



## **Requirements and Functionalities - Version A**

**Period Covered: 2013/11/01-2014/03/31**

<b>Project ref. no.</b>	FP7-ICT-2013-7 - 610691
<b>Project acronym</b>	BRIDGET
<b>Start date of project (duration)</b>	1 November, 2013 (36 months)
<b>Document due Date:</b>	2014/03/31
<b>Actual date of delivery</b>	2014/03/31
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<b>Document status</b>	Final

**Deliverable Identification Sheet**

<b>Project ref. no.</b>	FP7-ICT-2013- 610691
<b>Project acronym</b>	BRIDGET
<b>Project full title</b>	BRIDging the Gap for Enhanced broadcasT
<b>Document name</b>	D2 2_RequirementsAndFunctionalities.docx
<b>Security (distribution level)</b>	CO/PU
<b>Contractual date of delivery</b>	2014/03/31
<b>Actual date of delivery</b>	2014/03/31
<b>Document number</b>	D2.2
<b>Type</b>	Report
<b>Status &amp; version</b>	Final v1.0
<b>Number of pages</b>	42
<b>WP / Task responsible</b>	WP2/T2.1
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<b>Abstract</b>	This deliverable contains the BRIDGET user and functional requirements and the functionalities provided by BRIDGET applications for the 1 <sup>st</sup> phase of the project (Version A)
<b>Keywords</b>	Functionalities, requirements, user,
<b>Sent to peer reviewer</b>	2014/03/25
<b>Peer review completed</b>	2014/03/27
<b>Circulated to partners</b>	2014/03/31
<b>Read by partners</b>	All
<b>Mgt. Board approval</b>	Yes

Version	Date	Reason of change
0.1	2014-02-11	Leonardo Chiariglione – First table of contents
0.2	2014-02-14	Alberto Messina – Bridget requirements
0.3	2014-02-16	Leonardo Chiariglione – Revised bridget requirements
0.4	2014-02-19	Diego Gibellino – Revised bridget requirements
0.5	2014-02-20	Leonardo Chiariglione – Revised bridget requirements
0.6	2014-02-20	Karsten Müller – 3D requirements
0.7	2014-02-22	Leonardo Chiariglione – Added simple reference model
0.8	2014-02-23	Giovanni Cordara – Added 3D Audio requirements
0.9	2014-02-26	BRIDGET – restructuring and task assignment
0.91	2014-03-01	Leonardo Chiariglione – general revision
0.92	2014-03-08	Diego Gibellino – Added section “Methodology”
0.93	2014-03-10	Diego Gibellino & Stavros Paschalakis – Updates
0.94	2014-03-12	Veronica Scurtu – Updates
0.95	2014-03-15	Giovanni Cordara, Diego Gibellino, Alberto Messina, Stavros Paschasakis – Updates
0.96	2014-03-15	Leonardo Chiariglione – restructuring
0.97	2014-03-18	Giovanni Cordara, Ingo Feldmann, Alberto Messina - updates
0.98	2014-03-19	Adrian Gabrielli, Traian Lavric, Francisco Morán - updates
0.991	2014-03-19	All – updates
0.992	2014-03-20	All – updates
0.993	2014-03-20	Leonardo Chiariglione - First integrated version
0.994	2014-03-22	Diego Gibellino – General review of user requirements
0.995	2014-03-24	Marius Preda – Update
0.996	2014-03-24	Leonardo Chiariglione – Revision
0.997	2014-03-25	Diego Gibellino and Alberto Messina – update
0.998	2014-03-28	Diego Gibellino - Revision
1.0	2014-03-31	Helen Cooper – Tidying and removing typos prior to submission.

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## 1 Executive Summary

This document builds on Deliverable D2.1 Version A “First BRIDGET workshop and use scenarios” [1], in which the use cases that will drive the development of the first phase of the project (until month 18) were selected and described.

The process for requirements gathering, analysis, and refinement followed a use-centred approach, focusing on users and their anticipated usage of the system. The answers to questionnaires, the discussions and interviews with the participants of the first BRIDGET workshop during and after the event, in addition to interviews that partners arranged with end users and professional users, provided the initial set of information.

The process was divided into four different phases: elicitation, analysis, specification, and validation and two complete iterations were carried out in order to progressively refine high-level requirements and to confirm the correctness of each item.

The process has yielded two types of requirements:

1. **User Requirements** (Section 6) organised according to the different operations (creation, access, consumption) that can be performed on the two key technology enablers developed by the Project: the bridget (the link between contents) and the 3D object reconstruction system. In this document no distinction is made between types of user: bridget editor, 3D object creator or end user accessing bridgets or playing the linked content.
2. **Functional Requirements** (Section 7) applicable to the main BRIDGET systems and tools.

The Functional Requirements have been then mapped to the actual applications that will be developed to support and realise the use scenarios selected for Version A (Section 8). The list of resulting high level functionalities for each application will guide the design and specification of the BRIDGET architecture and interfaces, and the development of tools and applications for the first year.

## 2 Introduction

This document collects the requirements for the first phase of the BRIDGET project. It is intended to be used as input for the definition of the architecture and main interfaces of the BRIDGET system and for the design and development of Media Analysis, Visual Search and 3D technologies and tools. These tools will then be integrated in BRIDGET applications.

The document is organised as follows: Section 3 provides the definition of some terms used throughout, while Section 4 describes the methodology adopted to collect requirements and progressively refine them and the conventions and formatting used to represent these requirements. Section 5 describes a simple reference model of the BRIDGET system to give an overview of the main elements and context to the reader. Sections 6 and 7 respectively define User and Functional requirements. Section 8 maps the functional requirements to the applications that will actually implement those functionalities. Section 9 draws some conclusions and describe the next steps; Section 10 provides a list of references mentioned in the document. Annex A provides the full description of the functional requirements for each application according to what is defined in Section 8, and Annex B maps the user requirements to the related functional requirements to ensure that each user requirement is fulfilled by at least one functionality.



### 3 Glossary

The glossary in this section builds on the glossary provided in D2.1 Version A [1].

Table 1 - Terms and Definitions

Term	Definition
Bridget	Link from a piece of source content (e.g. TV programme) to a piece of destination content (e.g. an interactive media element)
BRIDGET	The EU-funded project that defines format, technologies, systems and develops applications (authoring, playing etc.) based on them
Bridget application	Any software component that includes technologies to handle bridgets, e.g. software that creates bridgets, or software to play or interact with bridgets
Bridget editor	A person in charge of creating bridgets or bridget templates, they can be either a professional or end-user.
Bridget repository	A component (e.g. a database) able to store and provide bridget information according to the bridget representation format
Bridget template	A data structure containing characteristics (e.g. in form of a combination of descriptors) denoting the source and/or the destination content of a bridget and parameters describing the presentation layout.
Bridget temporal scope	The duration in time of a time aligned bridget, during which the media time of the main programme matches with its temporal validity as defined by the bridget editor
Content repository	A repository of destination content
Destination content	The content that is linked to by a bridget
Embedded bridget	A bridget multiplexed with some other source content for transport. <i>Transporting bridgets in the main programme is out of the scope of the project.</i>
Global bridget	A bridget which links from the entire source content
Media-time aligned bridget	A bridget which links from a specific time interval of the source content
Media time/space segments	A specific time instant/interval, portion of frame or combination thereof in the source content
Programme	The audio-visual broadcast content used as source for bridgets.
Source content	The content used to create a bridget
Temporal detection accuracy	The maximum absolute error required from a synchronisation technology in identifying a media time point
User	A human operating a BRIDGET-based system (initially authoring tool and BRIDGET player)
Visual object	A distinct object in a video scene. It may be represented by a bounding polygon or by a ROI segmentation map.

## 4 Methodology

This section describes the methodology adopted to collect, harmonise and organise the requirements for BRIDGET as highlighted by the following steps

1. We use a specific classification schema
3. We derive and select requirements from the target service scenarios
4. We describe the process for requirements management and conventions adopted in the text, including the mechanism to define the priority of requirements according to business relevance and project constraints.

### 4.1 Requirements and Functionalities Classification

The requirements are traditionally classified in User Requirements and Functional Requirements. In BRIDGET the existence of a User Requirement means that a user (professional user or end user) must be able to perform a specific action with a BRIDGET-based system, whereas a Functional Requirement means that a BRIDGET-based system shall provide the described functionality with the expected behaviour. It should be noted that in this document some Functional Requirements may be classified also as characteristics of the system or component.

In BRIDGET we define and develop technologies, a framework to integrate them in services, and applications realising selected use scenarios. These very different “views” are reflected in the classification adopted in this document which is the final result of a process of merging, organisation and harmonisation of the original source information.

User Requirements are presented in Section 6 “User Requirements”, and are organised according to the different operations (creation, access, consumption) that can be performed using the two key technology enablers developed by the Project: the bridget (a link between 2 pieces of content) and the 3D object reconstruction system.

Functional Requirements, or “Functionalities”, are derived and defined in Section 7 and are mapped to the main areas of functionality of the system according to the Work Package structure of the Project. The Functional Requirements defined in Section 7 are then organised in different views in Section 8 to highlight which functionalities will be required by the actual applications that will be developed in the first year.

*Table 2 - Requirements types*

Type	Description	Example
User	Task that a user can perform using the system (User requirement)	The user shall be able to link destination content to a programme through the creation of a bridget.
Functional	Functionality exposed by the system (Functional requirement)	The synchronisation tool shall be able to identify the bridgents to retrieve and present at specific points in the media timeline of a programme.

### 4.2 Process for Requirements Development

The process for requirements gathering, analysis, and refinement followed a use-centred approach, focusing on users and their anticipated usage of the system. The first deliverable D2.1 of Work Package 2 provided a set of target use scenarios that was used as major driver for the definition of the requirements.

The process was divided into different phases: elicitation, analysis, specification, and validation [2] and two complete iterations were carried out in order to progressively refine high-level requirements and to confirm the correctness of each item.

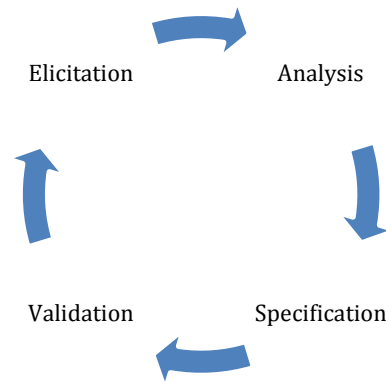


Figure 1- Requirements development phases in BRIDGET

#### 4.2.1 Elicitation

The objective of the elicitation phase was to discover requirements.

BRIDGET provides a platform including technologies and tools addressing the needs of Broadcasters and Content Providers as well as end users, consequently two classes of users were defined:

- Professional Users, also called “bridget editors”
- End Users

The Professional Users enrich content creating and defining bridgets during the post-production phase. They use professional tools and operate in the broadcaster or content provider domain; the end users access and consume bridgets and the related linked content through their second screens. In general end users should have a reduced functionality authoring tool at their disposal. However, this functionality is not available in phase 1.

The tools selected for gathering requirements were the first BRIDGET workshop and interviews.

A first set of requirements was derived from the first BRIDGET workshop held in Paris in December 2013. The workshop outcomes led to the selection and definition of the target use scenarios and provided also valuable information in terms of requirements through responses to questionnaires. Informal interviews and discussions with the workshop participants during and after the event provided additional information that was translated in user requirements in the following phases.

In addition some partners also conducted other interviews with experts, focusing on the professional domain (RAI) or on the Consumer domain (Telecom Italia and Huawei).

#### 4.2.2 Analysis

The target use scenarios selected and described in D2.1 [1] were modelled using a set of UML use cases diagrams (Figure 2). From these use cases preliminary user and system requirements were derived and harmonised with those provided in different forms by the stakeholders invited to the Workshop and by the partners of the Project.

In the following phase the set of high-level requirements were decomposed into a suitable level of detail to represent the functionalities of the system as functional requirements. Each functional requirement was then allocated to the related subsystem.

#### 4.2.3 Specification

In the specification phase the resulting requirements were included in the document, organised, and formatted for use during the development of the software components for Version A.

#### 4.2.4 Validation

In the validation phase the partners will review the requirements to ensure their correctness and avoid problems during the development activities. Therefore the development of acceptance criteria and trial were not included in this deliverable because they are part of the activities of Task 2.3 Validation.

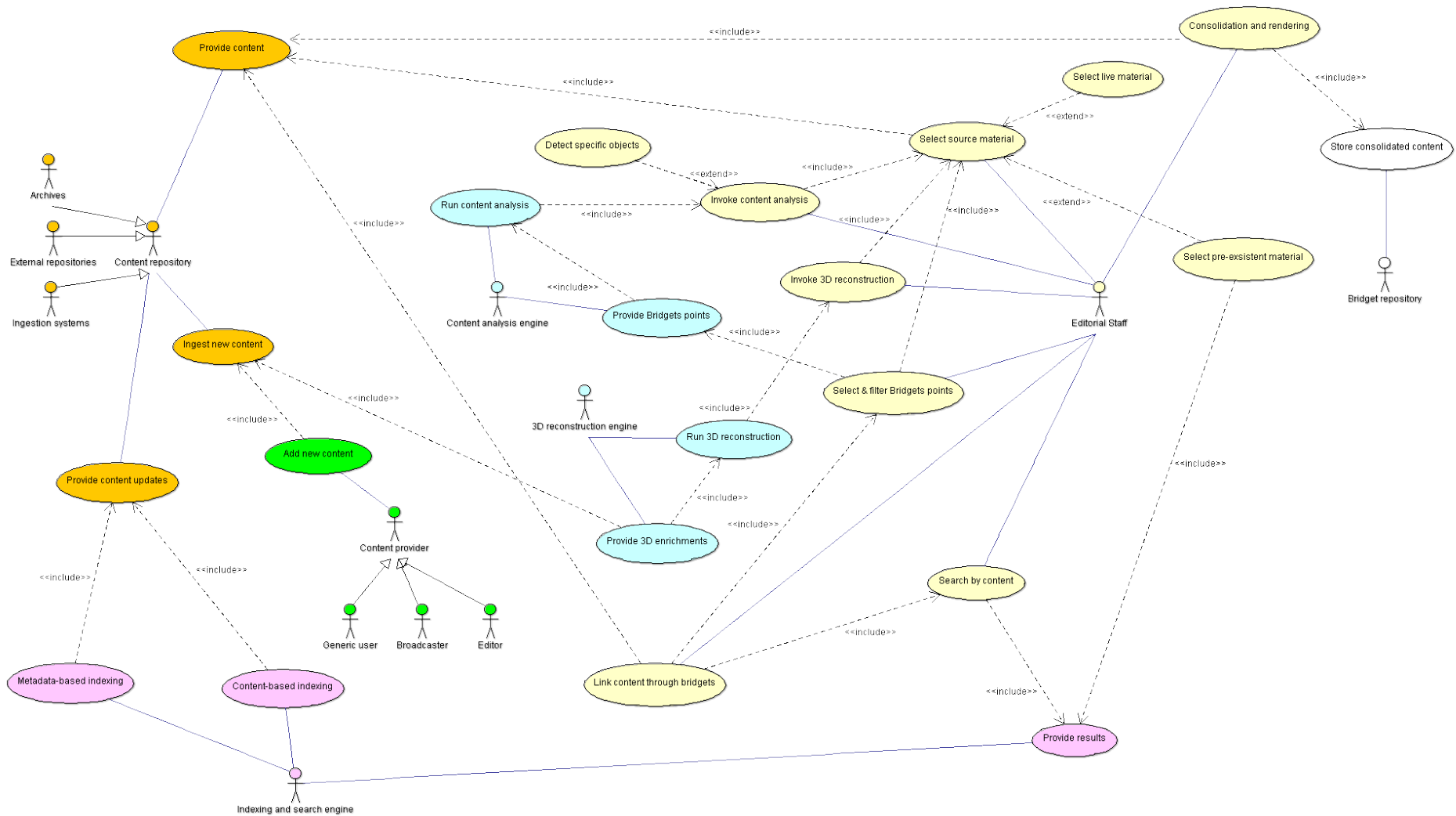


Figure 2 - Example of Use Case diagram developed during the analysis phase

### 4.3 Requirements Management

This document is a “requirements baseline” including requirements that support the realisation of the use scenarios selected for phase 1. It is a snapshot that represents the agreed-upon and reviewed required functionalities of the system at this point in time. During the development, integration and prototyping activities new requirements may be identified or modifications of some of the previously defined requirements may be necessary or requested.

The project will handle these events as follows:

- Evaluating the impact of the proposed changes
- Tracking the requirements status and the changes throughout the project
- Incorporating the agreed changes in a controlled way in revised baselines (document versions)

The latest revised baseline will be used as a basis for the development of the requirements for the advanced scenarios in Version B and documented in the related deliverable. The process for these updates is shown in Figure 3.

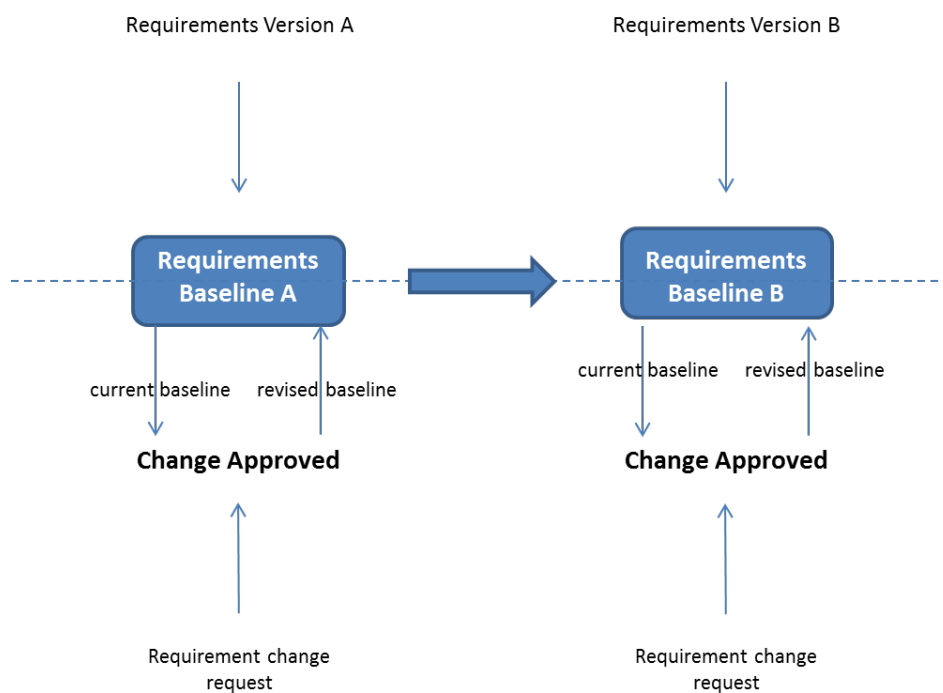


Figure 3 - Process for requirements management in BRIDGET

### 4.4 Conventions and Prioritisation

#### 4.4.1 Requirements Format

The requirements are identified by a number that, associated with an identifier, provides a unique Requirement Identifier or “Req. ID”. The requirements are then organised in different “views” in the rest of the document to drive the following technical activities.

The Tables collecting requirements are organised as follows:

Req. ID	Name	Description
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- **Req. ID:** a combination of an alphanumeric identifier and a number. The first letter of the identifier can be: U for User Requirements, F for Functional Requirements. It provides a unique identifier for a specific requirement through the document
- **Name:** a short title providing an abstract of the description for this requirement
- **Description:** a textual description of the requirement

#### 4.4.2 Prioritisation

The requirements included in this document are expressed using the keywords SHALL and MAY. These terms are adopted to define the intended level of support of a requirement according to IETF RFC 2119 [2]. In particular, the following definitions are applicable:

- [1] MUST This word, or the terms "REQUIRED" or "SHALL", mean that the definition is an absolute requirement of the specification.  
[...]
- [5] MAY This word, or the adjective "OPTIONAL", mean that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item. An implementation which does not include a particular option MUST be prepared to interoperate with another implementation which does include the option, though perhaps with reduced functionality. In the same vein an implementation which does include a particular option MUST be prepared to interoperate with another implementation which does not include the option (except, of course, for the feature the option provides.)

The consistent usage of those terms across the document will also provide a way to prioritise the requirements during the development phase.

Currently, other terms such as MUST, MUST NOT, REQUIRED, SHALL NOT, SHOULD, SHOULD NOT, RECOMMENDED, and OPTIONAL are not applicable to this document.

Requirements in *italic* are planned for phase 2 (i.e. Version B). To the extent possible we identified all the requirements but the implementation focus will be on technologies developed by the project.

## 5 Simple BRIDGET Reference Model

A simple end-to-end BRIDGET reference model is depicted in .

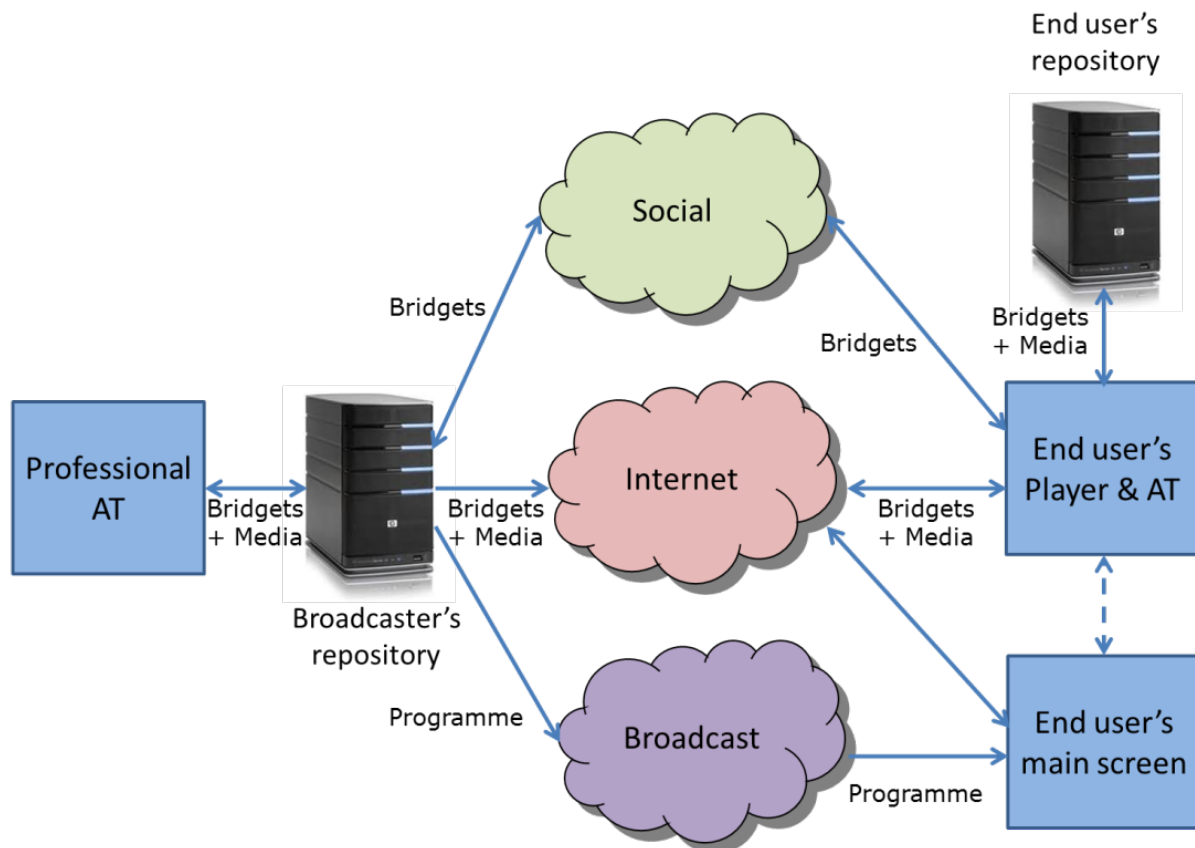


Figure 4 - Conceptual BRIDGET reference model

Video content is fed into the broadcaster's professional authoring tool. This generates bridgets to other video content.

Bridgets are stored in the broadcaster's repository and distributed via the internet and social networks. The project will not specifically handle distribution of bridgets via social networks but the conceptual reference model includes them to present the full picture of opportunities enabled by BRIDGET.

End users will watch video content on a main screen from a broadcast channel, and will typically receive bridgets via the internet on their second screen, synchronised with the main content. They may use the authoring tool on their second screen to create their own bridgets and store both the received and computed bridgets in their personal repository. End users can share their personal bridget by pushing it to the broadcaster's or a 3<sup>rd</sup> party repository. End user can also receive and redistribute bridgets via their social networks.

The hybrid model described above is conceived to naturally fit into the currently deployed broadcast/broadband architectures for connected TVs and Set-Top Boxes. Relevant examples are HbbTV [4] and the Italian platform for digital television defined in HD-Book specifications [5,6].

## 6 User Requirements

In this section the word “user” indicates any type of user of BRIDGET: bridget editor, 3D object creator, end user playing bridget or destination content.

### 6.1 Bridget Creation

This section collects requirements on how users create bridgets.

*Table 3 - Bridget creation user requirements*

Req. ID	Name	Description
UBC1	Content link	The user shall be able to link destination content to a programme through the creation of a bridget.
UBC2	Stored content	The user shall be able to create bridgets for stored programmes.
UBC3	<i>Live content</i>	<i>The user shall be able to create bridgets for live programmes.</i>
UBC4	Bridget association – time-aligned	The user shall be able to associate one or more bridgets to a defined interval in the timeline of the programme (time-aligned bridget).
UBC5	Bridget association – global	The user shall be able to associate one or more bridgets to the entire duration of the programme (global bridget).
UBC6	Bridget made global	The user shall be able to transform, media time-aligned bridgets into global bridgets.
UBC7	Bridget reuse	The user shall be able to store, retrieve and reuse the bridgets previously associated to a different programme.
UBC8	Time-aligned bridget points candidates	The user shall be able to retrieve a list of automatically generated candidate media time/space points or segments for bridget insertion.
UBC9	Destination content candidates	The user shall be able to retrieve a list of automatically generated candidate destination content for a programme segment.
UBC10	Destination content	The user shall be able to create a bridget whose destination content is a 2D audiovisual content or a 3D model of a scene including 3D visual objects, 3D Audio objects or both.
UBC11	Bridget information creation	The user shall be able to include and modify a set of information in a bridget, following a defined bridget representation structure.

### 6.2 Bridget Access

This section collects requirements on how users access bridgets.

*Table 4 - Bridget access user requirements*

Req. ID	Name	Description
UBA1	Devices for bridget access	The user shall be able to access bridgets and corresponding content using second screen devices (e.g. smartphones, tablets, laptops).
UBA2	Bridget retrieval	The user shall be able to retrieve bridgets based on the identification of the programme and of the media time point being watched on the main screen.



Req. ID	Name	Description
UBA3	Retrieval of remote bridgets	The user shall be able to retrieve bridgets from the Internet.
UBA4	Synchronised access & presentation	The user shall be able to access and present bridgets synchronised with the programme displayed on the main screen.
UBA5	Synchronisation independence	The user shall be able to access synchronised bridgets independently from the broadcast network (e.g. DVB-T/S/C) used to receive the programme
UBA6	Recording support	The user may be able to access synchronised bridgets from a programme previously recorded using a PVR or Network PVR.

### 6.3 Bridget Search

This section collects requirements on how users search bridgets and related content

*Table 5 - Bridget search user requirements*

Req. ID	Name	Description
UBS1	Bridget Search	The user shall be able to search and retrieve bridgets using metadata
UBS2	Content Search – production	The user shall be able to search and retrieve media content similar or related to a segment of the programme.
UBS3	Content Search – consumption	The user shall be able to search and retrieve media content similar or related to the content linked through a bridget.
UBS4	Video object selection	The user shall be able to select video objects from the programme at any time to perform a search of related content in an image database resource.
UBS5	Content search - metadata	The user shall be able to search for similar or related content using metadata.
UBS6	Content search – visual queries	The user shall be able to search for similar content through visual queries.

### 6.4 Bridget Presentation

This section includes requirements on how bridgets are presented to users for navigation and selection.

*Table 6 - Bridget presentation user requirements*

Req. ID	Name	Description
UBP1	Presentation of in scope time-aligned bridgets	The user shall be able to view a presentation of the bridgets according to their temporal scope on the media time interval of the programme.
UBP2	Presentation of out of scope time-aligned bridgets	The user may be able to view a presentation of associated time-aligned bridgets after their temporal scope of the media time interval of the programme.

Req. ID	Name	Description
UBP3	Presentation of bridgets or groups of bridgets	The user shall be able to decide the visual presentation of bridgets or groups of bridgets.
UBP4	Presentation of global bridgets	The user shall be able to view a presentation of global bridgets associated with a programme.
UBP5	Bridget presentation resources	The user shall be able to define how to notify the availability of bridgets using different media resources such as icons, images, text, video, and audio for appropriate presentation.
UBP6	Bridget notification	The user shall be able to enable and disable the notification of available active bridgets on the second screen at any time (for both media-time aligned and global bridgets).
UBP7	Multiple bridget notifications	The user shall be able to receive notifications of more than one available bridget at the same time.
UBP8	Filter & Selection – manual	The user shall be able to filter and select presented bridgets manually.
UBP9	Presentation preferences	The user shall be able to set and update preferences concerning bridgets presentation (e.g. preferred kind of content: 2D video, 3D model, etc...).
UBP10	Filter & Selection – automatic	The user may be able to filter and select presented bridgets automatically based on preferences.

## 6.5 Bridget Consumption

This section includes requirements on how user consume bridgets

*Table 7 - Bridget consumption user requirements*

Req. ID	Name	Description
UBU1	Bridget consumption	The user shall be able to consume available bridgets (i.e. bridget presented to the user) and corresponding destination content on the second screen.
UBU2	Global bridget consumption	The user shall be able to consume a global bridget and corresponding destination content at any time during the associated programme.
UBU3	Independent consumption	The user shall be able consume bridgets and corresponding destination content without interrupting the programme on the main screen.
UBU4	Bridget bookmarks creation	The user shall be able to bookmark time aligned and global bridgets for future use.
UBU5	Bridget bookmarks consumption	The user shall be able to consume bookmarked bridgets outside the context of the specific programme.
UBU6	Bridget context reset	The user shall be able to reset the context; deactivating bookmarked bridgets that are not related to the specific programme.

## 6.6 3D Object Creation

This section collects requirements on how users create 3D objects.

Table 8 - 3D object creation user requirements

Req. ID	Name	Description
U3C1	3D reconstruction	The user shall be able to create a 3D model representation reconstructed from a set of videos or images.
U3C2	Candidate selection for reconstruction.	The user shall be able to enable manual and automatic selection of content items for 3D reconstruction.
U3C3	Initial 3D reconstruction	The user shall be able to request the 3D reconstruction engine to generate a coarse 3D scene geometry.
U3C4	3D reconstruction refinement	The user shall be able to request the 3D reconstruction engine to refine the 3D scene geometry with new images and videos of the scene.
U3C5	3D input content	<i>The user shall be able to provide 3D content to the 3D reconstruction engine in order to either generate a coarse, initial 3D model of a real scene or refine an already existing 3D model.</i>

## 6.7 3D Object presentation

This section includes requirements on how 2D views from 3D objects are presented to users

Table 9 - 3D object presentation user requirements

Req. ID	Name	Description
U3P1	Viewpoint rendering	The user shall be able to request 2D views from the reconstructed 3D scene model at original viewing positions.
U3P2	Viewpoint navigation	The user shall be able to request 2D views from the reconstructed 3D scene model at intermediate viewing positions, to allow navigation inside/around the model.
U3P3	<i>Device independence</i>	<i>The user shall be able to view [almost] identical 2D images on devices with different capabilities, e.g. HW-based acceleration for 3D graphics, although the result may be obtained with very different response times or frame rates.</i>
U3P4	3D audio rendering	The user shall be able to listen to 3D spatial audio through headphones.
U3P5	<i>3D audio navigation</i>	<i>The user shall be able to listen to 3D spatial audio adapted to the virtual position selected through the user interface.</i>
U3P6	<i>3D audio/video rendering</i>	<i>The user shall be able to view 2D views at intermediate viewpoints synchronised with the spatial audio rendered according to the corresponding position.</i>

## 7 Functional Requirements

### 7.1 Bridget Representation

This section includes requirements on how bridgets are digitally represented. The definition of this structure implies that functionalities to set, modify, and read the related element shall be supported.

Table 10 - Bridget representation functional requirements

Req. ID	Name	Description
FBR1	Bridget identification	The bridget format shall support unambiguous and persistent domain-based identification of a bridget.
FBR2	Bridget authoring information	The bridget format shall support inclusion of bridget authoring information (e.g. title, date, copyright, etc...).
FBR3	Bridget source programme	The bridget format shall allow specification of the associated source programme.
FBR4	Bridget source programme description	The bridget format shall support inclusion of textual descriptions related to the associated source programme.
FBR5	Bridget types	The bridget format shall allow specification of whether the bridget is associated to a specific time interval of the programme (time-aligned) or to the entire programme (global).
FBR6	Bridget destination content	The bridget format shall allow specification of one destination content item.
FBR7	Bridget destination content types	The bridget format shall allow specification of audiovisual, audio, 3D video, 3D audio, or 3D video/audio scenes as destination content.
<i>FBR8</i>	<i>Bridget extended destination content types</i>	<i>The bridget format may allow specification of any kind of media or combination thereof as destination content (e.g. images, text, web pages, etc...).</i>
FBR9	Bridget destination content description	The bridget format shall support inclusion of descriptions related to the destination content (e.g. content type, media duration, MIME type, file size, etc...).
<i>FBR10</i>	<i>Bridget multiple sources for destination content</i>	<i>The bridget format shall support inclusion of a list of alternative sources for the destination content.</i>
FBR11	Bridget default icon	The bridget format shall allow the definition of a default icon or image that can be used to visually present the bridget to the user.
FBR12	Bridget presentation description	The bridget format may allow specification of the visual and the acoustic presentation of the destination content.
<i>FBR13</i>	<i>Bridget consumption-related information</i>	<i>The bridget format shall support inclusion of consumption-related information, (e.g. if destination content should be watched during or after the programme), parental rating, accessibility and device requirements (e.g. stereo headphones).</i>

Req. ID	Name	Description
FBR14	Bridget rights	The bridget format may support inclusion of rights and payment information for destination content consumption.
FBR15	Bridget modifications	The bridget format shall allow modification of all its representation data values excluding those related to identification.

## 7.2 Content and Bridget Management

This section defines requirements on how bridgets and content are handled by the system.

Table 11 - content and Bridget management functional requirements

Req. ID	Name	Description
FCM1	Content ingestion	The content management system shall allow media content ingestion and storage in content repositories.
FCM2	Content types	The content management system shall support the following media types: audiovisual content, audio content, and 3D models.
FCM3	Content metadata	The content management system shall allow storage of metadata and annotations related to content.
FCM4	Content removal	The content management system shall allow deletion of content and related metadata and annotations from a content repository.
FCM5	Content publishing	The content management system shall allow publication of content available on a content repository to the Internet.
FCM6	Protected Content publishing	The content management system may allow publication of content protected with a content protection system (e.g. DRM) and available on a bridget repository to the Internet.
FCM7	Indexed Content	The content repository shall maintain a list of indexed content.
FCM8	Bridget ingestion	The content management system shall allow bridget ingestion and storage in bridget repositories.
FCM9	Bridget publishing	The content management system shall allow publication of a bridget available on a bridget repository to the Internet.

## 7.3 Synchronisation

This section defines requirements on how bridgets are synchronised with the programme.

Table 12 - Synchronisation functional requirements

Req. ID	Name	Description
FSY1	Synchronisation presentation delay	The synchronisation tool shall allow bridget presentation, synchronised to a point in the media timeline of a programme, with a maximum delay of 5s.
FSY2	Detection accuracy	The synchronisation tool shall be able to identify the programme watched and the relative point in the media timeline with a temporal detection accuracy comparable to the average length of the visual shots.

Req. ID	Name	Description
FSY3	Bridget identification	The synchronisation tool shall be able to identify the bridgets to retrieve and present at specific points in the media timeline of a programme.
FSY4	Programme media time identification	The synchronisation tool shall be able to retrieve the media time from the main programme at specific points in time.
FSY5	Independence from main screen interactions	The synchronisation tool shall be able to synchronise the presentation of a bridget to a programme without any interaction with the main screen (e.g. using audio and/or video fingerprinting mechanisms).
FSY6	Automatic synchronisation	The synchronisation tool shall be able to identify and retrieve synchronisation information automatically from the programme stream (i.e. without the intervention of the user).
FSY7	Synchronisation information production	The synchronisation tool shall be able to create synchronisation information from a segment of a programme.

#### 7.4 Content Access

This section defines requirements of how bridgets and content are delivered to and through the system

Table 13 - Content access functional requirements

Req. ID	Name	Description
FCA1	Content delivery	The content access system shall support access to content delivered through HTTP and HTTP adaptive streaming.
FCA2	Network QoS	The content access system shall be able to access content with or without a defined Quality of Service (through managed or unmanaged networks).
FCA3	CDN	The content access system shall be able to access content delivered through a Content Delivery Network (CDN).
FCA4	Bridget delivery	The content access system shall support access to bridgets delivered through HTTP.
FCA5	<i>Audience measurement</i>	<i>The content access system may collect audience measurement data related to bridgets and content accessed by the user.</i>

#### 7.5 Media Analysis Tools

This section defines the requirements of the functionalities exposed by the Media Analysis tools. These tools perform the temporal segmentation and structure analysis of audiovisual content [7], as well as content description [8] and content quality assessment [9]. More specifically, the media analysis tools will enable the correct temporal association of the destination content within the source content, for example allowing the availability of destination content only at specific automatically determined intervals of the original content, aligned with the shot or chapter structure of the programme. Meanwhile, the media analysis tools will also greatly improve the efficiency and results of the visual search and 3D reconstruction tools. for example by filtering content with specific characteristics (e.g. daytime shot versus night-time shot, interior versus exterior) or quality (e.g. professional quality versus user-generated content).

Table 14 - Media analysis tools functional requirements

Req. ID	Name	Description
FMA1	Multiple content types	The media analysis tools shall be able to process audiovisual content comprising images and/or video and/or audio.
FMA2	Coding independence	The media analysis tools shall be able to process audiovisual content independently of the content coding format.
FMA3	Coding awareness	The media analysis tools may be able to process audiovisual content according to specific content coding formats, but shall produce comparable results to the media analysis tools which are able to process audiovisual content independently of the content coding format.
FMA4	Content duration independence	The media analysis tools shall be able to process audiovisual content of arbitrary duration.
FMA5	Content modification robustness	The media analysis tools shall be robust to audiovisual content modifications comprising temporal resampling, spatial resampling, spatial aspect ratio changes, A/D conversion, and I/P conversion.
FMA6	Content description self-containment	The media analysis tools shall provide audiovisual content descriptions which are self-contained, in that their use does not require the audiovisual content from which they were generated.
FMA7	Content non-alteration	The media analysis tools shall leave the audiovisual content on which they operate unaltered.
FMA8	Real-time content description extraction	The media analysis tools shall be able to generate audiovisual content descriptions in real time or near-real-time.
FMA9	Faster than real-time content description extraction	The media analysis tools may be able to generate audiovisual content descriptions at very high speeds, far exceeding real time, but shall produce comparable results to the media analysis tools which are able to generate audiovisual content descriptions in real time.
FMA10	On-the-fly content description extraction	The media analysis tools may be able to generate audiovisual content descriptions on the fly, processing video and audio only in a small temporal window around the current media time.
FMA11	Low-level structural segmentation	The media structure analysis tools shall be able to provide a shot-level temporal segmentation and keyframe representation of audiovisual content.
FMA12	Linear hierarchical structural segmentation	The media structure analysis tools shall be able to provide a hierarchical linear temporal segmentation and keyframe representation of audiovisual content.
FMA13	Non-linear hierarchical structural segmentation	The media structure analysis tools shall be able to provide a hierarchical non-linear temporal segmentation and keyframe representation of audiovisual content.



Req. ID	Name	Description
FMA14	Genre-specific structural segmentation	The media structure analysis tools shall be able to provide a temporal segmentation and keyframe representation of audiovisual content according to genre-based heuristics for a limited number of genres.
FMA15	Content-based annotation	The media annotation tools shall be able to provide low-level descriptions (e.g. dominant colour, colour layout, colour temperature, motion activity, and motion type) and high-level descriptions (e.g. indoor, outdoor, town, landscape) of audiovisual content.
<i>FMA16</i>	<i>Content-based quality assessment</i>	<i>The media quality assessment tools shall be able to provide quality descriptions (e.g. dark, bright, noisy, shaky, many coding artefacts) of audiovisual content.</i>
FMA17	Fast filtering/search	It shall be possible to perform faster than real-time filtering / search of audiovisual content using the descriptions provided by the media annotation tools.
FMA18	Unambiguous content description syntax	The media analysis tools shall present the content description they generate to the rest of the system in an unambiguous format.

## 7.6 Search Tools

This section defines the requirements of the functionalities exposed by the Search tools [10]. The search tools allow automated Visual Search in image [11] and video databases [12], supporting fast creation of content-based links for the Authoring Tools (ATs) and user-originated search capabilities for the player. They include tools for off-line descriptor extraction, database indexing and on-line search suitable for ultra-large databases of images and videos. The user will be able to select a specific object of interest in the query via Region of Interest (ROI) selection. The tools will also support feature selection and matching for use in 3D model extraction in the WP6. In the first project cycle, video search tools will rely on indexing key-frames in video, the full video support will be added in the second cycle.

Table 15 - Search tools functional requirements

Req. ID	Name	Description
FST1	Visual search in image library	The visual search engine shall support visual search in a pre-indexed image library based on a query image.
FST2	Visual search in image library where query specifies ROI in the query image	The visual search engine shall support visual search in a pre-indexed image library based on a query image with a ROI specified as bounding polygon or ROI segmentation map.
FST3	Visual search in video library utilising video key frames	The visual search engine shall support visual search in a pre-indexed video library based on a query image. Search and access points are restricted to video key-frames.



Req. ID	Name	Description
FST4	Visual search in video library utilising video key frames where query specifies ROI in the query image	The visual search engine shall support visual search in a pre-indexed video library based on a query image with a ROI specified as bounding polygon or ROI segmentation map. Search and access points are restricted to video key-frames.
FST5	Off-line indexing of image library	The visual indexing engine shall support off-line creation of a database/index for a library of image resources.
FST6	Off-line indexing of video library based on video key-frames	The visual indexing engine shall support off-line creation of a database/index for a library of video resources where search and access points are restricted to video key-frames.
FST7	Ranking of the search results based on matching confidence	The visual search engine shall support ranking of the search results based on match confidence.
FST8	Spatial Localisation of the matched region	The visual indexing and search engines shall support coarse spatial localisation of the matching regions.
FST9	Multiple content types	The visual search and indexing engines shall be able to process audiovisual content comprising images and/or video.
FST10	Coding independence	The visual search and indexing engines shall be able to process audiovisual content independently of the content coding format.
FST11	Content modification robustness	The visual search and indexing engines shall support visual search to be robust to audiovisual content modifications such as temporal resampling, spatial resampling, spatial aspect ratio changes, A/D conversion, and I/P conversion.
FST12	Robustness to visual deformations	The visual search and indexing engine shall support visual search that is robust to viewing aspect, illumination changes, partial occlusion and similar artefacts.
FST13	Content description self-containment	The visual search and indexing engines shall derive and use content descriptions which are self-contained, in that their use does not require the access to the content from which they were generated.
FST14	Content non-alteration	The visual search and indexing engines shall leave the audiovisual content from which they were derived unaltered.
FST15	Integration with content-based search	The visual search and indexing engines shall execute queries based on content input by the user.

## 7.7 3D Tools

This section defines the requirements of the functionalities exposed by the 3D tools. These tools shall be able to perform computer vision [13] tasks, including 3D scene reconstruction, coding, decoding and rendering. In particular, the tools shall support the following workflow for 3D scene reconstruction:

1. Taking as input several pictures of a given 3D scene shot from different viewpoints (and possibly with different cameras or zoom factors), both the intrinsic and extrinsic camera calibration parameters can be estimated. This requires feature point matching [14], but not necessarily the use of calibration patterns [15], and yields as well, thanks to the disparities between feature points across different pictures, depth data [16] leading to a cloud of isolated, coloured 3D points.
2. From the calibrated cameras and the sparse 3D point cloud, a denser 3D model can be extracted, e.g., a polygon mesh to be multi-textured with the input pictures of step 1 [17][18].
3. The initial 3D scene model obtained in the previous steps can then be progressively refined with similar material from other sources, like the web, where individuals or user groups will also upload new content, such as pictures taken from yet other viewpoints, or even synthetic 3D models.

Furthermore, the 3D tools shall be able to generate a description of the acoustic properties of the 3D scene which allows performing an adaptive auralisation of the environment for arbitrary positions of the listener [19]. First, the 3D tools provide a geometric description of the environment by exploiting the 3D model and define initial positions of all sound sources within the environment. Then, room acoustic parameters such as the reverberation time and early reflections are derived from the description of the 3D scene [20].

Table 16 - 3D tools functional requirements

Req. ID	Name	Description
F3T1	Feature point extraction	The feature point extraction tool shall extract a set of robust feature points in several images corresponding to the same 3D scene.
F3T2	Generation of matching pairs	The generation of matching pairs tool shall identify pairs of 2D points in different images known to correspond to the same 3D point in the related 3D scene.
F3T3	Camera calibration	The camera calibration tool shall provide both, the intrinsic and extrinsic parameters of the user's camera which took particular pictures.
F3T4	Reconstruction of isolated 3D point locations	The reconstruction of isolated 3D point locations tool shall provide reconstructed isolated 3D points.
F3T5	Dense mesh reconstruction	The dense mesh reconstruction tool shall create a dense 3D reconstruction starting from a sparse representation.
F3T6	3D model update	The 3D model update tool shall be able to update a precomputed 3D model by adding additional images/videos.
F3T7	3D model rendering	The 3D engine shall be able to render a 3D model through a sparse representation (e.g. point clouds) or <i>dense representation</i> (e.g. meshes).
F3T8	3D viewpoint synthesis	The 3D engine shall be able, starting from a 3D model of a scene, to create a synthetic 2D view of that scene from any possible viewpoint.
F3T9	3D model coding	The 3D model coding tool shall be able to efficiently compress/decompress sparse/dense 3D model representations.

Req. ID	Name	Description
F3T10	Audio scene modelling	The audio scene modelling tool shall be able to generate a description of the position of the acoustic sources and acoustic properties of a 3D scene.
<i>F3T11</i>	<i>Audio scene projection</i>	<i>The audio scene projection tool shall be able to project the Audio scene model onto the scene geometry described by a 3D model</i>

## 7.8 Application-related Presentation

This section defines the requirements of the functionalities exposed by the presentation layer of the BRIDGET applications.

Table 17 - Application-related presentation functional requirements

Req. ID	Name	Description
FAP1	Bridget presentation	The presentation system shall present time-aligned and global bridgets associated with a programme using the information provided by the synchronisation system.
FAP2	Multiple bridgets presentation	The presentation system shall be able to present more than one bridget at the same time.
FAP3	Bridget filtering	The presentation system shall provide a way to filter the retrieved bridgets based on type (time-aligned or global) or destination content type.
FAP4	Bridget filtering mode	The presentation system shall provide a way to select automatic or manual bridget filtering.
FAP5	Groups of bridgets	The presentation system shall provide a way to interact with a group of bridgets allowing collapsing or expanding the related items.
FAP6	Bridget bookmark	The presentation system shall provide a way to save a bridget for future use, consume and remove it
FAP7	Content presentation	The presentation system shall be able to decode and render destination content linked by a bridget.
FAP8	Programme presentation and navigation	The presentation system shall provide at least one way to navigate the source programme timeline using information provided by the Media Analysis tools.
FAP9	Search results presentation	The presentation system shall provide at least one way to present the content or the bridgets provided by the Search tools.
FAP10	Multi-view scene on-line reconstruction	The presentation system shall provide scene rendering and reconstruction methods.
FAP11	3D model rendering – sparse	The presentation system shall be able to render 3D models through a sparse representation (e.g. point clouds) using the 3D engine.
<i>FAP12</i>	<i>3D model rendering – dense</i>	<i>The presentation system shall be able to render 3D models through dense representation (e.g. meshes) using the 3D engine.</i>

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<b>Req. ID</b>	<b>Name</b>	<b>Description</b>
FAP13	Binaural audio rendering	The presentation system shall be able to render audio tracks binaurally.
FAP14	Enable/disable bridget presentation	The presentation system shall provide a way to enable or disable at any time the presentation of new bridgets.

## 8 Requirements of Applications

This section provides a map of the functionalities required by the BRIDGET applications that will be developed during the first year of the Project (Version A): the Professional Authoring Tool (PAT) and the Player. The end-user level authoring tool will not be included in this version of the applications.

The following sections include a list of Requirements IDs from Section 7 that will be implemented in the related applications. The detailed resulting tables are available in Annex A.

### 8.1 Professional Authoring Tool

The Professional Authoring Tool (PAT) Version A shall implement the following BRIDGET functionalities:

- Bridget Representation
  - FBR1, FBR2, FBR3, FBR4, FBR5, FBR6, FBR7, FBR9, FBR11, FBR12, FBR15
- Content and Bridget Management
  - FCM1, FCM2, FCM3, FCM4, FCM5, FCM7, FCM8, FCM9
- Synchronisation
  - FSY7
- Content Access
  - FCA1, FCA2, FCA3, FCA4
- Media Analysis
  - FMA1, FMA2, FMA3, FMA4, FMA5, FMA6, FMA7, FMA8, FMA9, FMA11, FMA12, FMA13, FMA14, FMA15, FMA17, FMA18
- Search tools
  - FST1, FST2, FST3, FST4, FST5, FST6, FST7, FST8, FST9, FST10, FST11, FST12, FST13, FST14, FST15
- 3D Tools
  - F3T1, F3T2, F3T3, F3T4, F3T5, F3T6, F3T7, F3T9, F3T10
- Application-related Presentation
  - FAP1, FAP2, FAP5, FAP6, FAP7, FAP8, FAP9, FAP10

### 8.2 Consumer Authoring Tool

This application will not be available for Version A.

### 8.3 Player

The Player Version A shall implement the following BRIDGET functionalities:

- Bridget Representation
  - FBR1, FBR2, FBR3, FBR4, FBR5, FBR6, FBR7, FBR9, FBR11, FBR12
- Synchronisation
  - FSY1, FSY2, FSY3, FSY4, FSY5, FSY6
- Content Access
  - FCA1, FCA2, FCA3, FCA4
- 3D Tools
  - F3T7, F3T8, F3T9
- Application-related Presentation
  - FAP1, FAP2, FAP3, FAP4, FAP5, FAP6, FAP7, FAP11, FAP13, FAP14

## 9 Conclusions

The list of functional requirements organised and presented in this document will guide the definition of the architecture and interfaces and the development of tools and applications for the first year.

This document also contains a list of requirements that will not be supported in phase 1. They have emerged in the analysis carried out to produce this document and, while immediate attention will not be dedicated to them, they have been kept for future reference and they are expressed in *italic*.

It can be envisaged that some of these non-phase 1 requirements will be revisited and that additional phase 2 requirements will be identified in the future.

## 10 References

- [1] BRIDGET, First BRIDGET workshop and use scenarios, Deliverable D2.1v1, 2014/01/31
- [2] Abran et al. - 2004 - Guide to the software engineering body of knowledge
- [3] IETF, RFC 2119 (1997-03), IETF, "Key words for use in RFCs to Indicate Requirement Levels", <https://www.ietf.org/rfc/rfc2119.txt>
- [4] ETSI, TS 102 796 1.2.1 Hybrid Broadcast Broadband TV, November 2012
- [5] HDFI/DGTVi, HD-Book DTT: "Compatible High Definition receivers for the Italian market", ver 2.1.1, October 2012
- [6] HDFI/Tivù, HD-Book SAT: "Compatible High Definition receivers for the Italian market", ver 2.0, October 2012
- [7] Tapu, R.; Zaharia, T., "A complete framework for temporal video segmentation," 2011 IEEE International Conference on Consumer Electronics, vol., no., pp.156,160, 6-8 Sept. 2011
- [8] Jun Yang, Yu G. Jiang, Alexander G. Hauptmann, Chong W. Ngo, "Evaluating bag-of-visual-words representations in scene classification", Proceedings of the International Workshop on Multimedia Information Retrieval, pp. 197-206, 2007
- [9] Chikkerur, S.; Sundaram, V.; Reisslein, M.; Karam, L.J., "Objective Video Quality Assessment Methods: A Classification, Review, and Performance Comparison," IEEE Transactions on Broadcasting, vol.57, no.2, pp.165,182, June 2011
- [10] Bernd Girod, Vijay Chandrasekhar, Radek Grzeszczuk, Yuriy A. Reznik, "Mobile Visual Search: Architectures, Technologies, and the Emerging MPEG Standard," IEEE Multimedia, vol. 18, no. 3, pp. 86-94, July-September 2011.
- [11] Text of ISO/IEC CD 15938-13 Compact Descriptors for Visual Search
- [12] ISO/IEC w14095 - Draft Requirements for compact descriptors for video search
- [13] R. Hartley and A. Zisserman, "Multiple View Geometry in Computer Vision", Cambridge University Press, 2003.
- [14] N. Atzpadin, P. Kauff, and O. Schreer, "Stereo Analysis by Hybrid Recursive Matching for Real-Time Immersive Video Conferencing", IEEE Trans. on Circuits and Systems for Video Technology, Special Issue on Immersive Telecommunications, vol. 14, no. 3, pp. 321-334, Mar. 2004.
- [15] P. Carballera, J.I. Ronda and A. Valdés, "3D reconstruction with uncalibrated cameras using the six-line conic variety", Proc. IEEE Intl. Conf. on Image Processing (ICIP'08), pp. 205-208, Oct. 2008.
- [16] W. Waizenegger, I. Feldmann, and O. Schreer, "Real-time Patch Sweeping for High-Quality Depth Estimation in 3D Videoconferencing Applications", Proc. SPIE Conf. on Real-Time Image

and Video Processing, vol. 7871, pp. 78710E-10, Jan. 2011.

- [17] A. Smolic, K. Müller, P. Merkle, T. Rein, M. Kautzner, P. Eisert, T. Wiegand, “Free Viewpoint Video Extraction, Representation, Coding, and Rendering”, Proc. IEEE Intl. Conf. on Image Processing (ICIP’04), vol. 5, pp. 3287-3290, Oct. 2004.
- [18] F. Morán (ed.), ISO/IEC 14496 16:2011/Amd.1:2011, “Animation Framework eXtension (AFX)” [a.k.a. MPEG 4 Part 16 Ed. 4], Amendment 1, “Efficient Representation of 3D Meshes with Multiple Attributes”, ISO, 2011.
- [19] Michael Vorländer, “Auralization - Fundamentals of Acoustics, Modelling, Simulation, Algorithms and Acoustic Virtual Reality”, Springer Verlag, Berlin, 2008.
- [20] J. H. Rindel, “Modelling in auditorium acoustics: From ripple tank and scale models to computer simulations”, Forum Acusticum, Seville, Revista de Acústica XXXIII, no. 3-4, pp. 31-35, 2002.



## Annex A – List of Functional Requirements of Applications

This Annex provides the list of functional requirements implemented by each BRIDGET application and defined in Section 8. The tables below include name and description of the related requirements.

### A.1 Professional Authoring Tool

Table 18 - Professional authoring tool functional requirements

Req. ID	Name	Description
FBR1	Bridget identification	The bridget format shall support unambiguous and persistent domain-based identification of a bridget.
FBR2	Bridget authoring information	The bridget format shall support inclusion of bridget authoring information (e.g. title, date, copyright, etc...).
FBR3	Bridget source programme	The bridget format shall allow specification of the associated source programme.
FBR4	Bridget source programme description	The bridget format shall support inclusion of textual descriptions related to the associated source programme.
FBR5	Bridget types	The bridget format shall allow specification of whether the bridget is associated to a specific time interval of the programme (time-aligned) or to the entire programme (global).
FBR6	Bridget destination content	The bridget format shall allow specification of one destination content item.
FBR7	Bridget destination content types	The bridget format shall allow specification of audiovisual, audio, 3D video, 3D audio, or 3D video/audio scenes as destination content.
FBR9	Bridget destination content description	The bridget format shall support inclusion of descriptions related to the destination content (e.g. content type, media duration, MIME type, file size, etc...).
FBR11	Bridget default icon	The bridget format shall allow the definition of a default icon or image that can be used to visually present the bridget to the user.
FBR12	Bridget presentation description	The bridget format may allow specification of the visual and the acoustic presentation of the destination content.
FBR15	Bridget modifications	The bridget format shall allow modification of all its representation data values excluding those related to identification.
FCM1	Content ingestion	The content management system shall allow media content ingestion and storage in content repositories.
FCM2	Content types	The content management system shall support the following media types: audiovisual content, audio content, and 3D models.
FCM3	Content metadata	The content management system shall allow storage of metadata and annotations related to content.
FCM4	Content removal	The content management system shall allow deletion of content and related metadata and annotations from a content repository.

<b>Req. ID</b>	<b>Name</b>	<b>Description</b>
FCM5	Content publishing	The content management system shall allow publication of content available on a content repository to the Internet.
FCM7	Indexed Content	The content repository shall maintain a list of indexed content.
FCM8	Bridget ingestion	The content management system shall allow bridget ingestion and storage in bridget repositories.
FCM9	Bridget publishing	The content management system shall allow publication of a bridget available on a bridget repository to the Internet.
FSY7	Synchronisation information production	The synchronisation tool shall be able to create synchronisation information from a segment of a programme.
FCA1	Content delivery	The content access system shall support access to content delivered through HTTP and HTTP adaptive streaming.
FCA2	Network QoS	The content access system shall be able to access content with or without a defined Quality of Service (through managed or unmanaged networks).
FCA3	CDN	The content access system shall be able to access content delivered through a Content Delivery Network (CDN).
FCA4	Bridget delivery	The content access system shall support access to bridgets delivered through HTTP.
FMA1	Multiple content types	The media analysis tools shall be able to process audiovisual content comprising images and/or video and/or audio.
FMA2	Coding independence	The media analysis tools shall be able to process audiovisual content independently of the content coding format.
FMA3	Coding awareness	The media analysis tools may be able to process audiovisual content according to specific content coding formats, but shall produce comparable results to the media analysis tools which are able to process audiovisual content independently of the content coding format.
FMA4	Content duration independence	The media analysis tools shall be able to process audiovisual content of arbitrary duration.
FMA5	Content modification robustness	The media analysis tools shall be robust to audiovisual content modifications comprising temporal resampling, spatial resampling, spatial aspect ratio changes, A/D conversion, and I/P conversion.
FMA6	Content description self-containment	The media analysis tools shall provide audiovisual content descriptions which are self-contained, in that their use does not require the audiovisual content from which they were generated.
FMA7	Content non-alteration	The media analysis tools shall leave the audiovisual content on which they operate unaltered.

Req. ID	Name	Description
FMA8	Real-time content description extraction	The media analysis tools shall be able to generate audiovisual content descriptions in real time or near-real-time.
FMA9	Faster than real-time content description extraction	The media analysis tools may be able to generate audiovisual content descriptions at very high speeds, far exceeding real time, but shall produce comparable results to the media analysis tools which are able to generate audiovisual content descriptions in real time.
FMA11	Low-level structural segmentation	The media structure analysis tools shall be able to provide a shot-level temporal segmentation and keyframe representation of audiovisual content.
FMA12	Linear hierarchical structural segmentation	The media structure analysis tools shall be able to provide a hierarchical linear temporal segmentation and keyframe representation of audiovisual content.
FMA13	Non-linear hierarchical structural segmentation	The media structure analysis tools shall be able to provide a hierarchical non-linear temporal segmentation and keyframe representation of audiovisual content.
FMA14	Genre-specific structural segmentation	The media structure analysis tools shall be able to provide a temporal segmentation and keyframe representation of audiovisual content according to genre-based heuristics for a limited number of genres.
FMA15	Content-based annotation	The media annotation tools shall be able to provide low-level descriptions (e.g. dominant colour, colour layout, colour temperature, motion activity, motion type) and high-level descriptions (e.g. indoor, outdoor, town, landscape) of audiovisual content.
FMA17	Fast filtering / search	It shall be possible to perform faster than real-time filtering / search of audiovisual content using the descriptions provided by the media annotation tools.
FMA18	Unambiguous content description syntax	The media analysis tools shall present the content description they generate to the rest of the system in an unambiguous format.
FST1	Visual search in image library	The visual search engine shall support visual search in a pre-indexed image library based on a query image.
FST2	Visual search in image library where query specifies ROI in the query image	The visual search engine shall support visual search in a pre-indexed image library based on a query image with a ROI specified as bounding polygon or ROI segmentation map.
FST3	Visual search in video library utilising video key frames	The visual search engine shall support visual search in a pre-indexed video library based on a query image. Search and access points are restricted to video key-frames.

<b>Req. ID</b>	<b>Name</b>	<b>Description</b>
FST4	Visual search in video library utilising video key frames where query specifies ROI in the query image	The visual search engine shall support visual search in a pre-indexed video library based on a query image with a ROI specified as bounding polygon or ROI segmentation map. Search and access points are restricted to video key-frames.
FST5	Off-line indexing of image library	The visual indexing engine shall support off-line creation of a database/index for a library of image resources.
FST6	Off-line indexing of video library based on video key-frames	The visual indexing engine shall support off-line creation of a database/index for a library of video resources where search and access points are restricted to video key-frames.
FST7	Ranking of the search results based on matching confidence	The visual search engine shall support ranking of the search results based on match confidence.
FST8	Spatial Localisation of the matched region	The visual indexing and search engines shall support coarse spatial localisation of the matching regions.
FST9	Multiple content types	The visual search and indexing engines shall be able to process audiovisual content comprising images and/or video.
FST10	Coding independence	The visual search and indexing engines shall be able to process audiovisual content independently of the content coding format.
FST11	Content modification robustness	The visual search and indexing engines shall support visual search to be robust to audiovisual content modifications such as temporal resampling, spatial resampling, spatial aspect ratio changes, A/D conversion, and I/P conversion.
FST12	Robustness to visual deformations	The visual search and indexing engine shall support visual search that is robust to viewing aspect, illumination changes, partial occlusion and similar artefacts.
FST13	Content description self-containment	The visual search and indexing engines shall derive and use content descriptions which are self-contained, in that their use does not require the access to the content from which they were generated.
FST14	Content non-alteration	The visual search and indexing engines shall leave the audiovisual content from which they were derived unaltered.
FST15	Integration with content-based search	The visual search and indexing engine shall execute queries based on content input by the user.
F3T1	Feature point extraction	The feature point extraction tool shall extract a set of robust feature points in several images corresponding to the same 3D scene.

Req. ID	Name	Description
F3T2	Generation of matching pairs	The generation of matching pairs tool shall identify pairs of 2D points in different images known to correspond to the same 3D point in the related 3D scene.
F3T3	Camera calibration	The camera calibration tool shall provide both, the intrinsic and extrinsic parameters of the user's camera which took particular pictures.
F3T4	Reconstruction of isolated 3D point locations	The reconstruction of isolated 3D point locations tool shall provide reconstructed isolated 3D points.
F3T5	Dense mesh reconstruction	The dense mesh reconstruction tool shall create a dense 3D reconstruction starting from a sparse representation.
F3T6	3D model update	The 3D model update tool shall be able to update a precomputed 3D model by adding additional images/videos.
F3T7	3D model rendering	The 3D engine shall be able to render 3D model through a sparse representation (e.g. point clouds) or <i>dense representation</i> (e.g. meshes).
F3T9	3D model coding	The 3D model coding tool shall be able to efficiently compress/decompress sparse/dense 3D model representations.
F3T10	Audio scene modelling	The audio scene modelling tool shall be able to generate a description of the position of the acoustic sources and acoustic properties of a 3D scene.
FAP1	Bridget presentation	The presentation system shall present time-aligned and global bridgets associated with a programme using the information provided by the synchronisation system.
FAP2	Multiple bridgets presentation	The presentation system shall be able to present more than one bridget at the same time.
FAP5	Groups of bridgets	The presentation system shall provide a way to interact with a group of bridgets allowing to collapse or expand the related items.
FAP6	Bridget bookmark	The presentation system shall provide a way to save a bridget for future use, consume and remove it
FAP7	Content presentation	The presentation system shall be able to decode and render destination content linked by a bridget.
FAP8	Programme presentation and navigation	The presentation system shall provide at least one way to navigate the source programme timeline using information provided by the Media Analysis tools.
FAP9	Search results presentation	The presentation system shall provide at least one way to present the content provided by the Search tools.
FAP10	Multi-view scene on-line reconstruction	The presentation system shall provide scene rendering and reconstruction methods.

## A.2 Consumer Authoring Tool

This application will not be available for Version A.

## A.3 Player

Table 19 - Player functional requirements

Req. ID	Name	Description
FBR1	Bridget identification	The bridget format shall support unambiguous and persistent domain-based identification of a bridget.
FBR2	Bridget authoring information	The bridget format shall support inclusion of bridget authoring information (e.g. title, date, copyright, etc...).
FBR3	Bridget source programme	The bridget format shall allow specification of the associated source programme.
FBR4	Bridget source programme description	The bridget format shall support inclusion of textual descriptions related to the associated source programme.
FBR5	Bridget types	The bridget format shall allow specification of whether the bridget is associated to a specific time interval of the programme (time-aligned) or to the entire programme (global).
FBR6	Bridget destination content	The bridget format shall allow specification of one destination content item.
FBR7	Bridget destination content types	The bridget format shall allow specification of audiovisual, audio, 3D video, 3D audio, or 3D video/audio scenes as destination content.
FBR9	Bridget destination content description	The bridget format shall support inclusion of descriptions related to the destination content (e.g. content type, media duration, MIME type, file size, etc...).
FBR11	Bridget default icon	The bridget format shall allow the definition of a default icon or image that can be used to visually present the bridget to the user.
FBR12	Bridget presentation description	The bridget format may allow specification of the visual and the acoustic presentation of the destination content.
FSY1	Synchronisation presentation delay	The synchronisation tool shall allow bridget presentation, synchronised to a point in the media timeline of a programme, with a maximum delay of 5s.
FSY2	Detection accuracy	The synchronisation tool shall be able to identify the programme watched and the relative point in the media timeline with a temporal detection accuracy comparable to the average length of the visual shots.
FSY3	Bridget identification	The synchronisation tool shall be able to identify the bridgets to retrieve and present at specific points in the media timeline of a programme.

Req. ID	Name	Description
FSY4	Programme media time identification	The synchronisation tool shall be able to retrieve the media time from the main programme at specific points in time.
FSY5	Independence from main screen interactions	The synchronisation tool shall be able to synchronise the presentation of a bridget to a programme without any interaction with the main screen (e.g. using audio and/or video fingerprinting mechanisms).
FSY6	Automatic synchronisation	The synchronisation tool shall be able to identify and retrieve synchronisation information automatically from the programme stream (i.e. without the intervention of the user).
FCA1	Content delivery	The content access system shall support access to content delivered through HTTP and HTTP adaptive streaming.
FCA2	Network QoS	The content access system shall be able to access content with or without a defined Quality of Service (through managed or unmanaged networks).
FCA3	CDN	The content access system shall be able to access content delivered through a Content Delivery Network (CDN).
FCA4	Bridget delivery	The content access system shall support access to bridgets delivered through HTTP.
F3T7	3D model rendering	The 3D engine shall be able to render 3D model through a sparse representation (e.g. point clouds) or <i>dense representation</i> (e.g. meshes).
F3T8	3D viewpoint synthesis	The 3D engine shall be able, starting from a 3D model of a scene, to create a synthetic 2D view of that scene from any possible viewpoint.
F3T9	3D model coding	The 3D model coding tool shall be able to efficiently compress/decompress sparse/dense 3D model representations.
FAP1	Bridget presentation	The presentation system shall present time-aligned and global bridgets associated to a programme using the information provided by the synchronisation system.
FAP2	Multiple bridgets presentation	The presentation system shall be able to present more than one bridget at the same time.
FAP3	Bridget filtering	The presentation system shall provide a way to filter the retrieved bridgets based on type (time-aligned or global) or destination content type.
FAP4	Bridget filtering mode	The presentation system shall provide a way to select automatic or manual bridget filtering.
FAP5	Groups of bridgets	The presentation system shall provide a way to interact with a group of bridgets allowing collapsing or expanding the related items.

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<b>Req. ID</b>	<b>Name</b>	<b>Description</b>
FAP6	Bridget bookmark	The presentation system shall provide a way to save a bridget for future use, consume and remove it.
FAP7	Content presentation	The presentation system shall be able to decode and render destination content linked by a bridget.
FAP11	3D model rendering – sparse	The presentation system shall be able to render 3D models through a sparse representation (e.g. point clouds) using the 3D engine.
FAP13	Binaural audio rendering	The presentation system shall be able to render audio tracks binaurally.
FAP14	Enable/disable bridget presentation	The presentation system shall provide a way to enable or disable at any time the presentation of new bridgets.



## Annex B – User Requirements to Functionalities Map

This Annex provides a map of the BRIDGET Functionalities that fulfil each User Requirement.

*Table 20 - User requirements and functional requirements relationships*

Req. ID	Name	Functional Requirement ID
UBC1	Content link	FBR3, FBR6, FBR7
UBC2	Stored content	FBR3
UBC4	Bridget association – time-aligned	FBR5, FSY7
UBC5	Bridget association – global	FBR5
UBC6	Bridget made global	FBR15
UBC7	Bridget reuse	FPA5
UBC8	Time-aligned bridget points candidates	FAP6, FMA12, FMA13
UBC9	Destination content candidates	FST1, FST3, FST7
UBC10	Destination content	FBR3
UBC11	Bridget information creation	FBR1, FBR2, FBR9, FBR12
UBA1	Devices for bridget access	FCA1
UBA2	Bridget retrieval	FST2, FST3,
UBA3	Retrieval of remote bridgets	FCA1, FCA4, FCM9
UBA4	Synchronised access & presentation	FSY1-6
UBA5	Synchronisation independence	FSY5
UBA6	Recording support	FSY5,FSY6
UBS1	Bridget Search	FAP9
UBS2	Content Search – production	FST1, FST3, FST7, FMA17
UBS3	Content Search – consumption	FST1, FST3, FST7, FMA17
UBS4	Video object selection	FST2, FST4, FAP9
UBS5	Content search - metadata	FMA17, FAP9
UBS6	Content search – visual queries	FST1-4, FAP9
UBP1	Presentation of in scope time-aligned bridgets	FSY1, FAP1
UBP2	Presentation of out of scope time-aligned bridgets	FAP6
UBP3	Presentation of bridgets or groups of bridgets	FAP5
UBP4	Presentation of global bridgets	FAP1
UBP5	Bridget presentation resources	FBR11, FBR12

<b>Req. ID</b>	<b>Name</b>	<b>Functional Requirement ID</b>
UBP6	Bridget notification	FAP14
UBP7	Multiple bridget notifications	FAP2
UBP8	Filter & Selection – manual	FAP3
UBP9	Presentation preferences	FAP3
UBP10	Filter & Selection – automatic	FAP4
UBU1	Bridget consumption	FAP1
UBU2	Global bridget consumption	FAP7
UBU3	Independent consumption	FSY5
UBU4	Bridget bookmarks creation	FAP6
UBU5	Bridget bookmarks consumption	FAP6
UBU6	Bridget context reset	FAP6
U3C1	3D reconstruction	F3T1-6
U3C2	Candidate selection for reconstruction.	F3T1, F3T2
U3C3	Initial 3D reconstruction	F3T4, F3T5, F3T9
U3C4	3D reconstruction refinement	F3T6
U3P1	Viewpoint rendering	F3T8, FAP11
U3P2	Viewpoint navigation	F3T8, FAP11
U3P4	3D audio rendering	FAP13