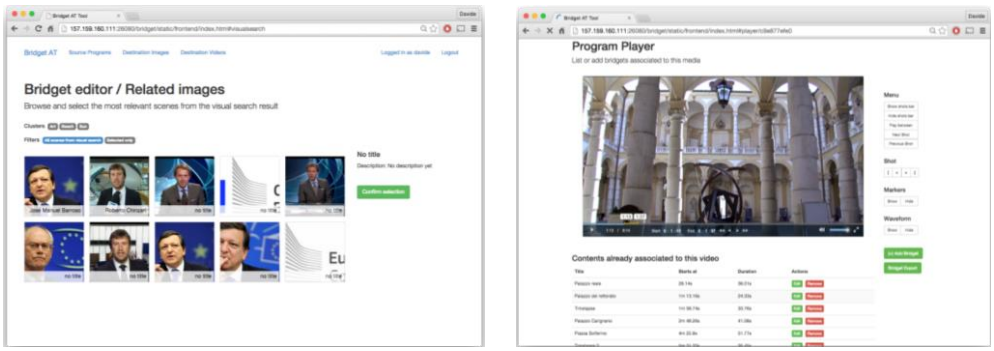
- Interaction with RAI experts and professionals to select user requirements and critical aspects of a user interface for the authoring of bridgets, as described in section 2.1 and 2.3;
- Translation of user requirements into functional requirement and drafting the user workflow then shared with the partners for agreement. Such requirements are aligned with the general BRIDGET requirements described in deliverable 2.2;
- Analysis of software solution and libraries to support browser client-side application development and creation of rich user interface;
- Definition of a first set of APIs to support the first minimum bridget workflow;
- Creation of interfaces and logic for source and destination content upload and description (metadata);
- Creation of user interfaces and application logic to view enriched multimedia contents with associated bridgets on the timeline;
- Addition of advanced UI functionalities for:
  - Enabling user selection of time segments in the multimedia player;
  - Conversion of a video frame to an image using HTML5 Canvas APIs;
  - Enabling the user selection of an area of the image to select specific objects inside a scene.
- Creation of the user workflow to:
  - Register/Login/Logout/Unregister;
  - Create and remove bridgets;
  - Edit metadata;
  - Run visual searches and select results;

As an example, the Figures below demonstrate how some of the BRIDGET AT functionalities can be accessed.



(a)(b)

Figure 2: (a) Video is played to find source content for a bridget; (b) Bridget creation



(a)(b)

Figure 3: (a) Images suggested by CDVS search; (b) Viewing all bridgets in a program

3.1.2 Authoring Tool Backend

The AT backend is implementing the architecture defined in WP3 and described in details in D3.1, "BRIDGET System Architecture and Interfaces". The Authoring Tool is built around a set of services called *Bridget engines (BE)* which are exposed to the frontend through a REST API.

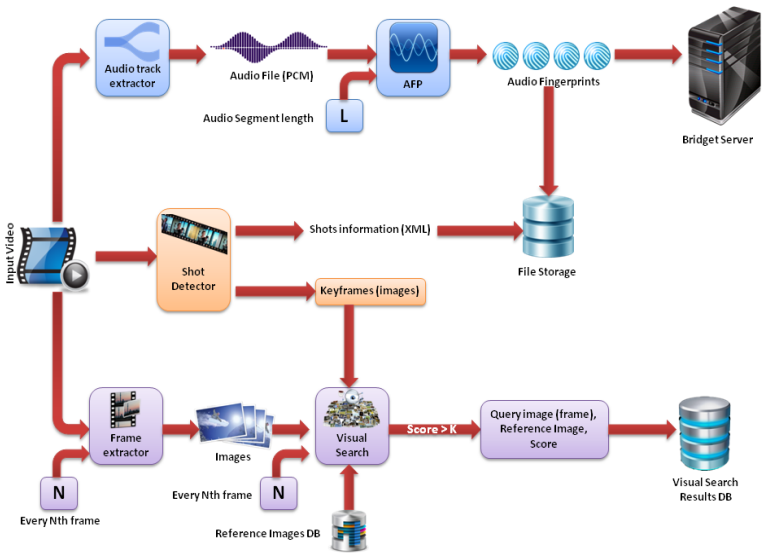


Figure 4: BRIDGET AT backend architecture

- As presented in Figure 4**,** the backend is composed of:
- *Web Server*: provides the REST API for the frontend, manages and launches the BE (*Shot Detector, Visual Search*, *Audio Fingerprint*); BE are activated through system calls directed to the engines themselves;
- *Shot Detector*: video analysis tool that receives as input the program video and outputs a hierarchical structured file that contains the start, duration and key frames (image) for each detected video shot;
- *Video frames extraction*: video tool that receives as input the program video and an integer parameter (N) and outputs the extracted frames (as individual image files). The integer input parameter N is used to subsample input frames (only 1 each N is analysed);
- *Visual Search* : image analysis tool that performs a visual search operation (compliant to Compact Descriptors of Visual Search – CDVS standard) with an input query image (extracted video frame), outputs the first K more similar images (ordered descending according to computed matching score) and stores in a database a combination of query image, reference image and score. The descriptors of the reference images are pre-computed and stored;
- *Audio track extraction*: receives as input the program video and outputs the extracted audio track in uncompressed PCM format;
- *Audio Fingerprint (AFP)*: audio analysis tool that receives in input the uncompressed PCM file corresponding to the program and an integer (L = audio segment length in seconds) and outputs a set of files containing the audio fingerprints (audio descriptors) corresponding to each audio segment. These files are then pushed to the Bridget Server so that the Bridgeted program can be identified based on the audio fingerprints.
- *Scripts*: a set of scripts (written in bash, perl or python) with the purpose to launch the engines in a pre-defined order and to link the input and output of each BE;
- *Server:* The Bridget Server is mainly composed of a web service which provides access to a database through a set of REST HTTP calls. Its main goal is to store published bridgets and provide access to them for the Bridget applications.

3.2 Companion screen application

The starting point for the BRIDGET Player was GPAC, a multimedia interactive framework, property of IMT (but distributed as open source)[3] and the activity was focused on integrating MPEG ARAF functionalities in OSMO4, the GPAC multimedia player. OSMO4 is an open source MPEG-4 compliant multimedia player which is supported on multiple platforms: Windows, Windows mobile, Android, iOS, Linux and MacOSX. OSMO4 supports different multimedia formats as well as a JavaScript execution engine based on the Mozilla SpiderMonkey engine. The implementation supports most of the Script features defined in the MPEG-4 standard and includes full support for interaction with any object in a scene. Additionally, Osmo4 supports PNG and JPEG for static images, MP3 and AAC for audio, H.264/AVC and HEVC for video. Files can be accessed from the local drive or through HTTP. OSMO4 uses OpenGL and OpenGL-ES for rendering mixed environments including 2D and 3D graphic objects. The player has also access to a variety of sensors such as motion sensors, location sensors, microphones, cameras and others.

Apart from implementing support of ARAF in OSMO, the main modification needed in this first period, in order to enable full support of BRIDGET functionalities in GPAC, was the introduction of a mechanism for support and management of audio fingerprint (AFP) within the player architecture.

The schema presented in **Figure 5** illustrates the AFP functional architecture.

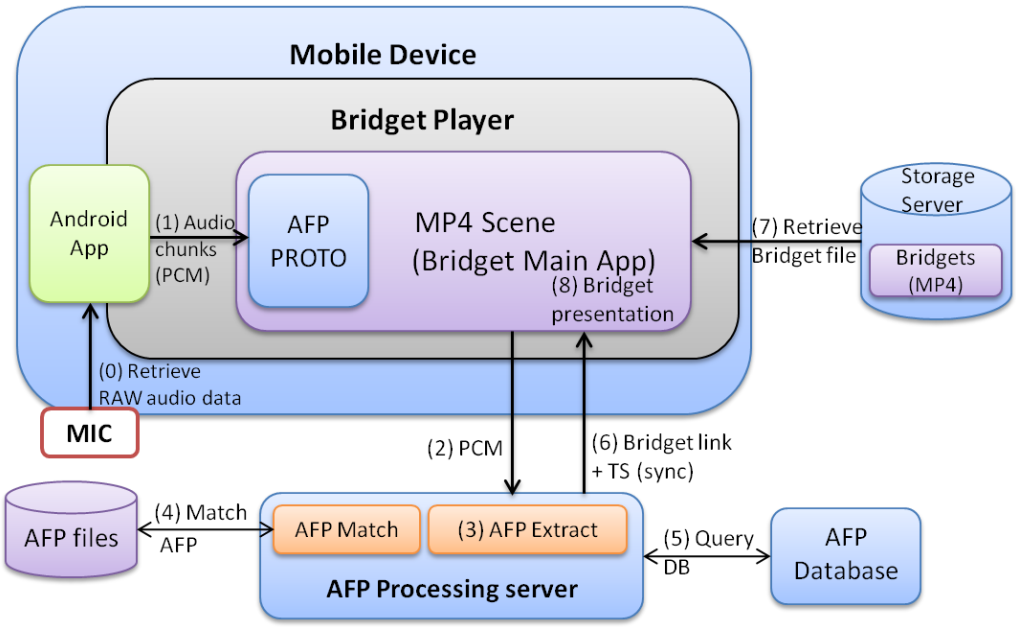


Figure 5: BRIDGET player

4 Second BRIDGET workshop

4.1 Introduction

Workshops are an essential component of the BRIDGET workflow. The 2nd workshop was planned to be held by the end of the second year and was envisaged as a traditional workshop held at a central place and attended by industry representatives (very much like the 1st workshop).

The project realised that in the current economic environment such a workshop could have seen a reduced attendance. Therefore, also based on reviewers' recommendation, the project decided to hold "distributed workshop" (DWS). With a long and laborious process a list of potential targets was drafted and individuals invited to an interview.

The following sections detail the complete process and reports the main results.

[3] http://gpac.wp.mines-telecom.fr/

4.2 Preparation of distributed workshop

4.2.1 Selection of questions

A subset of the questions developed for the BRIDGET AT user trial was identified. This was extended with a reduced number of additional questions. The number of questions was deliberately kept low in order to avoid rejection of the questionnaire.

Table 2 – Selected questions for interviews

#	Question
GE2	Do you think that BRIDGET as a project is addressing relevant problems for broadcasters and media companies?
GE3	Do you think that the project is at the right time to address these problems (e.g., is it late or too early)?
GE4	Which other technologies or systems you know existing address the same topics (be they used or not in your company)? Or, do you see a competing solution doing the same or better than BRIDGET?
GE5	Is the content you usually produce appropriate for being distributed on more than one screen?
GE7	Do you think that distributing on tablets and smartphones personalized content semantically linked to the main screen would change the way you conceive and produce your programmes?
GE13	Would you need a real time Bridget AT? Which main features would you like to have supported
GE14	Do you think bridget will help you to understand the reaction of people to your programs or integrate social aspects?
AT9	If BRIDGET were a reality in your organization, would you try to convince your management to deploy a similar authoring tool?
AT12	How much would the use of such an authoring tool help you to reuse existing material which was never broadcasted (e.g., raw material, outtakes)?
AT14	Assuming that you introduce bridgets in your production how well would the AT help you?
AT15	Can this kind of tool co-exist with your current working processes and workflows?

Questions GE13, GE14, AT14 and AT15 were not used in the user trials.

4.2.2 Summary of BRIDGET AT user trials

To facilitate comparisons some of the results of the questions used in the professional user trials were extracted and given to the project members conducting the interviews. The results are provided below.

Legend:	P	Produzione TV
	R	Ragazzi
	P	Partially
	NA	Not available
	S	Shazam

Table 3 – AT user trial results for selected questions

Service	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**P**	**R**	**R**	**R**	**R**	**R**	
Job title	TV Dir.	Ass. Dir.	TV Dir.	Ass. Dir.	Ass. Dir.	Ass. Dir.	Graphic designer	Graphic designer	Ex. Prod.	Ass. to Prg.	Ass. to Prg.	TV dir./Ex.Pro.	TV Dir.	Average
GE2	Y	Y	Y	Y	Y	N	Y	Y	Y	/	Y	Y	Y	11 Y, 1 N, 1 NA
GE3:	4	3	2	4	4	3	3	3	5	5	2	2	3	3,31
GE4:	/	/	/	/	S	/	S	S	/	/	/	/	S	
GE5	Y	Y, P	Y	Y	Y	Y	Y, P	Y, P	Y	Y	Y	Y, P	Y, P	8 Y, 5 Y P
GE7	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	12 Y, 1 N
AT9	4	3	3	4	5	3	5	4	3	2	4	2	5	3,62
AT12:	5	2	3	4	5	3	4	3	4	/	3	2	4	3,50

4.2.3 Selection of workshop participants

The following is the list of 47 contacts (and their affiliations) that were considered for an interview.

Table 4 – Pool of interview candidates

1st name	**Last name**	**Position**	**Affiliation**	**Co**
Stefan	Adamczyk	Production manager	2DF	DE
Visan	Alex		Antena1	RO
Artur	Alves	Consultant to the Board	INESC TEC	PT
Shuichi	Aoki	Researcher	Nippon Hoso Kyokai	JP
Fernando	Araùjo	Gerente de Operações de Engenharia	Globo TV Network	BR
Giovanni	Ballocca	Research Engineer	Sisvel Technology	IT
Evamaria	Bauer	Produktion	OKTO Community TV	AT
Stefano	Braghieri	R&D Manager	Mediaset	IT

Donciu	Carla		Antena3	RO
Luca	Catalano	CEO	Communication Video Engineering	IT
Daniel	Catalão	Journalist-Anchor	RTP	PT
Preda	Cosmin		ProTV	RO
Matteo	Feraboli	Head of Business Continuity, CTO	SKY-Italia	IT
Andy	Finney	Owner	ATSF	UK
Qiang	Fu	Deputy General Manager	CIBN	CN
Ciro	Gaglione	Interactive TV technical manager	Sky-IT	IT
Amadeu	Gassó	Director de explotación e ingeniería	TV3	ES
Andy	Gower	Head, Interactive Media Research Group	BT	UK
Marcin	Grochociński	Technology & Service Delivery Dep. Dir.	INEA SA Poznań	PL
Yasunobu	Kasai	Service and Technology Strategy	Jupiter Telecommunications	JP
Kyuheon	Kim	Chairman of UHD sub-committee	Next Generation Broadcasting Forum	KR
Mariusz	Kołodziejski	Technical Director	Telewizja Puls Sp. z o.o.	PL
David	Krames	Senior System Engineer	Czeska Televize	CZ
Bruce	Kruger	Head, Operations & Broadcast Services	SKY-UK	UK
Marek	Lagowski		TVP	PL
Yoonjae	Lee	Technical research	KBS	KR
Keigo	Majima	Researcher	Nippon Hoso Kyokai	JP
Radu	Mioara		Digi	RO
Oprea	Mirela		Realitatea Tv	RO
Yoon-Seok	Nam	Researcher	MBC	KR
Joost	Negenman	Senior Policy Advisor R&D	Nederlandse Publieke Omroep	NL
Roeland	Ordelman	Researcher	Sound and Vision	NL
Luk	Overmeire	Researcher	Vlaamse Radio en Televisie	BE
Francesco	Palmitessa	Software Engineer	Sky-IT	IT
Marco	Pellegrinato	R&D Director	RTI	IT
Paolo	Peraboni	Sr SW Developer Application	SKY-Italia	IT
Angelo	Pettazzi	Head of DTT Content Factory	Mediaset	IT
Angelo	Pettazzi	Strategic Marketing Manager	Mediaset	IT
Niina	Piiparinen	Project Assistant, Production Designer	YLE	FI
Francesco	Portincasa	IP Transport Strategy Engineer	Sky-IT	IT
Cosmin	Preda	Head of Digital Sales	ProTV	RO

Glenn	Reitmeier	Technology Standards, Policy & Strategy	NBC Universal	US
Vladislaw	Richter	Programátor	Nova	CZ
Miguel	Roser	Gestor de proyectos de innovación	Telefónica	ES
Ibrahim	Ruba	Head of Operations	Al Arabiya News	AE
Shane	Ruggieri	Colorist	Dolby	US
Dolf	Schinkel	Senior Architect iTV	KPN W&O NS TV &Media	NL
Ali	Shah	Head, Technology Direction	BBC	UK
Tampu	Stefan		AXN	RO
Sergio	Toffetti	Director	Centro Sperim. di Cinematografia	IT
Josbert	van Rooijen	Manager Broadcast & IT	SBS Broadcasting	NL
Charles	Viray	Senior Project Engineer	AL JAZEERA	QA
Nick	Wells	Research Fellow	BBC R&D	UK
Ryozo	Yamashita	Executive Engineer	ImpressR&D	JP

The following table lists the names of the 26 individuals (and their affiliation) that it was actually actually possible to interview. The last column gives the approximate short-hand indication of the industry they belong. Five individuals were from outside Europe.

Table 5 – List of interviewees

1st name	Last name	Position	Affiliation	Co.	Categ.
Luk	Overmeire	Researcher	Vlaamse Radio en Televisie	BE	Broad
Qiang	Fu	Deputy General Manager	CIBN	CN	OTT
Vladislaw	Richter	Principal Software Engineer	Nova Television	CZ	Broad
Amadeu	Gassó	Director de explotación e ingeniería	TV3	ES	Broad
Miguel	Roser	Gestor de proyectos de innovación	Telefónica	ES	Telco
Giovanni	Ballocca	Research Engineer	Sisvel Technology	IT	Techn
Luca	Catalano	CEO	Communication Video Engineering	IT	Comp
Ciro	Gaglione	Interactive TV technical manager	Sky-IT	IT	Broad
Angelo	Pettazzi	Strategic Marketing Manager	Mediaset	IT	Broad
Sergio	Toffetti	Director	Centro Sperim. di Cinematografia	IT	Educa
Shuichi	Aoki	Researcher	Nippon Hoso Kyokai	JP	Broad

Yasunobu	Kasai	Service & Techn. Strategy	Jupiter Telecommunications	JP	Cable
Ryozo	Yamashita	Executive Engineer	ImpressR&D	JP	Publi
Kyuheon	Kim	Chairman of UHD sub-committee	Next Generation Broadcasting Forum	KR	Broad
Yoon-Seok	Nam	Researcher	MBC	KR	Broad
Joost	Negenman	Senior Policy Advisor R&D	Nederlandse Publieke Omroep	NL	Broad
Roeland	Ordelman	Researcher	Sound and Vision	NL	Cultu
Dolf	Schinkel	Senior Architect iTV	KPN W&O NS TV &Media	NL	Telco
Josbert	van Rooijen	Manager Broadcast & IT	SBS Broadcasting	NL	Broad
Marcin	Grochociński	Technology & Service Delivery Dep. Dir.	INEA SA Poznań	PL	Cable
Mariusz	Kołodziejski	Technical Director	Telewizja Puls Sp. z o.o.	PL	Broad
Artur	Alves	Consultant to the Board	INESC TEC	PT	Cable
Daniel	Catalão	Journalist-Anchor	RTP	PT	Broad
Cosmin	Preda	Head of Digital Sales	ProTV	RO	Broad
Andy	Finney	Owner	ATSF	UK	Consu
Nick	Wells	Research Fellow	BBC R&D	UK	Broad
Glenn	Reitmeier	Technology Standards, Policy & Strategy	NBC Universal	US	Broad
Shane	Ruggieri	Colorist	Dolby	US	Comp

This is the summary of statistical data of the distributed workshop:

- Companies interviewed: 28
- Countries: 13
- Industries:
    - Broadcast (14)
    - CATV (3)
    - Commercial Company (2)
    - Consulting (1)
    - Cultural (1)
    - Education (1)
    - OTT (1)
    - Publishing (1)
    - Research (1)
    - Technology (1)
    - Telco (2)

4.3 Execution of interviews

The following steps were suggested when contacting a potential interviewee:

1. Explain how you became aware of the contact (IBC etc.)
2. Explain
    a. What is BRIDGET: EU FP7 project
    b. What it is for: to enrich broadcast content with additional information (called bridget) related to what is being broadcasted for typical use on a companion screen
3. Explain at what stage we are in the project
    a. 2 out of 3 years duration
    b. We have developed
        i. A bridget authoring tool for typical use in broadcasters' studios
        ii. An Android 4.x app
4. Explain that the approved project requires holding a workshop at month 24 (now) to hear what professionals think of the usage prospects of the bridget approach as implemented by the project
5. Request a 30 minute interview via skype
    a. To show a real usage of the bridget authoring tool
    b. To ask a very limited number of questions related to the demonstration (no need to fill out questionnaires)
6. Assure that no confidential information will be communicated and that the identity of the interviewee will not be disclosed to the EC (unless the interviewee is OK with it)
7. Promise to make available the *aggregated* result of the interviews carried out on some 50 individuals operating in the broadcast business

The following steps were suggested (for interviews done on skype):

1. Explain the purpose of the interview, if not already done before (see points 2-3-4 above))
2. Share the screen
3. Present the slides
4. Show the operation of the BRIDGET AT[4]
5. If the user has installed the app[5]
    a. Start the stream for which bridgets were created
        i. Gulp Girl
        ii. News
        iii. Porta a porta - Concordia
    b. Guide him in the use of bridgeted content
6. Ask a selection of the 10 questions and fill out the form yourself, possibly taking advantage of the answers given by RAI production people in the AT user trials
7. Give the URL of the IBC video[6]
8. Make sure that there is an independent internet connection if the interview is face-to-face.

4.4 Snapshots of interviews

The following is a selection of the most representative and/or interesting answers to the questions. The source of the answers is not provided because interviewees were told that their answers could not be traced back to their identity in order to create a rapport between interviewer and interviewee facilitating "candid answers".

[4] located at http://157.159.160.115/bridgetAT1/static/frontend/
[5] available at http://www.mymultimediaworld.com/files/bridget/apk/Bridget_trials.apk
[6] http://ict-bridget.eu/data/videos/

GE2: Do you think that BRIDGET as a project is addressing relevant problems for broadcasters and media companies?

Most answers have been "yes" or "enthusiastic yes". Some other answers:

- If the users are creative they will do it
- Bridget creates value among the broadcasters content and solves the need of the simultaneous consumption TV + Tablet/Smartphone by keeping its users in their ecosystem
- Yes with the following caveats:
  - Relevant for access services (subtitles)
  - Need to learn how to convert from lean back to lean forward experience
  - Personalised (user profile based) content bundles
  - Good for drama (lean back)
  - Must be done properly for sport, or you lose the viewer
  - Don't put too much content
- Addressing problems we probably will have in the near future
- 2nd screen sync is significant and growing. Bridgets for internet are less novel, but AT is good
- More than solving unknown problems, it creates opportunities
- Generally speaking it could be relevant. Actual use depends on business model
- One of the main problems of broadcasters is to increase audience and BRIDGET helps, because it engages in the viewers. Besides, they create a new "job model"
- Difficult to say. Certainly it gives a new perspective and a new way to make television.

GE3: Do you think that the project is at the right time to address these problems (e.g., is it late or too early)?

Most answers have been "just in time". One "too late". Some other answers:

- It could be the right time to start a commercial exploitation in form of a product in order not to lose the gained competitive advantage that might vanish quickly
- Timing is appropriate because the behaviour of consumers are changing and there is a need of more info during the TV consumption
- Broadcasters had been waiting for something like this
- More late than early. It is never too late if you got it right and you test things in practice
- Slightly too early. Companies are beginning to think about linear enrichment
- It seems to be right on time for a research project: just ahead of the real market need
- Could be the right time. It depends on what is happening in HbbTV. It can be a building block in a system
- BRIDGET is late. Bridgets are just a formalisation of what industry has been doing. We need to be **proactive** more than **reactive**. We need to think of what next generation 2nd screen should do. We need to think of the next trend in media consumption
- It depends on how the AT is used
- Just in time, broadcasters in some countries are developing 2nd generation Broadcasting Systems and there is increasing recognition by broadcasters that there future hinges on a combination of broadcasting and internet.

GE4: Which other technologies or systems you know existing address the same topics (be they used or not in your company)? Or, do you see a competing solution doing the same or better than BRIDGET?

Most answers have been "no known comparable solutions". Some answers have pointed out that there are several alternative solutions to BRIDGET's that achieve audio synchronisation (which we know, but was not the question).

- No known company providing this kind of product. Some address the marking of content (e.g. with audio fingerprints), but not in an integrated manner, within an AT (in a 2nd screen contents pilot the

main problems were content creation and audio fingerprints: the fingerprint team was different from the creation one, and the combined process of content creation and marking was very tedious)
- Not aware of authoring tools. Requires integration with traditional authoring tool. In some countries content and ad creator is different than the distributor and this can have big impacts.

GE5: Is the content you usually produce appropriate for being distributed on more than one screen?

This question received disparate answers, also because the range of interviewees' interest. Some answers:

- HTML epub could trigger a bridget (on an Amazon reader)
- Yes, our content is Multiscreen
- Some content yes, some no
- It should be, we are experimenting with ideas
- Definition of 2nd screen is about new experiences
- So far, we only have a few experiences of second screen applications, of which the most important was based on a choir competition (the audience could vote online through their second screens after watching and hearing all choirs on their main screens)
- Yes, suitable for company content, e.g. documentaries and story telling
- The vision is to be present in more than one screen, so there is a need for solutions like BRIDGET
- Not all of them. We buy a lot of content and we have not the right to touch it. We have rights for linear tv not for VoD, but there are some productions for which we have full rights
- Producers do not like bridget. First and foremost if they do not have control of them but, even if they have they are reluctant because their message is altered. They need time to understand and absorb the concept, to learn that bridget can give more value to their productions. For other case (e.g. lectures, corporate messages etc.) the problem is less serious
- Some of the content we produce is suitable: focused on news – second screen would enable commercials on the second screen but also other content, e.g. Glamour magazines.

GE7: Do you think that distributing on tablets and smartphones personalized content semantically linked to the main screen would change the way you conceive and produce your programmes?

In most cases the answer was yes. Some answers:

- Yes, because it makes the process of producing movies visible, storyboard
- Yes, but not now, sometimes in the future. For today, only small extra production would be justified, the costs are too big vs the revenues generated
- This is the future of TV
- Beware that the program originator may not be aware that later bridgets will be added. Again, don't add too much additional content
- Yes, storytelling, not linear content
- If the second screen paradigm is really adopted, it is obvious that the production system must change: a little at the beginning, and gradually more and more if the paradigm is successful. But another good question is whether second screen applications will really become commonplace, and when… The key factor to success will be to choose carefully those programmes for which the second screen makes sense, instead of trying to force the idea upon the audience without clear criteria
- Not in our case
- Yes, the way content is being produced is already changing. Only "popular" programs are produced the old way
- Yes, but it would make think twice how we use our videos
- This is the main idea. The innovation is about changing the production paradigm by considering bridgets from the beginning as an integral experience of the user
- Bridgets provide an opportunity to make money. Product placement exists not just for the main but also for the 2nd screen content and the two can be in competition
- We are moving toward a "visual web" where bridgets between videos are not just created by humans but also automatically

- The BRIDGET AT would impact content production, which should be done differently and would take advantage of existing content (creation cost recovery). The influence would not only be at the content creation level, because it would allow creation of new AV services completely different from those we know now. In these new services, we will be looking for an increment of user's interactivity.
- It would be great if such a change could happen in the short term, but will happen in the long term. Change will take some time because many people are conservative. Longer term traditional TV will disappear in favour of interactive medium, such as Bridget
- Yes, it will and will bring a lot of legal issues. Broadcasters are concerned by how their content is used
- To be understood. No data on that. But, companion screen could possibly open up new viewing proposition that could be beneficial
- Yes, but it will take time (e.g. 20 years) in broadcasting because it is a cultural shift. Things may be different where production and distribution happen in the same company.

GE13: Would you need a real time Bridget AT? Which main features would you like to have supported

The general answer was yes. Some contributed additional information:

- Easy to use, easy to integrate with production system (even though it is a separate system)
- Yes, in the case of new previously created links to media
- Yes, particularly for sport
- Yes. Adding 360° content enabled while the live event is streamed; would need statistics, useful for less interesting parts of the event
- Something like this already exists
- Nice for sports and Olympic Games. Good for channel switching. Needs the ability to store bridgets
- Yes, an AT like BRIDGET's will definitely be needed to create second screen applications linked to broadcast content, but probably not only: it would also be useful for any kind of digital content to be indexed and archived at web servers for distribution over the Internet
- Makes sense: audience may wish to contribute bridgets back. Kind of twitter on steroids
- Very important for broadcasting. Support to co-production.
- Yes, especially for sports etc. where you want to show more info. Adding content to real time content is going to happen. For such scenarios an AT is needed.
- Yes, e.g. you have a 4-hour parliamentary debate and you can inject bridgets on related matters. Or in a football game, where you have 1 hour pre-match talks, clips of which can be reused during the match
- Most of our content is prepared in advance, but real time AT is useful is some cases
- Yes. We hope to do it because we have a sports channel.
- Yes, the idea is a dashboard where the bridget producer can express needs for content. You need to be able to automatically search of content that you want to feed to the AT in real time
- For sport it is important to keep the user concentrated on the event, but for other formats (e.g. recipes) it helps to add a "social" slant to the user experience
- It would be great to have it. But from practical point of view most content is prepared beforehand. The same people prepare all content, so BRIDGET is extra load, therefore simple & efficient tools are required
- Even more important than in the recorded media case
- Essential function. Use of bridgets can start either way, off line or on line.

GE14: Do you think bridget will help you to understand the reaction of people to your programs or integrate social aspects?

The general answer was yes. Some contributed additional information:

- Some ebook readers have reporting capabilities to book sellers. Bridget could give more info (careful about privacy implications)
- May be. It depends on the balance between "walled garden" approach and interactivity
- Yes, particularly for education or to get viewers' opinion about how the serial story should end

- Yes, when we will have a critical and relevant mass
- Yes, you always need more analytics to understand the users' preferences
- Could augment the social experience of programs such as context of live event or if you can see who else is watching the same bridget
- No, companion apps do not work very well
- The audience always welcomes means to collaborate. BRIDGET would help integrate social aspects, e.g. tourism guides created collaboratively
- Yes, useful to know e.g. the number of people watching a particular bridget, but also as a means of crowd sourcing bridgets
- Yes, but it is a complex matter. Technology can do a lot but there are legal restrictions. Besides that you need to understand user needs and desire for privacy
- Yes, although there is a need to study users
- Yes. The world is evolving towards TR (Total Rewards), and this is what the end users want.
- Absolutely. If the BRIDGET concept is accepted, we would love to get statistics on what the user is doing, what is clicking, etc. Users can rate content real time. Interface with social network is very desirable. At the moment our presence in social network is limited. BRIDGET could change that
- The social domain is a too complex topic to answer. Probably having second screen applications is something dividing people more than fostering sociality
- Yes, although this is not an exclusive BRIDGET feature. It is possible because of the connection to the web
- Use of links with social media is possible. It needs big data and data mining.

AT9: If BRIDGET were a reality in your organization, would you try to convince your management to deploy a similar authoring tool?

The general answer was yes. Some contributed additional information:

- Happy to use app in company, need resources to deploy
- After a trial of the final version, yes
- It will depend on the type of content. In any case the need should come from inside. It is possible to explain the possibilities, but creative people will make the final decision
- The AT may be useful for some applications, but it is not so good for video. E.g., another view of the football match is not really used
- It would depend on clients, but 2nd screen is relevant
- We are not a big company. We cannot develop an AT ourselves, but we are ready to buy useful things if available
- Yes, it's all about experiences that people feel great about. Marketing people would use it.
- We are having the Linked TV project, which is similar to BRIDGET
- Yes. We already launched a second screen functionality pilot but the problem was the lack of availability of TR
- Yes, we would like to deploy and introduce our own features and interface with our existing systems. This means that the source code should be open (extendable)
- It will depend on cost and time to author of BRIDGET services
- Yes, but before you have to develop a business case.

AT12: How much would the use of such an authoring tool help you to reuse existing material which was never broadcasted (e.g., raw material, outtakes)?

The general answer was yes. Some contributed additional information:

- Broadcast time is limited but server time is unlimited. You do it because you just add the bridget and some people will open it
- We would use big data connected with this system to help linking a source to a destination video that is relevant to users' interests
- Yes, when we will have a critical and relevant mass

- Very much, AT allows enlarged use of broadcast content
- Content producers would love it, because they could show how a program is made or giving other views of a wild life program
- No
- Yes, there is always a reason why a content was not broadcast on a particular device in the past, but IP is a big issue
- It would be very helpful: in general, we broadcasters are always trying to reuse content, no matter if it has already been broadcast or not, or if it is still raw. However, I think an AT like this would be especially useful for content created ex novo, specifically targeting a second screen application and personnel cost reduction
- Yes, there is always a good reason for reusing content. Note, however, that one would also generate material for this particular new channel
- It would not be a reality for us now. Bridgets are certainly more effective than HbbTV because did not give enough thought about useful roles for distributors.
- Useful for old content or short movies about next episodes
- When sending Rambo 5 you link to Rambo 3 and give news about Rambo 6 (to generate interest in a Rambo 6)
- Not possible to decide. May be for sport it will be possible
- There is a lot of content that can be re-used with some technical difficulties (e.g. old formats). Re-using other material could be a big attraction to the viewer, e.g. photos taken during production, behind the scene, etc.
- It has to be a complete package of source-bridget-destination media. It should be able to convey metadata, watermarking etc. across production and distribution. In movie production they already save some extras (DVD etc.), but this is not happening yet in broadcasting and television production.

AT14: Assuming that you introduce bridgets in your production how well would the AT help you?

The general answer can be summarised by "Without AT it will be very hard to exploit bridgets".

- Useful to give the full story of a person in a movie or serial and not just show the slice of the person's history that is shown in a particular serial
- 80%
- Any personnel cost reduction is welcome
- There is a need for automation, such as finding something useful in 1 million hours
- For the short term an AT is needed. However, in a visual web you will eventually need something different. Crowd sourcing of bridgets is an opportunity
- It is essential, and as stated previously it must be extensible so that new features can be added easily, possibly in-house.

AT15: Can this kind of tool co-exist with your current working processes and workflows?

The general answer was yes. Some contributed additional information:

- Bridgets can be used in parallel to production of main content
- There might be a need for a closer integration of the main stream
- It has to be connected to other systems
- Need to integrate seamlessly with current video on demand production chair, metadata
- Bridgets follow the right kind of paradigm. Even in broadcast 1st and 2nd stream should become more integrated
- It can coexist, but it will force changes in the methods that are currently used
- I think so, it is just another page, another menu
- Yes, it bridgets them
- Technology must have a fast response and be aligned with the current way producers work
- Difficult to say at this time, but if the interest is there, problems can be overcome

- It can coexist. Actually current processes are not so tightly integrated. Introduction of AT would be an improvement also to existing processes (e.g. search)
- We need to study how it can be integrated
- It takes time to integrate with legacy broadcasting system
- Easy, as long as it is compatible with HTML5
- Yes, but attention must be paid to interfaces and other capabilities.

4.5 Conclusions

These are the main conclusions that be drawn from the tens of hours of interviews with the selected industry representatives.

Table 6 – Main results on interviews

Issue	Responses
Relevance	The verdict is unanimous: the BRIDGET solution is relevant to the media creation and distribution industry
Timeliness	• Generally BRIDGET is timely, with some variance (a little too early or a little too late or the respondent was just being cautious). • One radical view about BRIDGET being way too late.
Competition	Overall the BRIDGET AT has no competition. Some mention alternative synchronisation technologies, which was not the purpose of the question
2nd screen content production	• Some have deployed 2nd screen content and found that people did not care. • Others are experimenting with new types of content. • Some say they don't produce 2nd screen content but plan to
Novelty	• All see the value of bridgets in knowing their customers better (some cautious about legal implications) • Most understand the implication on content production, some more bullish about deploying bridget and some concerned by traditional video producers • Almost everybody agrees that bridgets are an excellent tool to reuse content or use so far unused content • Some understand the value of an authoring tool that works for broadcast and the web • Most understand that bridgets are a great social tool (excellent suggestions received)
More features	• Most need a real time AT. Different views about the amount of bridgets that should be pushed and the type of programs that can benefit from bridgets (excellent use cases suggested) • Some awareness that the BRIDGET AT should expose API to simplify interfacing with existing production software or to add proprietary features • Some mention automatic search of *semantically* relevant destination media as important
Readiness to buy	• Some see a bridget AT as a distant prospect • Some need to understand better the value of the bridget proposition • Some would like to buy a bridget AT if available (they are price conscious: some 2nd screen solutions are really expensive)

Deployment problems	• People understand that in the case of broadcast, bridget creation is an almost parallel process • People stress the fact that bridget creation for online content requires a stronger integration with company MAMs

The project plans to conduct more interviews during project life time. This also will be done with the goal to help project exploitation.

5 Identification of use scenarios

The first use scenario "The world in 3D" will add a new dimension of user interaction and visual experience. Based on a realistic 3D reconstruction of the real world the user can enjoy new ways of visualization and interaction with the displayed second screen content.

The second use scenario "Social live" intends to explore the social aspects of bridgets in a live broadcast environment. This has been selected for three reasons. the first is because the 2nd workshop interviews have placed a high importance to bridgets in live broadcast. The second because, while social aspects of bridget is not specifically part of the BRIDGET, theprojects sees bridgets as capable of introducing a new social face to broadcasting. Lastly the ability of end users to acting on bridgets by simply distributing them to a community or by doing so after editing allows the project to introduce an instance of an end user authoring tool.

A BRIDGET Authoring Tool for consumers can take different forms, for example a web-based or a stand-alone application. After careful consideration, it was decided that the WimBridge AT, as deployed by CEDEO, is well suited to support both professionals and consumers. Thus WimBridge AT will function as a general purpose AT for web content.

It was decided that a consumer screen of WimBridge AT shall enables a user to start from existing main video + bridgets + destination content, and replace some destination content with other content selected by the user. This allows the original bridget creator to retain a level of control on the bridgets released, an element that several of the people interviewed at the 2nd workshop stressed as important.

5.1 The world in 3D

BRIDGET links supplementary audio-visual content to a dedicated broadcast stream. In this way, the user can enjoy additional information on a second screen device. Traditional visual content has the form of images, videos and text. The BRIDGET “3D” scenario adds a new dimension of user interaction and visual experience. Based on a realistic 3D reconstruction of the real world the user can enjoy new ways of visualization and interaction with the displayed second screen content. Hereby, the general application scenario for 3rd year of the BRIDGET project is as follows:

Generation of 3D models: The user explores a set of images, for example containing a building. These images are uploaded to the BRIDGET server. A subsequent processing step computes the 3D reconstruction of the selected building automatically. Once the task is completed, the user can enjoy the just created 3D model.

Refinement of 3D model: In a subsequent step the generated 3D model can be refined. The user initiates this procedure by uploading an additional image data set. This second data set is processed by the BRIDGET 3D media algorithms. As a result, a refined 3D model is generated which provides an extended version of the original 3D model.

Visualization of the 3D model: Various ways of 3D model visualization will be available to the BRIDGET user: firstly, a straightforward *point cloud* can be shown. This approach gives the user a first impression of the 3D object and can be used in cases where more complex 3D reconstructions fail. A more immersed visualization form provides the *point cloud plus blended original images* (2.5D visualization). Here, in parallel with the 3D point location, the original captured images are blended to the screen depending on the virtual navigation and viewpoint of the scene. Finally, a more complex *mesh* as well as *splat* based

rendering is provided. This gives a natural impression of the 3D object with a high level of detail. Finally, a *combined mesh plus splat* version allows the maximum of 3D rendering quality even in situations where standard mesh reconstructions fail to achieve high quality results.

Usage of 3D models within BRIDGET framework: In the BRIDGET framework we differentiate between two types of users, the *professional user* and the *home user*. The professional user is active at the authoring side creating *bridgets* by actively generating 3D content and linking it to 2D images or text. On the other hand, the home user is able to upload additional images in order to refine the existing 3D model.

The activation of a 3D visualization is shown exemplarily in **Figure 6:**. The user explores a 2D image and receives additional information to broadcasted content (left-hand side of the figure). If further interested, the user may click on the 2D image. A 3D model opens (right-hand side) which can be interactively explored. Here, two ways of user navigation are possible. First, the user can rotate the 3D object. Secondly, the user can virtually navigate in the related 3D scene. Both types of user navigation can be assigned to a given bridget depending on the related 3D scene or object. For example, larger scenes may be more suitable for virtual navigation, whereas small 3D objects as shown in **Figure 6:** are more dedicated to object rotation.

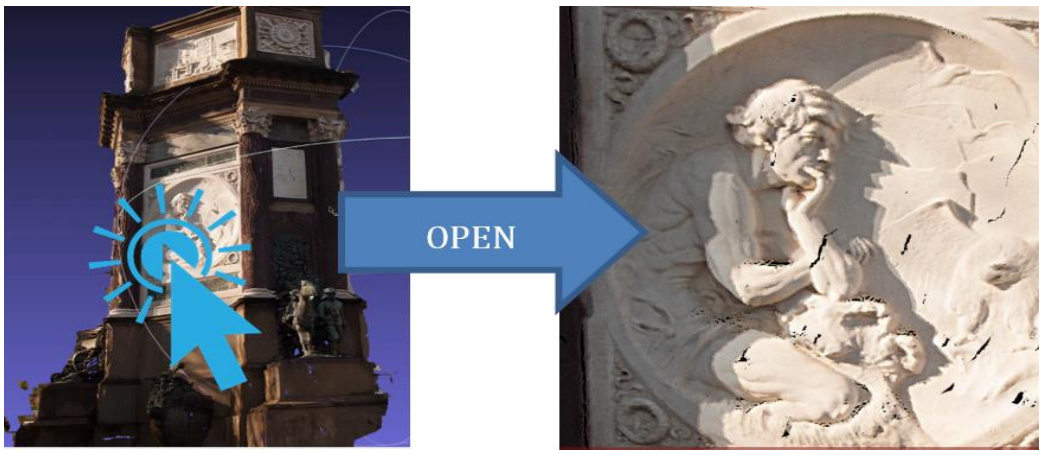


Figure 6: Sample of activation of a 3D bridget (R) by clicking a dedicated area in a 2D image (L)

5.2 Social live

This use scenario is concerned with the implementation of a BRIDGET case during the production of a television programme about a live event. Live events (such as sports matches, festivals, elections) are characterised by the fact that the production of the show is based on a schedule of the main parts of the show but naturally it is impossible to have a precise advance knowledge of the exact timings at which these parts occur. Furthermore, unexpected events can happen at any time, although some of these can be predicted in advance and associated to a certain probability of occurrence (e.g., a goal from the favourite team has a higher probability than a goal from the other team in a football match).

In this scenario, the current BRIDGET approach based on audio fingerprint synchronisation is only partly usable, and limited to the signalling and detection of well-known sound artefacts (such as jingles) that can be used as representations of the start (or end) of some event to which associate some companion content. Nevertheless, such an approach would introduce serious constraints in the production (both the audio and the video part) and have a non-trivial impact on the editorial direction of the programme.

Therefore, to implement a pilot live scenario for BRIDGET the following elements have to be considered:

- How to change the mechanism which provides the end user BRIDGET Application information about a newly available bridget and its corresponding temporal validity?
- How to change the authoring workflow to be more tightly coupled with the actual production of the programme?

The following story illustrates how this change of paradigm can happen in a realistic scenario.

5.2.1 Context

Broadcaster A is in charge of producing a national song festival in a beautiful location on Liguria coast. The festival has two main tracks (star singers and young talents), as well as a series of performances and interviews from international representatives of the star system, culture, science and politics. The list of singers is known in advance as well as the lyrics and authors of the songs, while instead the list of guest performers and famous guests is only a draft. In fact, some guests may be contacted at the very last moment or it may happen that some interviews are cancelled due to external factors (e.g., a Minister can be called to solve an urgent matter) or moved in the programme to a different slot than initially planned. Such an important show is also a big opportunity for the broadcaster in terms of advertising.

5.2.2 Phase 1 - Preparation

Impressed by a demonstration of a new system called BRIDGET to which he has been exposed during his visit to the last IBC, the executive producer of the programme decides to produce a BRIDGET second screen experience associated to the festival and organise the production resources accordingly. A team of music experts prepare material about each song (lyrics, music sheets, author information, and backstage clips) and create one bridget for each song organising the material in one visual experience using the lay-outing tools available from the Professional Authoring Tool. For the moment, i.e. before the show, the bridgets are marked as “inactive” in the authoring tool. Some of the bridgets are also marked as "editable", i.e. end users will be able to change some parts of the bridgets before they are distributed on a social network. At any time, the destination content of each bridget can be modified by its creator. Although the starting time of these bridgets is unknown, their duration is known in advance since it can be estimated from the duration of the song plus some setup and teardown time for the orchestra.

At the same time, a team of specialised journalists prepare information about the guests who are going to appear during the five days of the manifestation. This include CVs, photographs, quotations and all other relevant information items regarding the people and their lives and that can attract audience stimulating them to follow the programme and interact with it through other dedicated social bridgets. In the same manner as their colleagues expert in music, they prepare a set of inactive bridgets, one or more for each guest, depending on the planned duration of the performance/interview.

Each bridget, both the ones associated to singers and guests, may contain links to the relevant social pages and representative tags allowing users to interact seamlessly during the event.

A series of additional global bridgets is also prepared by a team of assistants to programmes, regarding the location, the history of the theatre in which the manifestation takes place, the history of the festival and its former winners and so on.

Since the programme production secured a series of very important sponsors, a team of employees of the broadcaster’s sales house prepare some advertisement bridgets. One of these is planned to appear during the final ceremony, when the winning artist is given a gold trophy sponsored by a famous international fashion firm.

In this phase each role in the production (music experts, journalists, assistants to programmes) is able to see and modify their own bridgets only. A bridget production supervisor can instead view the whole set of bridgets and interacts with the various teams in order to optimise the overall presentation and solve possible inconsistencies. Although the exact timing of each bridget is not known, a running order can be established for bridgets, based on the planned schedule.

Few hours before the start of the show, the executive producer reviews and authorise the bridget production. Unfortunately a couple of guests are no more available and have been replaced by another guest. The journalist team modify their bridgets accordingly before the final authorisation takes place. After authorisation, bridgets change state from “draft inactive” to “authorised inactive” and are published on the Bridget server.

5.2.3 Phase 2 – Pre-publication

Already a few days before the show actually starts, several programmes are scheduled with the intention of “launching” the main event. These programmes are also bridgeted with some of the global bridgets

prepared for the main programme, which have been exported and re-used by the assistant director in charge of the BRIDGET production. Those who have an End-user BRIDGET Application start to enjoy information about the location, the collateral events and some entertaining clips from the backstage[7]. The show promises to be very exciting, and some of these early viewers invite their friends to see the show and share their views during the event.

5.2.4 Phase 3 - Live!

The show starts. In many of the ten million households tuned from the very first second with the broadcast channel airing the show, there are devices equipped with the End-user BRIDGET Application[8].

These applications start inquiring the broadcaster Bridget server, which responds with the list of global bridgets which have been published in the Pre-publication phase together with a set of new global bridgets which have been published contextually with the start of the show. One of these latest bridgets illustrates the "making of" the splendid scenography set up in the theatre for the event.

During all the event, the production teams (journalists, assistants, sales house employees), would use the Professional Authoring Tool to perform their actions. The source content player of the tool is in fact showing them the streaming of the live broadcast.

As long as the many artists taking part in the contest follow each other on stage, the corresponding bridgets are activated on the Bridget server. Some changes in the rundown of appearances occurred due to some organisational issues. This does not impact too much on the BRIDGET production, if not for a corresponding change in the order of the bridgets to be activated and published, and operated from the Authoring Tool interface. Whenever an artist closes her performance, the corresponding bridget fades out without any manual intervention (the duration of these bridgets has been estimated in advance).

Guests and performers also give their contribution to the show. In this case, it was not possible to preset bridgets' duration, therefore they are initially published with a nominal duration which is finalised by the director's assistant in charge when each performance or interview actually finishes.

Unexpectedly, the production is informed at the last minute that one of the performing guests has got a terrible cold and is unable to take part in the show. The corresponding bridget is therefore not activated from the Authoring Tool by the director's assistants. No need to delete the bridget though: there are still some hopes that the guest may appear during the last day of the event.

Some of the bridgets released as "editable" can be edited by the end user with a "Consumer Authoring Tool" (CAT). The CAT also allows the end user to distribute the edited bridget to their preferred social networks.

Social channels associated to the production of the main event are constantly monitored by a specialised production team who can modify the content of a global social bridget with some additional content reflecting what's happening on those channels. For example, one of the artists' girlfriend has just delivered their first baby (a girl). When he gets on stage the social bridget has been adorned with a big pink bow and a photo of the newborn posted by his girlfriend!

The show is very successful and happily proceeds towards the end. During the closing ceremony, the winner is announced among the three finalists. A bridget representing the three artists in some of their best moments of the show has been prepared and authorised just few minutes before the ceremony and published. The winner is announced and receives the price. The advertisement bridget of the fashion firm appears on the second screen of the 10+ million followers.

[7] The application in this case works as usual: the audio fingerprint of the programme is pre-calculated and used to match against the user's device recorded audio.

[8] In this case the application is used in a different modality than usual. There are two active threads in the application: one thread is periodically checking that the user is still on the channel airing the live show, while a second thread is polling the Bridget server for available bridgets associated to the live programme. When the first thread detects that the user has switched channel, the live bridget show is paused.

5.2.5 Phase 4 – Post-publication

At the end of each of the five days of the manifestation the recorded version of the episode is available for online and on-demand services (e.g., catch-up TV). The editorial team exploits this by producing a downsized version of the BRIDGET experience, and publishing it on the Bridget server. When fans enjoy the recorded programme from their smart TVs, from the End-user BRIDGET Application interface they can enjoy again the bridgets published during the show plus some additional bridgets prepared overnight by the editorial team showing some backstage and the highlights of the show.

At the end of the manifestation all the recorded clips remain available on the Broadcaster A's online website and bridgets on the Bridget server. Fans who have enjoyed the BRIDGET experience during the show days can also enjoy it on their devices at any time, using the "summary" functionality of the application. From time to time new bridgets are added, which contain excerpts, post-show interviews and social feedback, as well as new advertisements about the songs and the fashion firm. The availability of this new content is signalled with a notification on the End-user BRIDGET application, so that fans can continuously be up-to-date.

6 BRIDGET and the current technology and service context

6.1 Technology context analysis

The technology context in which second screen services and platforms play a role is an evolving environment: users are changing their behaviours, asking for more interaction and control over the content consumed. In addition to proprietary, vertical technologies available in the market, key technologies are becoming available thanks to different initiatives in several groups or Standard Developing Organizations (SDOs). Examples are HbbTV, DVB, and W3C.

6.1.1 Hbbtv 2.0

The HbbTV standard allows creation of hybrid TV services operating over different DVB broadcasting technologies, combining broadcast and over-the-top content and creating a global open platform as an alternative to proprietary technologies. The latest HbbTV specification has been published as ETSI standard the 12nd of November 2015 (TS 102 796 V.1.3.1, corresponding to HbbTV 2.0). The release includes support to companion devices in order to enrich the end user experience.

The Companion Screen Interface enables the hybrid terminal to discover Companion Screen Devices and other hybrid terminals and to be discovered by Companion Screen Devices. Through it, interactive applications running in the Browser can request an application be installed or started on a Companion Screen Device and an application running on a Companion Screen Device a can request the Browser to start an interactive application. The Companion Screen Interface and the Media Player together enable synchronization of content delivered to the hybrid terminal via either interface with content delivered to a Companion Screen Device or another hybrid terminal. Terminal and service endpoint discovery is performed using the DIAL Rest mechanism (http://www.dial-multiscreen.org/).

Media Synchronization is achieved through a MediaSynchroniser object performing the inter-device synchronization related elementary functions defined in the DVB CSS specification (ETSI TS 103 286-2).

6.1.2 DVB Companion Screens and Streams (ETSI TS 103 286-2)

DVB-CSS enables synchronization and communication between a TV set/STB and a CSA running on a personal device defining the information flow between them and the dedicated services on the Internet by interfaces and protocols.

The DVB CSS architectural model is based on six main interfaces offered by the TV set/STB to the companion device:

- Interface for Discovery and Association (CSS-DA);
- Interface for metadata exchange, including content identification (CSS-CII);

- Interface for Wall Clock synchronisation (CSS-WC);
- Interface for Timeline Synchronisation (CSS-TS);
- Interface for notification of Trigger Events (CSS-TE);
- Interface for Material Resolution Service (CSS-MRS).

CSS-CII, CSS-TE and CSS-TS interfaces are built over WebSockets or HTTP and information are deployed using JSON format.

CSS-DA is based on Universal Plug and Play (UPnP), with the significant pros of establishing and managing communications between the TV set/STB and the CSA without prior knowledge of the assignment of both network addresses.

CSS-CII is based on WebSocket; after the CSA get connected to the TV set/STB, it receives the Content Identification and other Information of the content being presented by the Main Screen Device, including the Content identifier (CI), the locations (as URLs) of the service endpoints for the CSS-MRS, CSS-WC, CSS-TS and CSS-TE interfaces in order to proceed with Timeline Synchronization. Response are deployed using JSON format.

CSS-MRS is based on HTTP-Rest interface; it translates the Content Identifier retrieved from the CII into Material Information, with details of the content to resolve described as a URI parameter, with the consistent advantage of enabling the adoption of caching technologies which make the system extremely scalable to the increasing number of content requests; the response messages, once again, are in JSON format.

CSS-WC is based on UDP and provides information on the internal reference clock of the TV set/STB in a NTP-like manner: the WC Client periodically sends a request message to which the WC Server shall respond, in order to trigger the Timestamp exchanged in the Timeline Synchronization considering the network latencies between the TV set/STB and the CSA.

CSS-TS is based on WebSocket; Timeline Synchronization is the process by which the CSA the TV set/STB exchange Timestamp information to coordinate the synchronized presentation of Timed Content.

CSS-TE is based on WebSocket; when a CSA receive a Trigger Event from the TV set/STB, it starts to discover if there's something editorially significant happening and being presented by the Main Screen.

DVB-CSS includes several functionalities supporting different companion screen devices scenarios; first implementations of this specification are expected to be available with the shipment of the first HbbTV 2.0 compliant products on the market.

6.1.3 W3C Second Screen Presentation

The W3C Second Screen Presentation Working Group was established at the end of 2013 to develop a specification for accessing Second Screen devices from a browser.

The main goal of the Group is to define simple APIs that allow web applications to use secondary screens to display Web content and providing means for the first screen to communicate with and control the second page, wherever it is rendered.

That API should hide the details of the adopted connection technologies and use common and well known web technologies for messaging.

This way, many different use cases like showing presentations on a nearby screen, playing multiscreen games, and performing media sharing/playback will be enabled, and the gap between native and mobile will be closed, providing web applications means to behave as only applications implemented using native APIs were able to do.

The Presentation API doesn't have strong dependencies on any given set of protocols. The following is a list of external bodies collaborating with the Group to ensure that the Presentation API can be implemented on top of widely deployed communication technologies for connected displays:

- *DLNA*: the Digital Living Network Alliance references home network protocols that secondary displays may support.
- *IETF*: the IETF develops home network protocols that secondary displays may support.
- *UPnP* Forum: the UPnP Forum develops home network protocols that secondary displays may support.

- *Wi-Fi Alliance*: the Wi-Fi Alliance develops home network protocols that secondary displays may support.

The latest draft of the "Presentation API - W3C Editor's Draft"[9] has just been published on the 13th of November 2015. The objective of the group is to reach the final recommendation stage in 2016.

6.1.4 W3C Media Fragments

The W3C Media Fragments are media-format independent Uniform Resource Identifiers based components that allow addressing temporal and spatial subparts of a media resource in the Web environment.

Every URI is composed of four parts, as described below:

<scheme name> : <hierarchical part> [?<query>][#<fragment>]

It should be possible to define Media Fragments taking advantage of both URI query and URI fragment mechanisms.

W3C Media Fragments support addressing the media along four dimensions:

- Temporal (in the basic version): a specific time range of the original media content, expressed in range of seconds;
- Spatial (in the basic version): a specific area of the content, expressed in range of pixels and coordinate;
- Track (in the advanced version): one or more tracks in the original media content
- Id (in the advanced version): a named temporal fragment within the original media, e.g. "chapter X".

The Media Fragments URI basic specification has been published as W3C Recommendation in 2012[10]. Advanced capabilities are defined in a separate working draft[11].

Media Fragments URI is an efficient and flexible mechanism to identify a particular segment within a media content. This technology can easily be used to create a linking mechanism among related content for second screen application scenarios, especially considering the temporal dimension which currently has a widespread adoption in most HTML5 compliant browsers. Thus, the chance to integrate and adopt this kind of mechanism in the BRIDGET player, will be the objective of an accurate evaluation in the technical work packages WP4, WP5 and WP6

In terms of technologies, several initiatives are trying to create a set of APIs and underlying models to facilitate the interaction between the (hybrid) first screen and companion screens and the development of second screen applications on horizontal platform. However, first implementations in commercial products of those technologies will take some time to break into the market, and closed proprietary solutions will be the only available option to service providers and operators for the next future. The set of technologies developed in BRIDGET, which do not require particular support by specific middleware running on the first screen, provide today an alternative for potential customers.

6.2 Service context analysis

Watching TV while simultaneously using a smartphone, laptop or tablet is on the verge of becoming a majority behaviour worldwide. Having this milestone in mind, in the last few years TV broadcasters and companies active in the second screen applications and platforms development fields started a probably never ending competition.

Several solutions are already present on the market, spanning a huge range of offered services, from integrating social activities like live chat and links to social media channels passing through providing programme related information or statistics to more interactive services such as live polls and couch

[9] http://w3c.github.io/presentation-api/
[10] http://www.w3.org/TR/media-frags/
[11] http://www.w3.org/TR/2011/WD-media-frags-recipes-20111201/

commerce. Making a comprehensive review of the state of the art in this field is out of the scope of this deliverable, therefore we here highlight few representative examples to help assess the position of a hypothetical BRIDGET service in the market.

Examples of second screen platforms are Active Loop[12], Kwarter[13], Parterre[14], Vetrya[15] and Tivin (powered by Vetrya)[16], all available for both Android and iOS operating systems. All of them share the characteristic to align provided services to the broadcasted programme through audio codecs.

An increasing number of second screen applications is now complementing TV programmes with the aim of enriching them through interactive services and further appealing content, in particular specific TV genres like films, TV series, children and sport programmes seem to be much more suitable for such kind of interaction. An example of application related to films for children, available only for DVD versions, could be considered the "Disney Second screen" application[17], allowing users to explore interactive galleries, check out activities, learn interesting facts about the scenes they're watching, connect to social media, and more.

In 2013, Warner Bros, in partnership with Canal +, launched "My Warner - Second screen"[18], a multi-programme application that synchronises with Warner films and television series released from November 2013 onwards.

The application includes artworks, backstage material, bonus material and opinions and comments from social networks. My Warner – Second screen is linked to the larger My Warner platform which monitors users' activities on social networks. My Warner accounts has a reward mechanism for users, who can eventually earn gifts such as invitations to previews of Warner films.

Other second screen applications related to TV programmes are growing across countries helping TV shows like "X-Factor" or TV series like "The Walking Dead" exponentially increase the number of fans through their use of massive extra content and of social channels.

In the above outlined context, which can be defined lively and quite competitive, we have now to assess how a hypothetical BRIDGET service would impact the current market of media services. This aspect can be analysed under many dimensions. We here consider the ones that potentially can position BRIDGET as innovative solution in the marketplace, namely the following: new business opportunities, enhanced content convergence and improved public utility.

From the point of view of new business opportunities, it is clear that the BRIDGET solution offers a novel way to enlarge the perspective of market players like broadcasters, content producers, sale houses at a time where Over-The-Top operators push as they never did before to conquer segments of market traditionally associated to them. A new service inspired by the BRIDGET key concept, namely the extensive use of authored companion content on a serial basis, would substantively contribute to fill the gap between the current mainstream media service offer and the increasingly diverging habits of users. The peculiarity of BRIDGET under this respect relies both on the capability to attract users with new types of content (e.g., 3D reconstruction), and on the ability to automatically discover and propose to the author interesting enrichment opportunities through the analysis of content. This latter point is especially true if considering visual search functionality, which allow to exploit existing metadata from diverse sources (both internal and external) and author second screen with richer and more interesting content.

From the point of view of enhanced content convergence, there is no doubt that the BRIDGET solution represents a valuable example of how to conceive and to actually implement new ways to produce and distribute content and therefore new or alternative creative mechanisms. The peculiarity of BRIDGET under this respect relies on its end-to-end approach. In fact, these new creative mechanisms can introduce

[12] http://www.active-loop.com/
[13] http://www.kwarter.com/
[14] http://www.parterre.eu/
[15] http://www.vetrya.com/
[16] http://www.tivin.it/en/
[17] http://disneysecondscreen.go.com/
[18] http://myappwiz.net/home/appdetail?platform=Android&appID=com.mfglabs.mywarner&refer=fromMatch&name=My+Warner+-+Second+Screen

novel ideas for new services in addition to or as an evolution of traditional broadcasting and content publishing, by taking into account – since the ideation phase - a richer and more articulated user experience. This experience would be taking place with content in all its various forms (from plain text to interactive 3D exploration and spatial audio), overcoming not only traditional linear television but also most of current online and on-demand services.

The previous considerations about new business opportunities and enhanced content convergence make it also foreseeable that new actors would appear on the market with new propositions for enhanced content navigation and targeting customer categories that benefit from such kind of services like public administrations, manufacturing firms, tourist agencies, private and public educational institutions. This is a completely novel dimension w.r.t. existing market offers. The unique selling point of BRIDGET under this respect relies on the specific way in which authoring tools have been designed and operate. Namely, they are very simple and provide all the needed functionality to produce engaging entry-level applications produced through an efficient authoring workflow.

From the point of view of improving public utility, especially for public broadcasters, BRIDGET is a completely unprecedented key enabler for new forms of exploitation of content and new forms of citizen engagement around themes of social and cultural relevance. This would foster also new ways to exploit national and trans-national legacy content with a special focus of enhancing viewers' opportunities to enlarge their knowledge while engaged in one of the yet most popular activity like that of watching media.

In summary, we can conclude that a BRIDGET – inspired service would have a substantial impact on the market of current media services by:

- Soliciting new forms of business by established as well as new market players;
- Enriching user experience at large through new and more articulated forms of content;
- Fostering wider education among citizens through improved exploitation of content legacy.

7 BRIDGET exploitation prospects

The project, taking advantage of the outcomes of workshops and interviews, has started the analysis of the exploitation potential of BRIDGET. These exploitation prospects have been defined and considered by each individual partner as well as by the whole Consortium as a single entity. A refined and comprehensive exploitation plan will be provided in Deliverable D2.7 Exploitation Plan to be delivered at project completion.

The envisaged exploitation opportunities are mainly in the following areas:

- BRIDGET Technology components;
- Integration/adaptation of BRIDGET services in existing application and service ecosystems;
- Analytics Services based on BRIDGET;
- BRIDGET Service platform proposition (one stop shop).

The first area of exploitation opportunity is the promotion of the enhanced Visual and 3D technologies developed, or optimized and integrated in the project. Each technology embedded in BRIDGET may be well adapted and integrated in other service contexts giving the opportunity to some of the companies in the Consortium to play the role of technology providers for third party integrators.

Another area identified is the integration of BRIDGET, as a service platform, in existing application and service ecosystems, and in particular, in workflow and platforms already set and used by customers. This means, for examples, the creation of layers to adapt the Digital Asset Management (DAM) or production workflow of a service provider or broadcaster willing to create BRIDGET-enabled services.

As a response to a demand from Broadcasters and Service Providers, Analytics Services are becoming essentials to evaluate the investments in advertisement campaigns and assess the related level of impact on the first and/or second screens. An important opportunity is the proposition of these kind of services taking advantage of the BRIDGET platform, which provides easy way to identify customers' behavior and collect relevant aggregated audience or interaction and consumption data.

The fourth area, based also on relevant feedbacks collected during interviews, is the option to provide a BRIDGET platform, relying on cloud-based infrastructures, allowing any entity to access, use, distribute,

and consume bridgets. This proposition should be intended as a *one stop shop* to create and offer BRIDGET services, in particular for service providers operating on the Internet.

The following sections provide a brief description of early exploitation prospects identified by some companies in the Consortium.

7.1 Telecom Italia

Telecom Italia has created in 2013 eight Joint Open Labs, new departments within the company with more than 200 employees directly working in Telecom Italia's innovation areas and an investment of 18 million euros (2012-2018). They are aimed at encouraging growth, research and development in specific technology areas. One of those Labs is the Visible Lab, whose mission is to develop and exploit Visual Research and Augmented Reality technologies. Several BRIDGET Visual related technology components developed in the Visible Lab are of interest for a wide range of commercial services, in particular for mobile and personal connected device domain. Examples are content-related applications and services, but also e-shopping, and education.

7.2 CEDEO

CEDEO has added the new WimBridge service to the WimTV application and service ecosystem. The purpose of WimBridge (www.wimbridge.tv) is to create enriched videos (that we call "video bridgets") for distribution on the web. Video bridgets can be consumed on an HTML5 browser on both desktop and mobile.

The figure below depicts how WimBridge adds to the existing set of WimTV functionalities.

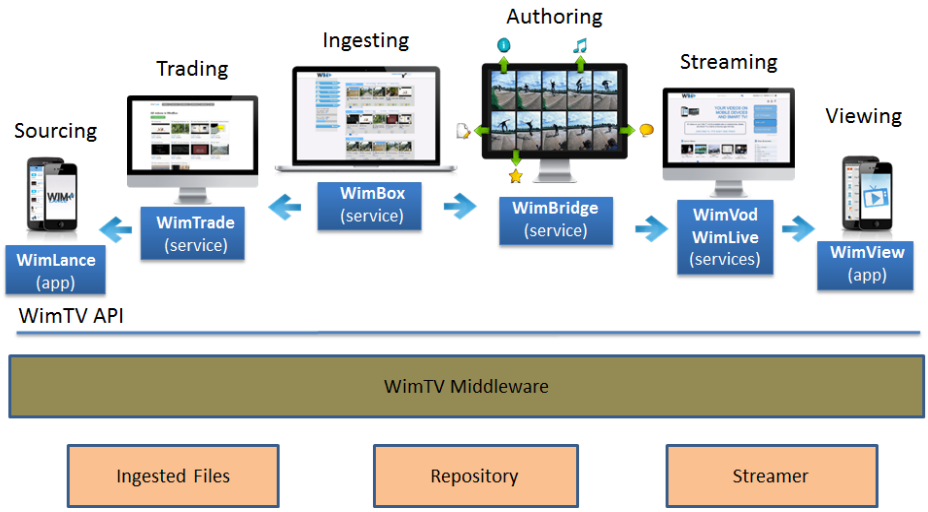


Figure 7: The WimTV ecosystem extended with including WimBridge

WimBridge is implemented as a web application whose content data base is partly shared with the WimTV data base. The WimBridge functionalities are:

1. Ingest images from the local environment;
2. Ingest videos from the local environment and from WimTV;
3. Select a video among those present in the WimBridge DB;
4. Define a shot;
5. Select and populate a bridget template with destination content (images and videos);
6. Preview video bridgets and its bridgets;
7. Save enriched video;
8. Obtain the embed code and URL of the video bridget.

Access to WimBridge is possible with the same business model of the other WimTV services and applications, namely, access to the service is free but actual exploitation can be done by paying for storage

and streaming cost. This is possible because WimBridge has limited (but still very valuable) functionalities. It is conceivable that in the future access to WimBridge will be offered in a two-tier fashion: free with basic functionalities and pay with full functionalities.

Currently the target WimBridge customers belong to the following categories

1. Corporate image: a short main video giving the essentials about the company with as many bridgets added to give more details about specific aspects of the company. A video bridget is being developed for the local Chamber of Commerce.
2. Education: a video lecture of a professor with bridgets leading to additional content (video, slides, pictures etc.). Additionally WimBridge offers the feature to superimpose slides to the video lecture. WimBridge has been shown to the Italian Ministry of Education and is currently a candidate for deployment in 50 Italian schools (typically middle and high schools).
3. Tourism: a short video providing the essentials of a city or monument with bridgets that provide additional views on specific spots.

CEDEO has also started adding bridget authoring functionalities to ADAPT (adapt.wim.tv). ADAPT is a platform that is licensed to business customers when extended customisation of the WimTV functionalities is required.

Of course the above does not exhaust the BRIDGET exploitation potential for CEDEO. It simply represents the current extent of BRIDGET result exploitation in the company.

8 Conclusions

The results of the interviews confirm the BRIDGET Authoring Tool's validity, timeliness and responsiveness to market needs. The interviews have also provided valuable suggestions concerning new use scenarios that will be implemented in the remaining project year.

It is clearly too early to engage in large scale exploitation plans as the relevant studies have barely started. It is, however, to be noticed that some partners have already made some steps toward market exploitations.

9 Acknowledgements

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Appendix A – Partners List

Table 7 – Partners list

Nr.	Organisation name	Short name	Country
1	University of Surrey	UNIS	UK
2	CEDEO SAS di Chiariglione Leonardo e C.	CED	IT
3	Fraunhofer Gesellschaft zur Foerderung der Angewandten Forschung E.V.	FHG	DE
4	Huawei Technologies Düsseldorf GmbH	HUA	DE
5	Institut Mines-Télécom	IMT	FR
6	RAI – Radiotelevisione Italiana	RAI	IT
7	Telecom Italia S.p.A.	TI	IT

8	Universidad Politécnica de Madrid	UPM	ES
9	Visual Atoms	VA	UK