FI content

D2.5

SOCIAL CONNECTED TV PLATFORM

FINAL PLATFORM

April 2015

ABSTRACT

This document keeps record of the development of the Social Connected TV Platform. The Platform architecture and its underlying SEs and GEs, as well as Applications for testing of Scenarios as defined in D2.1 are presented.

This document is a deliverable of the FI-CONTENT 2 integrated project supported by the European Commission under its FP7 research funding programme, and contributes to the FI-PPP (Future Internet Public Private Partnership) initiative.

SEVENTH FRAMEWORK PROGRAMME

FUTURE INTERNET PPP

DISCLAIMER

DELIVERABLE DETAILS

[Full project title]:	Future media Internet for large-scale CONTent experimENTation 2
[Short project title]:	FI-CONTENT 2
[Contract number]:	603662
[WP n°]:	WP2: Social connected TV Platform
[WP leader]:	Martin Gordon, RBB
[Deliverable n°]:	D2.5
[Deliverable title]:	SOCIAL CONNECTED TV PLATFORM Final platform
[Deliverable nature]:	Prototype (P) & Report (R)
[Dissemination level]:	Public (PU)
[Contractual delivery date]:	M25 - April 2015
[Actual delivery date]:	12.05.2015
[Editor]:	Christoph Ziegler, IRT
[Internal Reviewers]:	Jörn Berkefeld, BitTubes Ralf Neudel, IRT Olivier Duvoid, eBiz Stefan Lemme, DFKI
[Suggested readers]:	Executives in TV broadcast companies, SMEs, start-ups and developers in media and entertainment industries
[Keywords]:	Platform, Connected TV, HbbTV, interactive TV, Smart TV
[File name]:	FI-CONTENT 2_WP2-009_D2.5_V1.0.docx

EXECUTIVE SUMMARY

This document keeps record of the development of the final release of the Social Connected TV Platform. The Platform architecture and its underlying SEs and GEs, as well as Applications for testing of Scenarios as defined in D2.1 are presented.

The following Scenarios are part of this release of the Social Connected TV Platform:

- Rich Content
- Multi-Screen Experience
- Personalized Media

The following Applications are part of this release of the Social Connected TV Platform:

- Fall of the Wall
- Interactive Car Advertising Application
- rbbtext, ARD-EPG, ARD-Mediathek
- VideoCloud
- Interactive Football Match Application
- Vision

The following platform-Specific Enablers are part of this release of the Social Connected TV Platform:

- Audio Mining
- Content Optimisation
- Second Screen Framework
- TV Application Layer
- Content Enrichment
- HbbTV Application Toolkit

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ABBREVIATIONS

API	Application Programming Interface
EPG	Electronic Program Guide
GE	Generic Enabler
GUI	Graphical user interface
HbbTV	Hybrid Broadcast Broadband Television
HTML	HyperText Mark-up Language
HTTP	Hypertext Transfer Protocol
iOS	Mobile operating system developed and distributed by Apple Inc.
IPTV	Internet Protocol Television
MySQL	My Structured Query Language
NER	Named-Entity Recognition
NLP	Natural Language Processing
REST	Representational State Transfer
SCTVP	Social Connected TV Platform
SDK	Software Development Kit
SE	Specific Enabler
SME	Small and Medium Enterprises
TAL	TV Application Layer
UK	United Kingdom
URL	Uniform Resource Locator
VoD	Video on Demand
XML	Extensible Mark-up Language

1 - INTRODUCTION

1.1 - Overview

Derived from the scenarios developed in the first phase of the FIcontent project, technological gaps were identified that slow down or hinder the introduction of Social Connected TV Applications. In parallel, a number of TV platforms evolved in the market -- such as HbbTV, vendor-specific solutions, HDMI sticks and HTML5 browsers of regular smartphones, tablets and PCs.

The tools and components provided by the Social Connected TV Platform aim at closing the identified gaps respecting the heterogeneous technological landscape. They address very different aspects, including requirements from the content production side, specifics of the different distribution technologies and different feature sets of consumer devices.

This deliverable introduces the Social Connected TV Platform. Chapter "Social Connected TV Platform Architecture" (see Section 2) provides a high-level overview of all Social Connected TV related Scenarios and Applications as well as the tools -- also referred to as Enablers -- used to implement them. Chapter “Release 04/15 (see Section 3)” introduces the Social Connected TV Platform Specific Enablers, followed by chapter “SCTV Applications (see Section 4)” which explains the Applications that have been developed by the project in the Social Connected TV domain. Further chapters provide a summary of the "Interaction and Cooperation with other FIcontent Platforms (see Section 5)" and an overview of the runtime environments of the Social Connected TV Platform Specific Enablers (see Section 6).

Please be aware that this document is generated from the FIcontent Wiki [1]. Thus the document may sometimes still refer to the FIcontent Wiki. All information in this document is also available online. We suggest using the online version of this deliverable [2] for an advanced reading experience.

1.2 - Terminology

The following table contains terms, which are used in multiple deliverables. Therefore, we provide their shared definitions to ensure consistency across several documents.

Term	Definition
Application or Application software	Software layered on top of one or several platforms for realizing various useful tasks for end-users
Architecture	A structure of functional elements organized in a given way and presenting well defined interfaces
Capability	The ability of a component to satisfy a requirement
Conceptual Model	A set of view with written description of the organization of the FIcontent infrastructure to offer services
Enabler Software	Module or web service providing well-specified functionality, accessible and usable by application developers through clearly-described APIs (Application Programming Interfaces)
Experiment or Experimentation	Concrete test with actual users of one scenario in one of the experimentation sites in a given time frame
FI-WARE Tools	The tools put in place by FI-WARE to send requests for Generic Enablers are based on a backlog list in the frame of an agile methodology
Functional requirement	Either calculations, technical details, data manipulation, processing or other specific functionality that define what a system is intended to accomplish

Generic Enabler	An enabler realized by the FI-WARE project or its follow-up sustainability project
Platform	A comprehensive combination of technology infrastructure and Generic Enablers as well as Specific Enablers capable to host and to support development of application software
Point of Interest	A POI is a place, an area or a journey (short distance) which are geo-located. For example: a place (a restaurant, etc.), an area: a public garden, a journey (a hiking trail, etc.). A POI has possibly features such as : static features (opening hours, address, name description, etc.), dynamic features (price, menu, number of available places, the delay before the next bus, etc.), event features (a beginning and an end)
Scenario	Description of foreseeable interactions of users with one or several applications
Specific Enabler	An enabler realized by the FIcontent project. Specific Enablers may be layered on top of, or otherwise make use of, Generic Enablers. Please refer to the definition of a FIcontent Specific Enabler from deliverable D6.1 Architecture specification [3]
Interface	The connections between domains (or sub domain or functional elements) serving the actor's actions by exchanging information
Interoperability	The capability of two or more networks, devices, applications to exchange and use information
Technology	A standard or industry specification that has the capability of addressing requirements

2 - SOCIAL CONNECTED TV PLATFORM ARCHITECTURE

The below figure provides an overview of the Social Connected TV Platform building blocks, which can be grouped into four categories. Each category is assigned to a layer in the diagram as follows:

- Layer 1 (red): Scenarios
- Layer 2 (yellow): Applications
- Layer 3 (blue): Specific Enablers (SEs)
- Layer 4 (green): Generic Enablers (GEs)

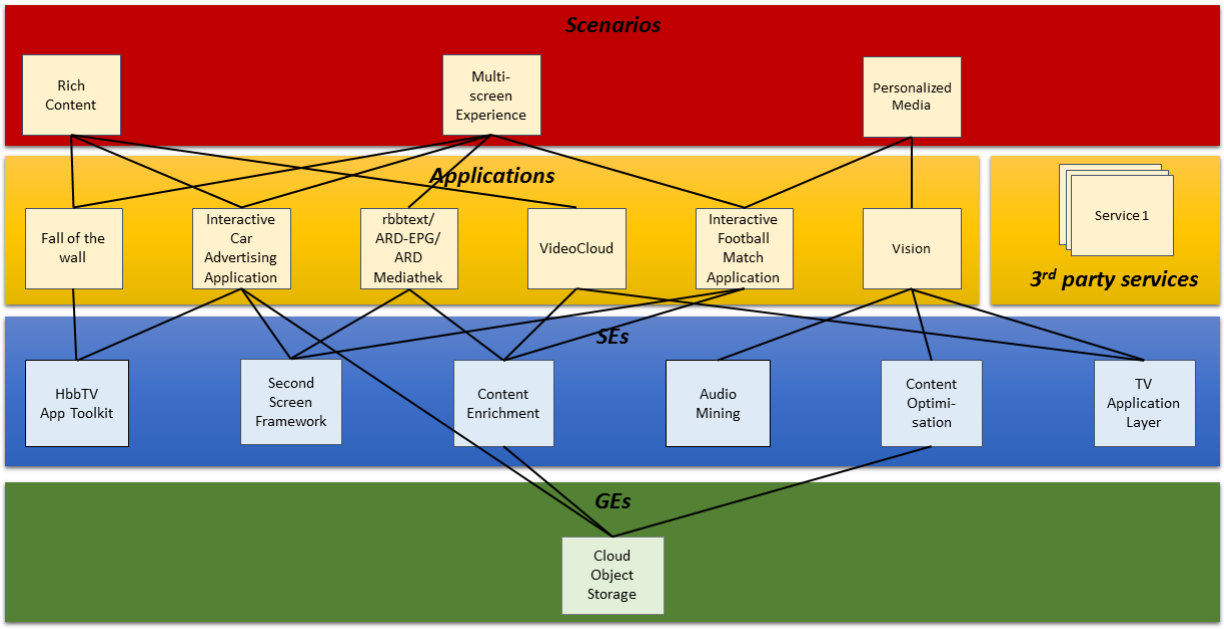

*Figure 1**Error! Bookmark not defined.** High-level architecture of the Social Connected TV Platform*

Scenarios are not technical components, but describe what users will be able to do with the Social Connected TV Platform. Scenarios are described in more detail in *Deliverable D2.1 Scenarios, functional and technical specifications*.

SEs and GEs are technological components that are used to implement the functional requirements of the scenarios. GEs are provided by the Core Platform of FI-PPP developed by the FI-WARE project. SEs are developed by FIcontent in order to complement GEs where domain specific features are needed. SEs are exposed to 3rd party developers and SMEs via the Social Connected TV Platform API.

Applications are pieces of software built on top of SEs and GEs that make certain scenario features available to end-users. There are two kinds of applications. The first group is built on those applications that are implemented by FIcontent partners with the goal of validating the scenarios and the SEs and GEs. The second group is built on those applications that are developed by third parties that are involved through Competitions (e.g. Hackathons) and Phase 3 of the FI-PPP programme.

Lines in the diagram indicate dependencies between Scenarios, Applications and Enablers. Dependieces are described in more detail in section SCTV applications (see Section 4).

2.1 - Architecture Description

Based on an exemplary TV application, we provide an overview of how the components of the Social Connected TV Platform can be used to augment TV services. The Chapter "SCTV applications" (see Section 4) explains in more detail how the actual Applications developed in the project integrate the SCTVP enablers.

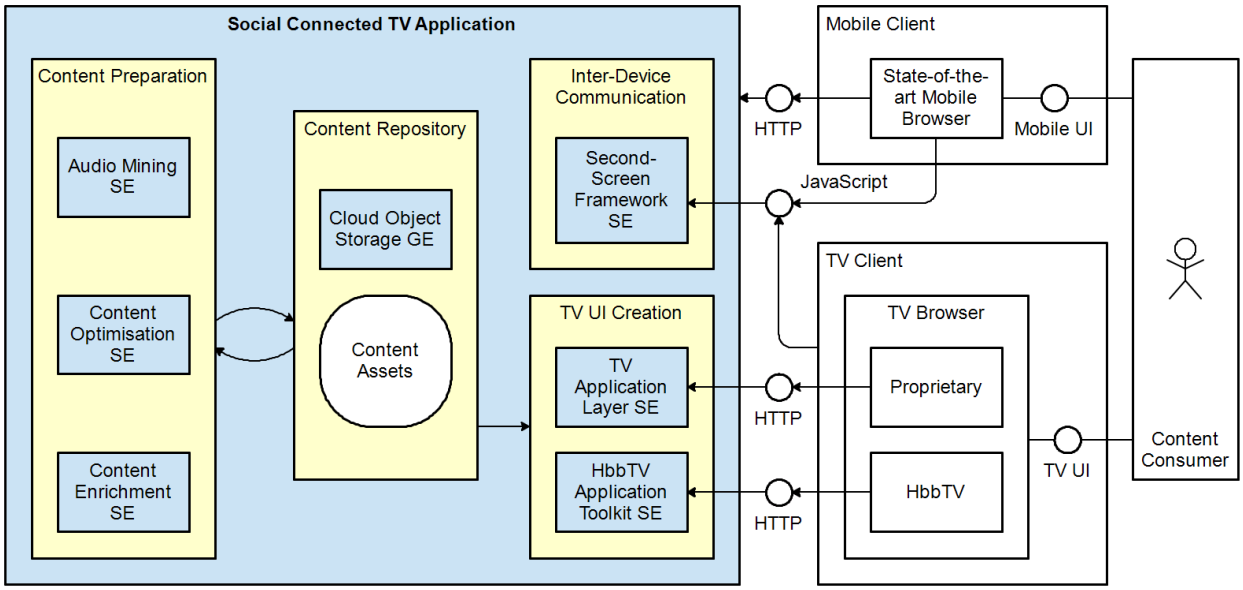

*Figure 2**Error! Bookmark not defined.** Block diagram of an exemplary SCTV application (based on Fundamental Modelling Concept).*

The above figure shows an architecture diagram of the exemplary application, which makes use of all SEs and GEs of the SCTVP. The diagram groups SEs by three categories. These are: Content Preparation, TV UI Creation and Inter-device Communication.

SEs in the **Content Preparation** block enable the analysis and enrichment of content assets stored in the Content Repository. The Audio Mining SE [4] runs a NLP analysis on the audio tracks contained in the media assets and annotates them with textual metadata. The textual metadata provides the basis for the Content Optimisation SE [5] to do a named entity recognition. Named entities can be used to gather additional information on content assets from various sources. The Content Enrichment SE [6] provides editorial means to embed this information into audio-visual content, which is then delivered to the content consumer. In summary, the purpose of the Content Preparation block is the annotation of media assets and the linking with additional content. This is a key component for interactive TV experiences.

The **TV-UI Creation** block provides means to adapt the information from the content repository to present them appropriately within a TV-tailored user interface. The TV market and the according application environments are very fragmented. There is a multitude of SDKs for developers of TV frontends – each of them is usually specific for a single manufacturer. The HbbTV standard aims at harmonising this heterogeneous landscape. With the HbbTV Application Toolkit SE [7] editors can choose from a set of layout and colour scheme templates and assign media assets to different layout elements of an HbbTV-compliant TV application. The uptake of the HbbTV standard is growing rapidly. However, to achieve a Europe-wide or even worldwide interoperability of their services, developers cannot yet rely on HbbTV only. This gap is closed by the TV Application Layer SE [8], which provides an abstraction layer on top of existing vendor-specific and proprietary APIs, which results in a unified API for developers to program against.

The Second Screen Framework SE [9] in the **Inter-device Communication** block enables multi-screen experiences, by providing the technical means for exchanging messages between the frontend applications on a TV and on a second-screen device. These can serve as control commands for various purposes like remotely controlling the playback of video content or sending the current play position of a video to the second screen to resume the playback there. The second screen can take over parts of the TV UI or even the whole UI, e.g., to let users continue browsing additional content on a smartphone or tablet while freeing up space on the TV screen for the main content. The frontend components of the Second-Screen Framework SE are built on APIs of the Open Web Platform that are interoperable with relevant browsers on TV and mobile devices.

2.2 - Specific Enablers

We will provide the following Specific Enablers through the Social Connected TV Platform.

- Audio Mining SE [4]
- Content Optimisation SE [5]
- Second Screen Framework SE [9]
- TV Application Layer SE [8]
- HbbTV Application Toolkit SE [7]

We utilise the following common Specific Enablers for the Social Connected TV Platform.

- Content Enrichment SE [6]

2.3 - Generic Enablers

We use the following Generic Enablers as part of the Social Connected TV Platform.

- Object Storage GE [11]

3 - SOCIAL CONNECTED TV PLATFORM - RELEASE 04/15

In the course of the project, findings from lab-scale and large-scale trials in the domains of Rich Content, Multiscreen Experience and Personalised Content on different experimentation sites all over Europe continuously fed back into the design of the Social Connected TV Platform and its underlying SEs and GEs. The final Platform covers SEs addressing essential aspects that have been identified, including requirements from the content production side, specifics of the different distribution technologies and different feature sets of consumer devices.

The following Specific Enablers are included in the final release of the Social Connected TV Platform.

3.1 - Included Specific Enablers

3.1.1 - Audio Mining

3.1.1.1 - What You Need

Audio Mining analyses a given audio/video file in German or English spoken language (e.g. content from a TV news show) and returns textual information for indexing (e.g. for search engines). Speech and speaker segmentation as well as speech recognition are performed in order to turn speech into text. The SE delivers segments, the speakers identified, characteristic keywords and various metadata in XML. Finally, the SE builds an index for Multimedia Search.

3.1.1.2 - Why You Need It

The Specific Enabler “Audio Mining” targets multimedia indexing and search scenarios such as “Rich Content”. Therefore, the SE analyses a given audio/video file and returns textual information for indexing. Speech and speaker segmentation as well as speech recognition are performed in order to turn speech into text. It delivers segments, characteristic keywords and various metadata. Finally, the SE builds an index enabling multimedia search.

3.1.1.3 - Documentation

- Technical Documentation of the Audio Mining SE [4]
- Developer Guide of the Audio Mining SE [12]

3.1.2 - Content Optimisation

3.1.2.1 - What You Need

Content Optimisation processes incoming textual content (e.g. from the Audio Mining SE) and extracts characteristic keywords. Afterwards, semantic enrichment based on natural language processing (NLP) will be performed to connect the transcripts and keywords with additional, contextual information. Therefore, the SE integrates and harmonises additional content from disperse sources. The software is intended for SMEs that want to build second screen applications (e.g. for TV documentaries).

3.1.2.2 - Why You Need It

The Specific Enabler “Content Optimisation” targets at scenarios in the context of Multimedia Mash-ups. Therefore, the SE processes incoming textual content (e. g. from Audio Mining SE) and extracts characteristic keywords. Afterwards, a semantically enrichment based on NLP (Natural language processing) will be performed to connect the transcripts and keywords with contextual information. Therefore, the SE integrates and harmonises additional content from disperse sources. The SE is intended for SMEs which want to build Second Screen Applications, e. g. for TV documentaries.

3.1.2.3 - Documentation

- Technical Documentation of the Content Optimisation SE [5]
- Developer Guide of the Content Optimisation SE [13]

3.1.3 - Second Screen Framework

3.1.3.1 - What You Need

The Second Screen Framework (SSF) provides web applications that are running on a TV with all the crucial functionalities to establish a persistent bi-directional communication path to a web application running in the browser of any second-screen device. This includes the possibility to launch applications from one a TV to a second screen.

3.1.3.2 - Why You Need It

All functionality is provided via a slim JavaScript API and can thus be easily integrated into any web application. Since the solution is fully compliant with the HbbTV standard, it enables content providers to create fully interactive applications with direct programme relation potentially targeting millions of already deployed devices on the market. Thus, the concept can be implemented without modifications to hardware and only minimal extensions to existing applications.

3.1.3.3 - Documentation

- Technical Documentation of the Second Screen Framework SE [9]
- Developer Guide of the Second Screen Framework SE [14]

3.1.4 - TV Application Layer

3.1.4.1 - What You Need

TAL was developed internally within the BBC as a way of vastly simplifying TV application development whilst increasing the reach of BBC TV applications such as iPlayer. Today all of the BBC's HTML-based TV applications (such as BBC News and BBC Sport) are built using TAL.

3.1.4.2 - Why You Need It

Most Connected TV devices contain a web browser built upon something fairly familiar like WebKit. However, there are still some big variations in the way that devices handle things like media playback, animation, networking, logging, JSON parsing, persistent storage, and remote control key codes. TAL abstracts away these things, enabling a TV application developer to build an application only once and deploy it seamlessly to different HTML-based TV devices.

3.1.4.3 - Documentation

- Technical Documentation of the TV Application Layer SE [8]

3.1.5 - HbbTV Application Toolkit

3.1.5.1 - What You Need

Developing HbbTV applications can be quite demanding due to the lack of proper tools for content creators and developers. The HbbTV Application Toolkit SE provides a powerful tool set for both Broadcasters, program editors as well as TV app developers to create HbbTV compliant TV apps in a fast and easy way.

3.1.5.2 - Why You Need It

As a developer of HbbTV apps, HAT allows you working more efficient. As a TV-content editor without a pronounced technical background, HAT allows you augmenting your services with additional interactive content on the TV screen in less than 5 minutes.

3.1.5.3 - Documentation

- Technical Documentation of the HbbTV Application Toolkit SE [7]

3.2 - Used common Specific Enablers

3.2.1 - Content Enrichment

3.2.1.1 - What You Need

Content Enrichment provides functions to create, distribute and play interactive video content across platforms and devices by making objects in the video clickable for their viewers. It also provides interfaces to incorporate Web 2.0 capabilities and community functionalities. Thus, the enabler acts as a common building block in future video and multimedia infrastructures. It allows seamless, platform-independent and convenient enrichment of any type of video content using any type of device for a plurality of application cases.

3.2.1.2 - Why You Need It

Content Enrichment is a hosted solution to create interactive video content consisting of a PHP and MySQL based backend. Interactive content can be created through an HTML5 based tagging tool that uses Java Script and communicates with the RESTful API via JSON to create and store metadata. Interactive video players can be implemented in HTML supporting the JSON player API.

3.2.1.3 - Documentation

- Technical Documentation of the Content Enrichment SE [6]

4 - SCTV APPLICATIONS

4.1 - rbbtext, ARD-EPG and ARD Mediathek

Three applications have been developed to test different aspects focused on inter-device between second-screen devices and connected TV devices to gain findings the area of Multiscreen Experience. The applications provide different interaction concepts, which allows us examining the influence on usability and user experience.

rbbtext is an HbbTV application offered as part of the regular broadcasting services delivered by German public broadcaster rbb. It builds upon the classic teletext service and uses the functionality of the HbbTV standard for navigation and presentation of content and information.

*Figure 3**Error! Bookmark not defined.** rbbtext in action*

In the second-screen enabled version the user can either choose synchronised navigation – what happens on one screen happens on the other screen as well - or can choose to use the application on the second screen only. This allows the user to continue watching the broadcast while browsing through additional accompanying information on the second screen. A further use-case is the possibility of opening URLs on the second-screen in order to show content which is beyond the scope of HbbTV on the TV screen; rbbtext editorial staff include such links in the HbbTV application.

The **ARD EPG** (Electronic Programme Guide) is an HbbTV application offered by the German public service broadcasting network ARD. The application provides information about current and upcoming TV programmes aired on channels of the ARD network. In addition, the ARD EPG enables users to access previously-broadcast content.

*Figure 4**Error! Bookmark not defined.** ARD-EPG in action*

The companion app on the second screen allows users navigating the EPG on the second screen using the more convenient touch interface of the tablet or smartphone. Users can choose to display the app only on the second screen to free up space on the TV screen for current broadcast. Users can also use the second-screen app to switch between channels of the ARD network and to initiate the playback of video clips from

the VoD catalogue displayed on the main TV screen. Moreover the second-screen simplifies full text search to find specific programmes.

The **ARD Mediathek** is the video-on-demand portal of the public broadcasting network ARD. In the second-screen version of the ARD Mediathek users can browse through the range of video clips of the ARD-Mediathek. They can use the full text search on the second screen, which can be cumbersome with the numerical key set of the classical remote. Once users discover a clip, they can select the clip to be played back on the TV screen. Moreover, they can remotely operate the video player controls like play-pause, fast forward and fast rewind options of the video player in the HbbTV application. The users can also maintain lists of videos for subsequent consumption.

*Figure 5**Error! Bookmark not defined.** ARD Mediathek in action*

The below figure shows the basic technical concept all three applications have in common. Links (URL) to HbbTV applications are referenced in the broadcast signal that is delivered to the consumer devices via DVB-S,-C or -T. The TV device requests the HbbTV application from a webserver hosted by the broadcaster. The Second Screen Framework SE [9] is used to establish a connection between the TV and the second-screen device and to launch the companion application on the connected second-screen device. Once the second-screen application is loaded from the broadcaster's webserver, the apps on TV and second screen can exchange messages via the webserver of the Second-Screen Framework SE.

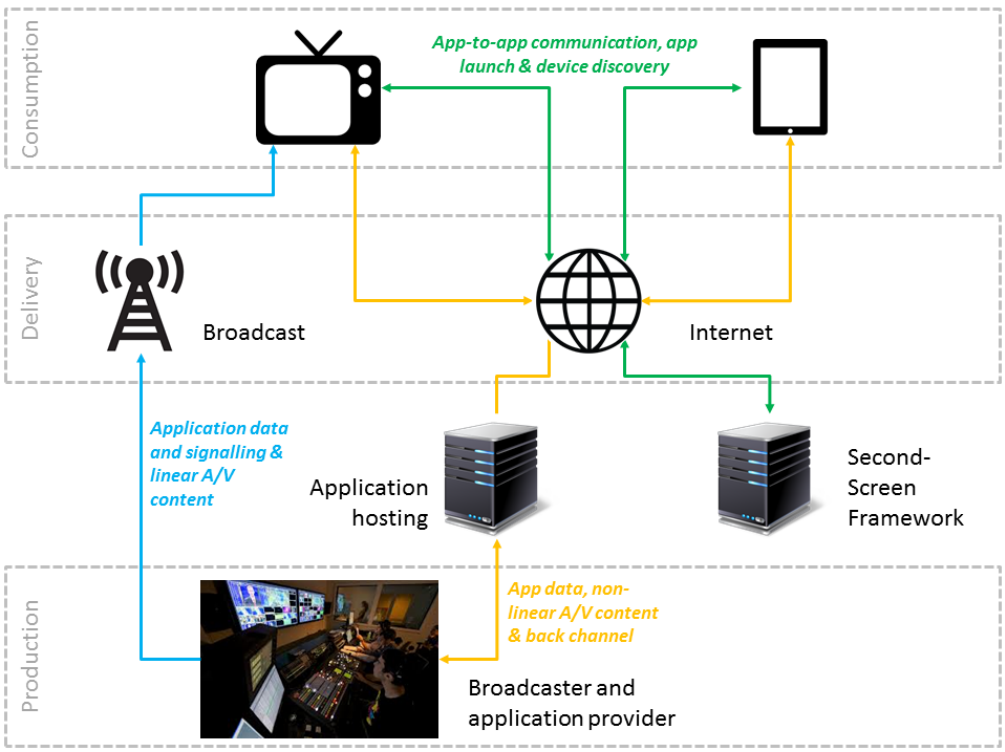

*Figure 6**Error! Bookmark not defined.** Technical concept of multi-screen applications realised with the Second-Screen Framework SE*

4.2 - VideoCloud

Video Cloud is an application for sharing and exploring interactive video content. By taking advantage of Content Enrichment SE, the application prototype enables interactive video on second screen devices (tablet and smartphone) to enhance established content experiences from TV to personal devices where interactivity should ideally take place. The current application runs independently from the TV or STB application. For future releases, it is planned to integrate with the Rich Content scenario and to realize companion screen features directly coupled to broadcast content via SmartTV applications. The Video Cloud application gains access to available interactive video content that was uploaded to the Video Cloud CDN, e.g. through the Video Cloud editing tool. Current supported formats are MP4, WebM, as well as the adaptive formats HLS and DASH.

Via the user front-end on the smartphone or tablet, the user is able to explore interactive content including comments, posts and related links from other users. Also editorial content can be integrated besides the user generated content. Individual comments and related content can be added to a section of the video in general or specific objects within the video, which are then turned into clickable areas within the video. The user can add images, textual information and links to other web content. It is also possible to link to other possibly interactive videos that were previously added to the system or create chapter and pause markers. The integration of meta-data from open encyclopedias like Europeana or Wikipedia is currently being evaluated for integration in a future release, potentially in the spring/summer of 2015 before the experimentation at the Berlin experimentation site.

We implemented a fully functional interactive video timeline, which uses video-timestamps of comments and interactive areas are used to automatically display related posts or data. This timeline shows viewers what parts of the video were enhanced and what to expect in these scenes both video-content wise and enhancement wise. Users can click on the previewed sections to either jump right into the video scene or get a detailed list of the added comments and interactive zones.

4.2.1 - Screenshots

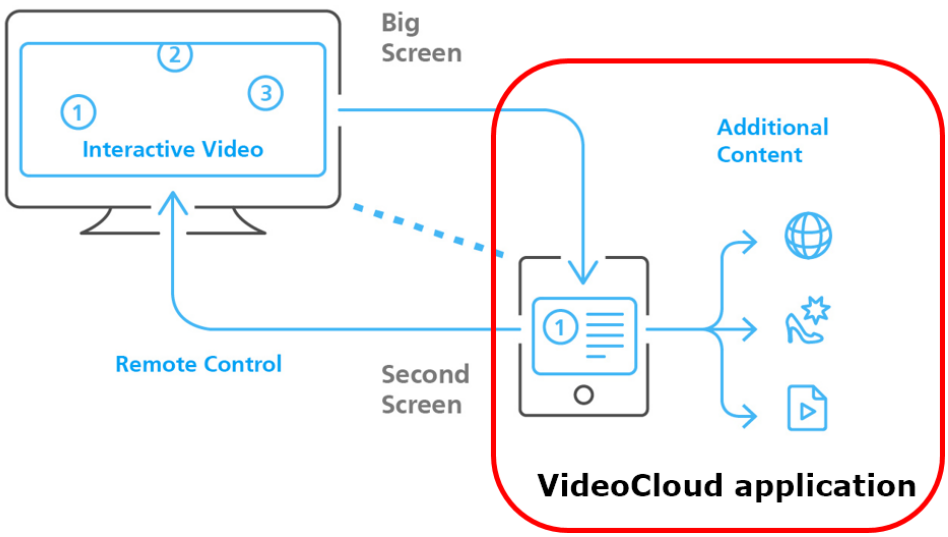

*Figure 7**Error! Bookmark not defined.** VideoCloud integration with Rich Content scenario*

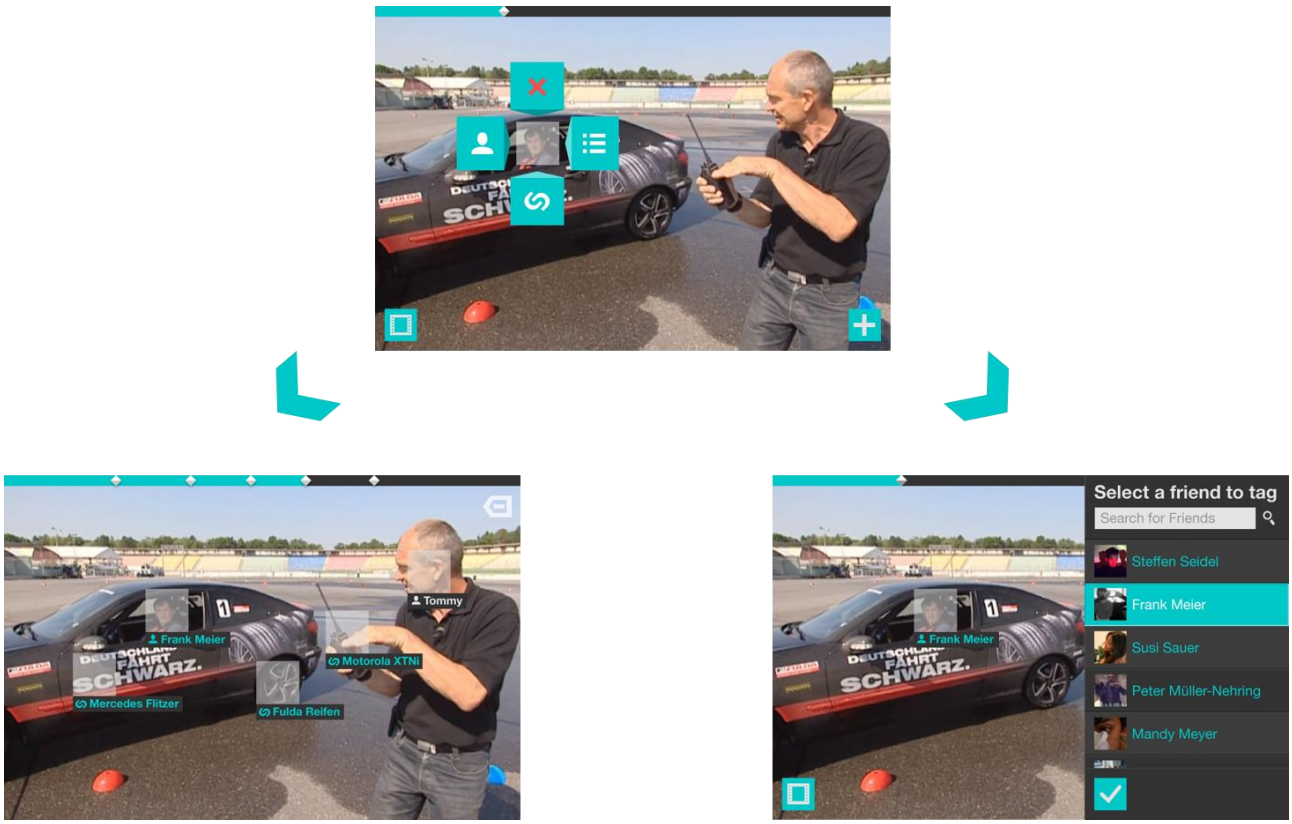

*Figure 8**Error! Bookmark not defined.** VideoCloud UI samples from tests*

4.2.2 - SEs

Video Cloud uses the Content Enrichment SE [6] (**CENR**) as well the TV Application Layer SE [8] (**TAL**). CENR is an integral part of the entire application, which handles all underlying data and enables all interactivity. TAL simplifies the portation of the TV application to various TV makers and models, which is required for a brought adoption of the video-sync module.

4.3 - Vision

Vision is an IPTV research and experimentation platform that delivers both live and on-demand (VoD) content from 30 TV and 20 radio free-to-air channels to students and staff on the Lancaster University campus. Vision manages the full content lifecycle, starting from metadata and content ingest via satellite and terrestrial broadcasts (DVB-T and DVB-S dual head-end) through to multi-bitrate HTML5-compliant video streams delivered to mobile, PC, game console and smart TV platforms. By April 2015, Vision has over 1800 registered users and recorded user activity data in millions.

Vision provides universal and easy access to content regardless of user device or locality (as long as it is within the boundaries of licensed content). Vision content is primarily delivered through its web portal (vision.lancaster.ac.uk). Further delivery options are available: an interface for smart TVs and gaming consoles is developed using the TAL enabler (TV Application Layer SE), and native iOS and Android apps are under development (currently in beta release). With its large content library and user base as well as its fully managed ecosystem, Vision offers a unique opportunity to carry out large-scale experiments to evaluate future TV technologies and UX designs.

4.3.1 - Screenshots

*Figure 9**Error! Bookmark not defined.** Vision IPTV platform*

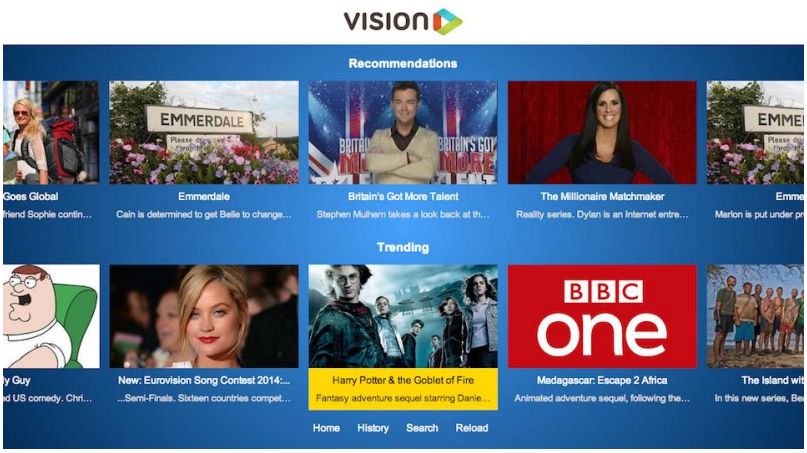

*Figure 10**Error! Bookmark not defined.** Homescreen of the Vision application*

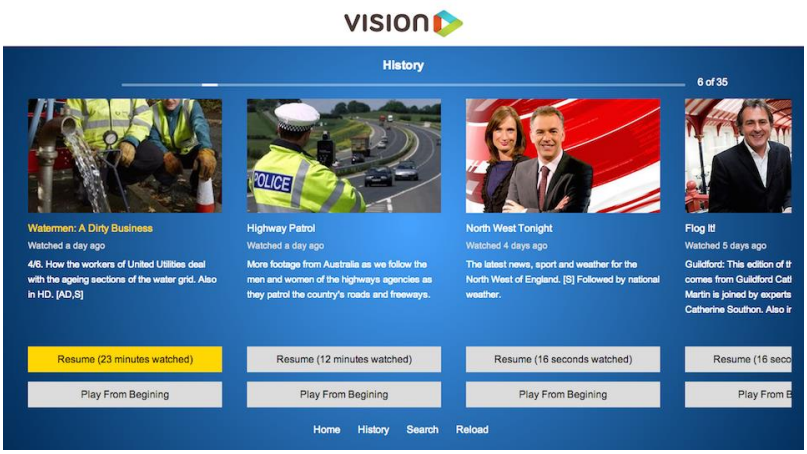

*Figure 11**Error! Bookmark not defined.** Users personal history in the Vision application*

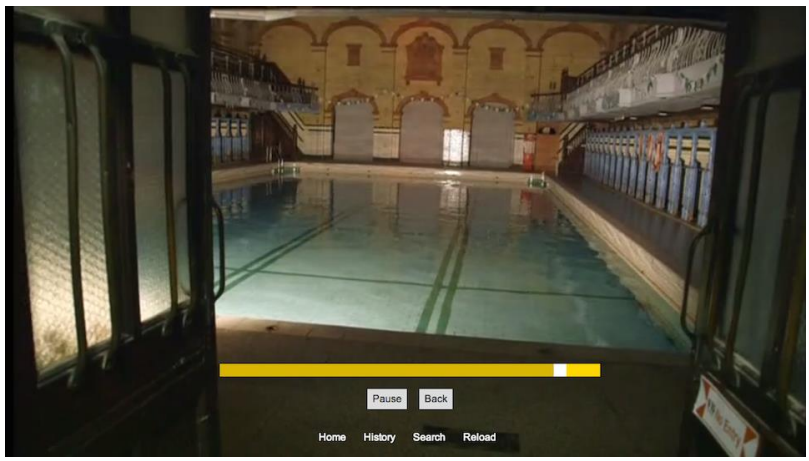

*Figure 12**Error! Bookmark not defined.** Resuming content in Vision.*

4.3.2 - Specific Enablers & interaction with other applications

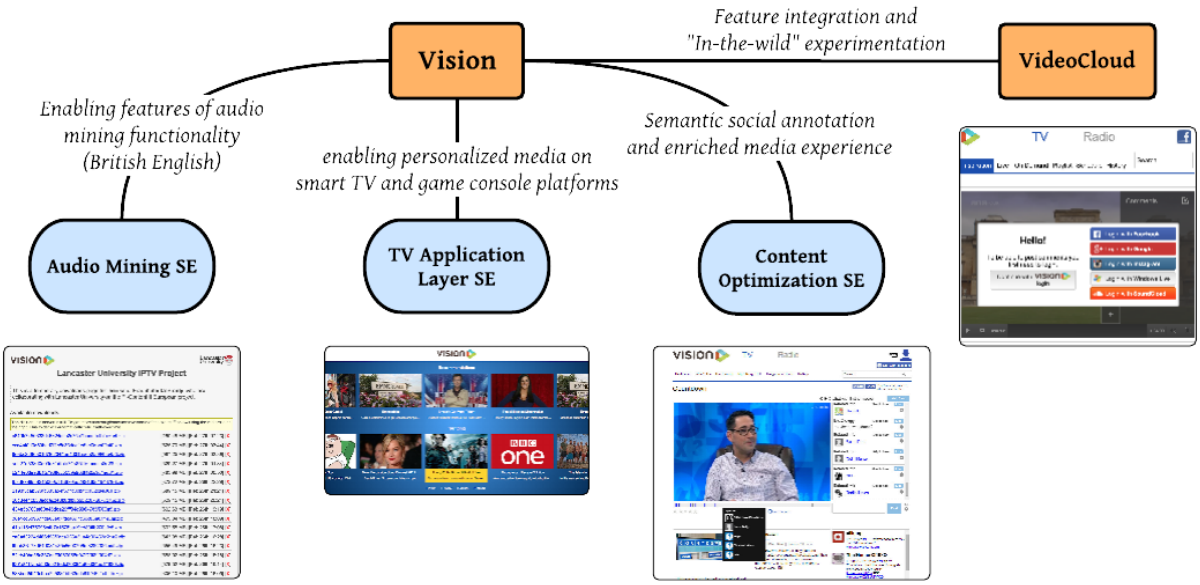

*Figure 13**Error! Bookmark not defined.** Interaction of Specific Enablers in Vision and integration of VideoCloud*

4.3.2.1 - TV Application Layer (TAL) SE

Vision uses TV Application Layer SE [8] (TAL) to enable its personalized media service, especially the cross device resume play feature, over smart TV and game console platforms. TAL serves as a middleware that provides nicely documented abstraction of user interactivity functions on connected TV platforms. It also helps developers to maintain a consistent user experience whether the input device is a keyboard, remote controller, or a game controller. Using TAL, developers at Lancaster efficiently designed and deployed production-level media services compatible with a wide-range of connected TV devices using existing content and metadata feed available in Vision. The Vision-flavoured TAL distribution is available on Github via: https:*github.com/bbcrd/tal-vision.*

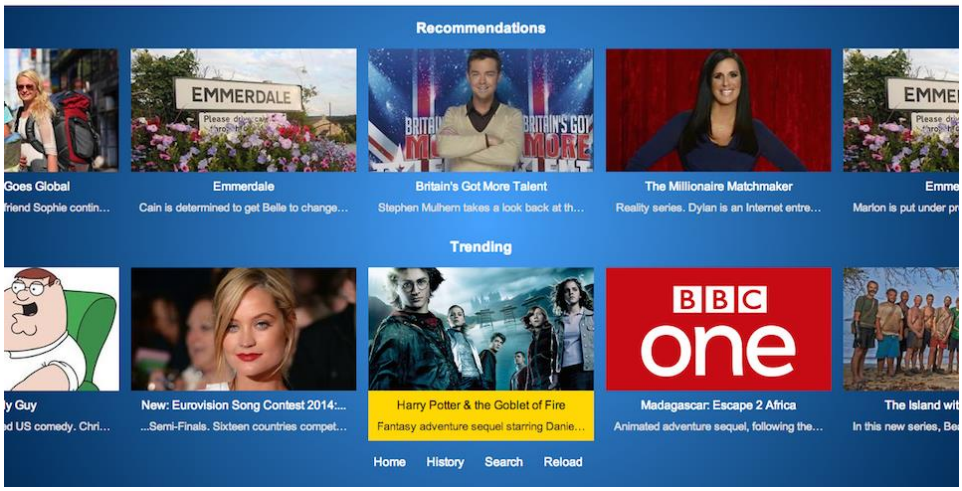

*Figure 14**Error! Bookmark not defined.** TV UI implemented on the basis of TAL SE*

4.3.2.2 - Audio Mining SE

Following reviewers' comments, it was suggested that internal cooperation between WP partners could be improved. Reviewers also noted that the linguistic capabilities of the Audio Mining SE [4] could be extended. Audio Mining SE is a potential solution for Vision to close the gap where text information like subtitles are sparse. Thus, the lack of British English support in Audio Mining was a limitation not only for phase 3 as stated in the reviewers comments but also in Vision as example application. With the broad variety of typical content in British English language and close to perfect subtitles Visio on the other hand offers access to valuable content both in amount and quality for training and evaluating an English version of Audio Mining SE. ULANC generated the training content using a purpose-built extraction service that automatically populates a content pool with TV programmes (with audio tracks in English) along with the processed and time-coded subtitle data as the source of supervised training. More than one hundred hours of representative data was selected from the Vision platform and used to develop and evaluate the technical capabilities of Audio Mining SE for Vision as well as platforms and projects in phase 3 and beyond building on top of English media and content.

4.3.2.3 - Content Optimization SE

One recent feature introduced was the Semantically-Enriched Social Annotation. This feature enables users to socially interact about media content and its events where messages are displayed to other users viewing the same content item. The social annotations are time-coded and perfectly synchronized with their associated content to deliver immersive media experience. Furthermore, links to semantic entities in the media are automatically identified from the content speech using Content Optimisation SE [5], and added to the social discussion. This enables users to explore relevant links extracted from the media content. For instance, the service provides users with key ingredients (with hyperlinks to knowledge networks such as the Wikipedia) mentioned in a cooking programme so that audiences can better follow the programme. One potential use case is online shopping where users can add recognized items mentioned in the TV programme into a shopping cart.

*Figure 15**Error! Bookmark not defined.** Named entities in catch-up content*

4.3.2.4 - VideoCloud Application

Besides the integration and experimentation with SEs, there has also been a internal corporation between Vision and VideoCloud. Vision's large user base is ideal for "in-the-wild" experiments and qualitative evaluation of applications emerged in FI-Content 2. This collaboration allows VideoCloud applications to be deeply integrated in Vision services and made accessible to all registered users of Vision. To this end, a development environment with statistics capturing capabilities has been built for the first time to support external development and testing from a remote site. The VideoCloud feature is now online and receiving an increasing number of users.

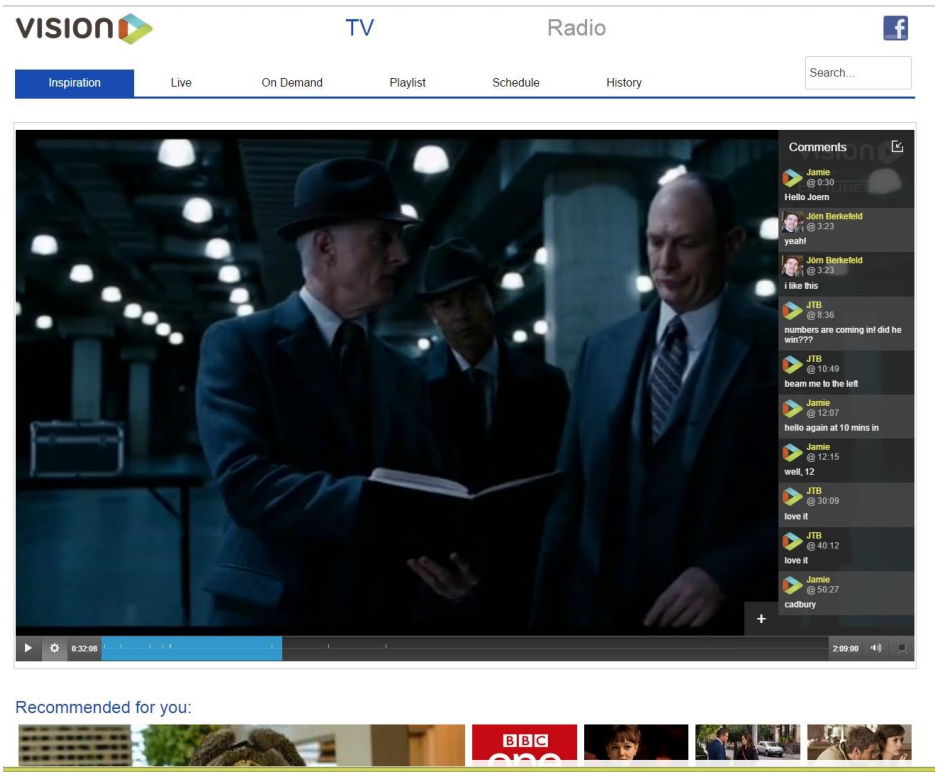

*Figure 16**Error! Bookmark not defined.** VideoCloud on Vision platform*

4.4 - Interactive Football Match Application

The Interactive Football Match Application combines multiscreen, rich content, user generated content and social media aspects. It allows users enriching content on their second screen devices and share it with their friends in an interactive way. The application, implemented by Fincons and developed within FIcontent project, provides to the end user a multi-interactive experience based on Second Screen and Content Enrichment Frameworks. A Connected TV can recognise enrichment metadata delivered with the streaming video. It notifies the presence of enriched content to the connected device thanks to the connection with the Second Device. The user can explore the enriched content on the second device (text, images and links). Users can share enriched content with a their friends via a social network platform (in this case Facebook). The content is published on the Social Network wall. In the Interactive Console on the device the user can follow the group members' comment associated to the event and can create a new one that is proposed in the chat section on the Smart TB. The user can also captured a frame from the Video Streaming and associate a comment in order to share it in the chat or in the Social Wall with FB function.

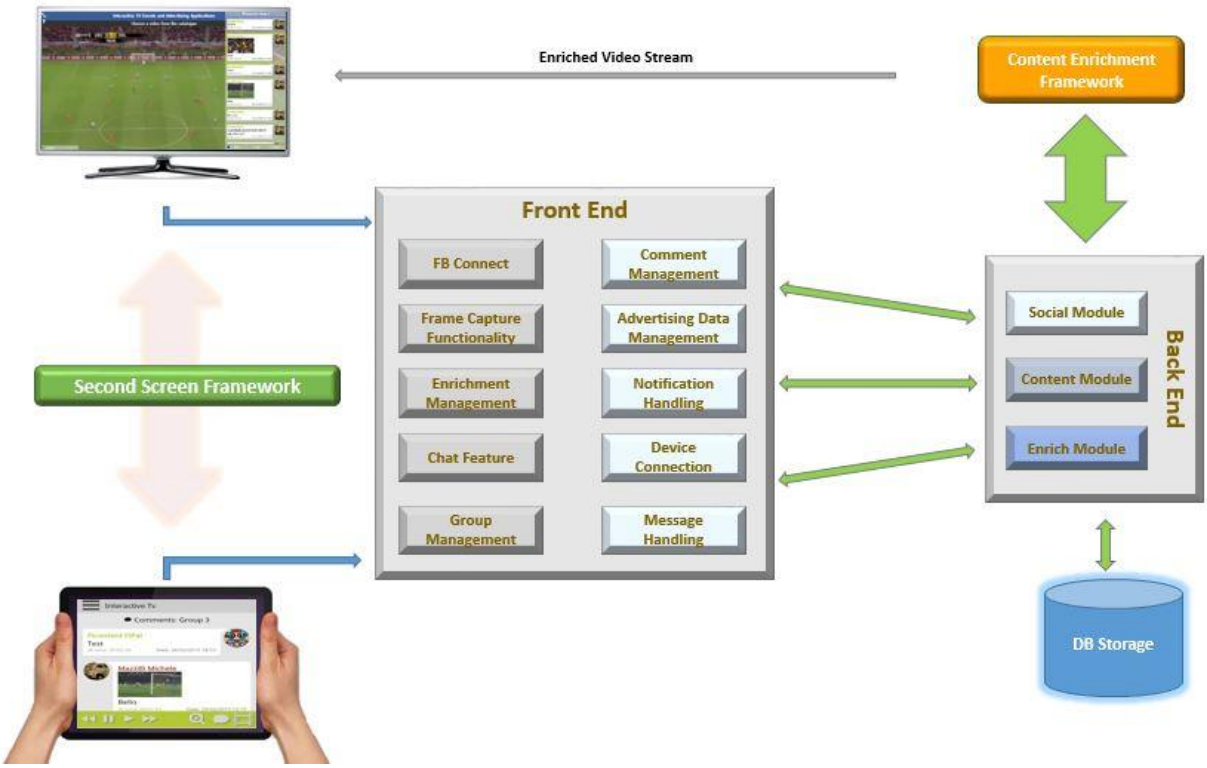

*Figure 17**Error! Bookmark not defined.** High-level architecture of the Interactive Football Game Application*

The application uses the Second Screen Framework SE [9] to establish a communication path between the connected TV and the second-screen device. Enrichment of video content by content editors and end-users and the recognition of enrichment meta-data in the video stream is realised on the basis of the Content Enrichment SE [6].

4.5 - Interactive Car Advertising Application

Interactive Car Advertising Application offers additional information like recommendations, comments and links on the second screen. This content can be presented to users' second screen devices for interactive advertising purposes and a dedicated banner is shown on the Smart TV. The users can add their comments and share them with other users (both using the Application or other social media platform)

The application uses the Second Screen Framework SE [9] to connect the TV and the second-screen device and to synchronise the content on the TV and the second screen.

4.6 - Fall of the Wall

Over the weekend of 8-9 November 2014, Rundfunk Berlin-Brandenburg broadcast a 25-hour long programme to mark the 25th anniversary of the fall of the Berlin Wall. On this occasion RBB delivered an accompanying HbbTV application with the broadcast signal that featured a social media stream. Viewers were able to contribute text messages or pictures via social networks and the RBB website that fed into the stream.

*Figure 18**Error! Bookmark not defined.** Fall of the Wall HbbTV App*

The application was built with the HbbTV Application Toolkit SE [7] (HAT). A dedicated HAT module was used to realise the Social Media feed. Editors were able to create and maintain the application via the responsive editor interface.

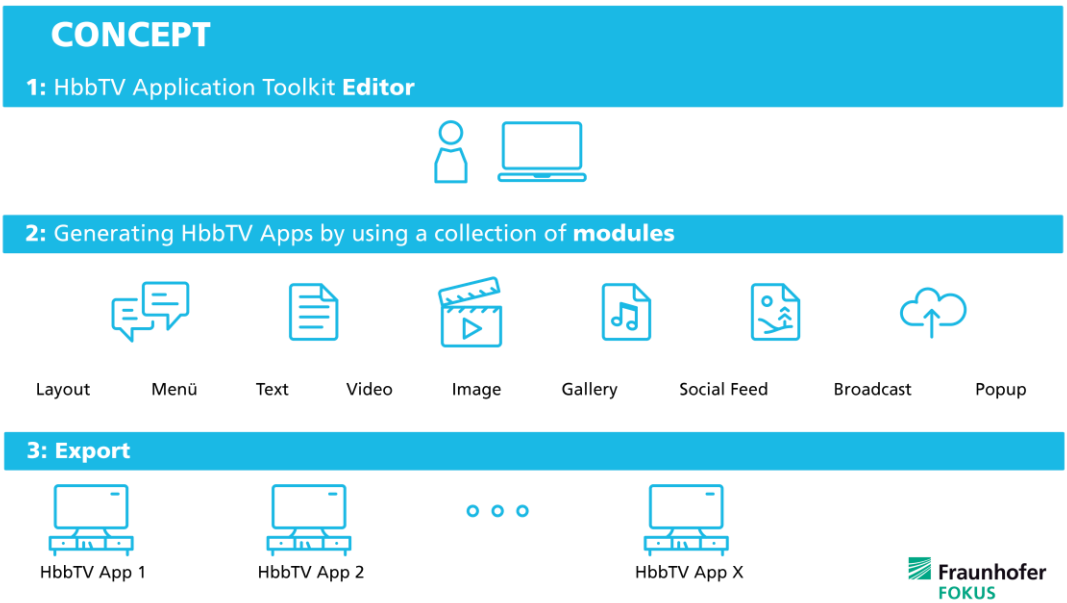

*Figure 19**Error! Bookmark not defined.** HAT Concept*

*Figure 20**Error! Bookmark not defined.** Overview of the HbbTV Application Toolkit - Editor and HbbTV App*

5 - INTERACTION AND COOPERATION WITH OTHER FICONTENT PLATFORMS

The Social Connected TV Platform uses the Content Enrichment SE [6], which was originally introduced by the Smart City Platform [15] and has been promoted as a Common Specific Enabler in FIcontent. The Content Enrichment SE enables the creation, distribution and play-back of augmented interactive video content. The original target runtimes for the playback of enriched A/V content were browsers of desktop and mobile devices. During the course of the project the enabler has been adapted to requirements of the Social Connected TV Platform. Since the Release 09/13 of the Social Connected TV Platform the Enabler allows the playback of enriched content on HbbTV devices. With the Release 10/14, Content Enrichment SE has been enhanced and integrated with the HbbTV Application Toolkit SE to allow interactive video content as part of video galleries in HbbTV Applications created via the HbbTV Application Toolkit SE.

Moreover lab trial applications have been developed on the basis of the Content Enrichment SE and the Second-Screen Framework SE to investigate how media experience can be enhanced with richer content and technology that allows making use of end-user devices core assets – namely the TV's large display for the presentation of content and the touch-gesture support of second-screen devices for the interaction with additional content.

6 - DEPLOYMENT OF THE SOCIAL CONNECTED TV PLATFORM

The figure below illustrates where the Enablers of the Social Connected TV Platform are located, i.e. where they are installed and running. On the left side we list the cloud services that mostly have a RESTful API to be used by clients or other services. The centre line indicates Enablers that run code on both the client and the server side. The right side shows Enablers that are running exclusively on the client side.

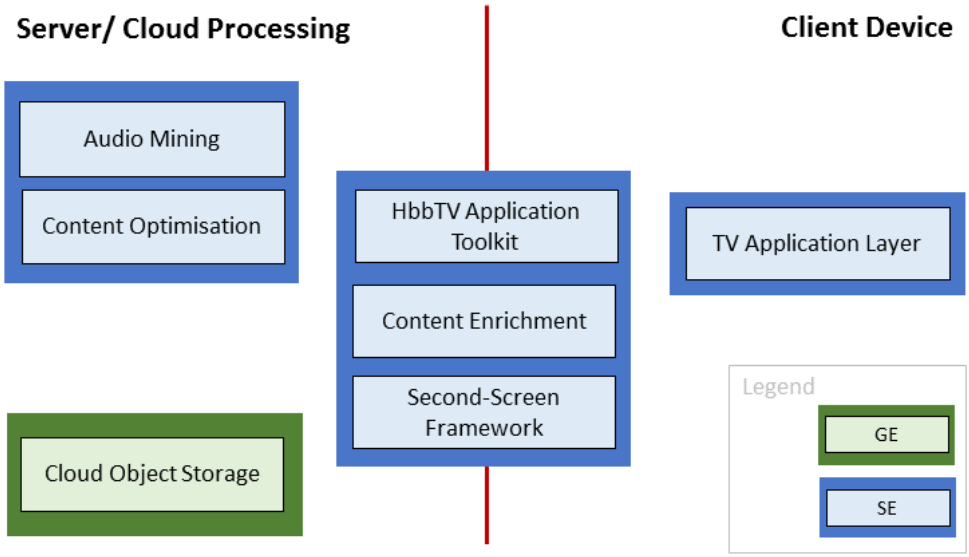

*Figure 21**Error! Bookmark not defined.** Deployment locations of the Social Connected TV Platform Enablers*

6.1 - Client Side Enablers

Some Specific Enablers of the Social Connected TV Platform are exclusively deployed on the client side. They consist of libraries, installation packages or standalone applications. Client Side Enablers will be made available through download links in the FIcontent catalogue ('where to get') but the files will usually be hosted by each responsible partner to allow easy updates. Client Side Enablers are:

- TV Application Layer SE [16]

6.2 - Server Side Enablers with a Shared Instance

Some GEs and SEs hold data that is used by multiple applications. These Enablers are provided as a single instance that is shared by different applications. These Enablers are:

- Object Storage GE [11]

6.3 - Server Side Enablers with One Instance per Application

Some Specific Enablers are web services that are specific for the application making use of it. These Enablers need to be installed on web servers or PaaS environments by the application provider. These Enablers are:

- Audio Mining SE [17]
- Content Optimisation SE [18]

For most server side Enablers we use the FIWARE Lab infrastructure. Three notable exceptions exist where dedicated servers might be used at the respective test sites:

- Latency-critical message handling for multi-user applications
- Ethical requirements regarding user data

- CPU computing power for high performance computing if not available on the FIWARE Lab testbed infrastructure

For these cases, the respective experimentation site provides its own server infrastructure for local experiments.

6.4 - Enablers on Both Client and Server Side

Some Enablers have components that are deployed on the client and on the server side. These Enablers are:

- Content Enrichment SE [19]
- Second-Screen Framework SE [20]
- HbbTV Application Toolkit SE [7]

6.5 - Infrastructure used in the 1st Experimentation Cycle

6.5.1 - Berlin Experimentation Site

The Infrastructure used for testing on the Berlin Experimentation Site is described in the wiki and in the chapter "Technical Infrastructure" in Deliverable D7.1.2.

6.5.2 - Lancaster Experimentation Site

The Infrastructure used for testing on the Lancaster Experimentation Site is described in the wiki and in the chapter "Technical Infrastructure" in Deliverable D7.1.2.

6.5.3 - Brittany Experimentation Site

The Infrastructure used for testing on the Brittany Experimentation Site is described in the wiki and in the chapter "Technical Infrastructure" in Deliverable D7.1.2.

7 - CONCLUSION

In this document, we presented a technical description of the Social Connected TV Platform. We have explained the overall architecture of the platform, listing the Specific and Generic Enablers that are involved and described how they interact with each other. A development roadmap presented the SEs provided with the final release of the Social Connected TV Platform. We provided a detailed description of the Applications developed in the project on the basis the Platform technologies. Finally, we discussed the deployment of the platform and added an explanatory note on the diversity of environments hosting the platform components.

In the course of the FIcontent project, technologies provided through the Social Connected TV Platform have been improved continuously. Feedback on Scenario concepts, the usability of Applications and the maturity of Enablers with regard to stability/security etc. has been collected via experimentations. Insights fed back into the implementation of scenarios and platform-specific Enablers and ensured high quality of the development of the Social Connected TV Platform.

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