D2.3.1

Version	1.10
Date	2014/07/29
Author	VSX
Dissemination status	PU
Document reference	D2.3.1

D2.3.1 – Common Technical Components (I)

Grant Agreement nº:	621014
Project acronym:	HBB4ALL
Project title:	Hybrid Broadcast Broadband for All
Funding Scheme:	CIP-ICT-PSP
Annex I reference version:	2013/10/22
Project Duration:	2013/12/01 – 2016/11/01 (36 months)
Coordinator:	Universitat Autònoma de Barcelona (UAB)
Beneficiaries:	Rundfunk Berlin-Brandenburg (RBB) Institut Fuer Rundfunktechnik Gmbh (IRT) Rádio e Televisão de Portugal SA (RTP) Televisió de Catalunya SA (TVC) Schweizerische Teletext (TXT) Vsonix Gmbh (VSX) Fundación Centro de Tecnologías de Interacción Visual y Comunicaciones VICOMTECH (VIC) Screen Subtitling Systems Ltd (SCREEN) Holken Consultants & Partners (HC) People's Playground BV (PPG) Universidad Politécnica de Madrid (UPM)

This project is supported by funding from the 'Competitiveness and innovation framework programme 20017-2013' of the European Union.

Project no. 621014
HBB4ALL
Hybrid Broadcast Broadband for All

CIP- Pilot actions
Competitiveness and innovation framework programme 2007-2013

D2.3.1 – Common Technical Components (I)

Due date of deliverable: 2014/06/31
Actual submission date: 2014/07/30

Start date of project: 2013/12/01
Duration: 36 months

Lead beneficiary for this deliverable: VSONIX GMBH (VSX)

Revision 1.10

Project funded by the European Commission within the Seventh Framework Programme		
Dissemination Level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

History Chart

Issue	Date	Changed page(s)	Cause of change	Implemented by
0.10	2014/06/03	-	First version of document	VSX
0.50	2014/07/09	All	Integration of partner input	VSX
0.70	2014/07/20	All	Integration of missing partner input / Pre-final revision	VSX
0.80	2014/07/22	All	Integration of missing partner input / Pre-final revision	VSX
1.00	2014/07/25	All	Revised document	VSX
1.10	2014/07/29	All	Format	UAB

Validation

No.	Action	Beneficiary	Date
1	Prepared	VSX	2014/07/21
2	Approved	WPL	2014/07/25
3	Released	UAB	2014/07/30

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1. Introduction

The aim of the deliverable is to give an overview about the technical components to be used or further implemented by the different Pilots of the HBB4All project. This includes the identification of the technical components as well as standards and protocols used by the pilots to realize their advanced accessibility services for their web, mobile and HBBTV based media applications.

At this early stage of the project, our main objective was to provide an overview about already existing or planned technologies. Therefore we have collected the information from all pilots about existing technical components and planned developments for the Hbb4all project. In the future, we will use this information as a basis for further discussions with the aim to identify potential common technical solutions and other technical development synergies.

Therefore, this deliverable can be seen as a first step for the identification of potential cross-pilot and intra-pilot synergies and to plan common future technical directions. A more in depth analysis of the common technical components development / usage synergies will be provided in deliverable D2.3.2, which is due in Month 14 of the project.

In the following, we will give an overview about the technical goals of the different pilots including existing technologies that are planned to be used in each pilot and its related sub-pilots as well as the technical components that are planned to be implemented for the final realisation of the different pilots. This includes a general overview of each pilot as well as a detailed description of existing and planned technologies for each of the different sub-pilots.

At the end of each pilot chapter, we determine potential personalisation and customisation opportunities for each of the accessibility services targeted in the pilots. Beside other existing approaches e.g. for subtitle customisation that are used by some of the partners (e.g. RBB), the personalisation of accessibility services based on user profiles was identified as being one potential common technological approach. vsonix aims to provide a user management, user initialisation and profiling service based on the results of the EU project “GUIDE” that can determine the accessibility needs of individual users for different modalities. Those requirements can be stored in a user profile that can be accesses by individual applications to adapt their services to the user needs accordingly. The user profile service is already planned to be provided for the online learning (MOOC) showcase targeted in Pilot A “subtitling” (see chapter 2) as well as Pilot C “UI Adaptation” (see chapter 4). In the future the service can be extended to include personalisation profiles and user initialisation services for advanced audio as well sign language rendering.

At the end of the document we will highlight already planned and ongoing cross pilot implementation activities and implementations related to HBBTV.

2. Pilot A – "Multiplatform subtitling services"

2.1. General overview

Pilot A covers all subtitling activities of this project. It joins broadcast partners, industrial partners and research partners in order to tackle crucial aspects in the presence and future of subtitling by broadcasters from production to service, the consumer end.
In short, Pilot A both aims at a) opening up and establishing multi-channel options for subtitling services, at b) taking advantage of new - especially hybrid - technologies for improving the presentation of subtitles on the end user side and at c) preparing the production facilities to enable both a and b.
We have three major strands in this pilot:

1. Establishing various new subtitling services ("subpilots") which will be tested in field trials by large groups of target end users.
2. Identify, partly implement and test components of a novel production workflow.
3. Extensive testing of qualitative parameters of subtitles in different European countries.

We start from the four central objectives of this Pilot A (summarised from the DoW):

Objective A-1 A prototypical complete subtitle production workflow chain for multi-platform purpose for broadcasters which enables basic (HbbTV1.1/1.5) and advanced (HbbTV2.0) customised HbbTV subtitling services aligned with existing subtitling services and integrates broadcast news transcription systems for automatic subtitling and subtitle translation provided by Screen, IRT and VIC and tested on feasibility in house with experts at RTP, RBB and TVC in Portugal, Germany and Spain, and in parts also in Switzerland at TXT.

Objective A-2 HbbTV-based VoD services allowing users to add subtitles and also to customise them for large scale provision and testing in Portugal, Germany (Berlin-Brandenburg), and Spain (Catalonia), provided by RBB, IRT, RTP, TVC, UAB. Switzerland will be considered as additional target region.

Objective A-3 An HbbTV-based News service allowing users to access live content automatically subtitled and translated to multiple languages, provided by VIC and UAB in Spain (Catalonia).

Objective A-4 Complementary user experience testing of different end user related aspects of subtitling in the hybrid world involving users from the target groups which will deliver metrics for Quality of Service done by UAB.

In the first six months of our Work Package 3 we have further specified this matrix:

- For Objective A-1 both a system components documentation of the status quo of our four broadcasters as well as a workflow analysis are being performed which will be fed into D3.1

and which are the prerequisite for the change requirements for current interfaces and processes.

- For Service objective A-2 and A-3 identified the following service sub-pilots and have also started to create a joint approach and time plan for establishing them.
    - Three subpilots "(Customizable) HbbTV Subtitles": TVC, RBB and TXT. Exchange of technical knowledge, concepts and components between the partners is the next step. Early ("Level 1") Applications are to be implemented by March 2015, customizable ("Level 2") Applications are to be ready in time for the Operation Phase by July 2015.
    - One Sub-pilot "Automated News Service"-Subtitles: VIC plus UAB.
    - One (additional) subpilot "PC based subtitles for multiple channels": RTP and UPM plus VSX.
    - Two (additional) subpilots "MOOC": VSX plus UAB.
- For Objective A-4 UAB defined and scheduled seven different tests in different EU Universities. Within these seven tests, data gathering has already started for two of them. First tests have already been started.

2.2. Technologies and standards used for the planned implementation of the Pilot

The subtitle workflow can be divided into three parts, each of which needs dedicated technical implementations:

- Authoring
- Contribution
- Distribution

Each workflow part will be introduced below; after that the planned technical components are described in some more detail.

Authoring

Authoring covers the creation of the subtitles. This is done either by a person with the help of a preparation tool or automatically by using speech recognition technologies. HBB4ALL will build on existing systems and will advance some of them with prototypical features to support a multiplatform workflow. A preparation tool that has the potential to be extended with these features is WinCaps Qu4ntum by the HBB4ALL partner Screen Subtitling Systems. As additional reference for generic, vendor independent strategies prototypical reference software modules are provided.
Essential for the adoption of a multiplatform workflow is the information model used for subtitle information; for prepared programs this involves the file based formats used and for live programs the applied network protocols. Apart from vendor specific file based subtitle formats EBU STL acts as an interoperable solution. For live programs several proprietary protocols are used. Most of them are derived from the NewFor Protocol. Both EBU-STL and NewFor have the disadvantage that they are not easy to extend and that they are restricted to subtitle information for teletext subtitles. In HBB4ALL the XML format EBU-TT will be used in prototypical implementations. EBU-TT can carry subtitle information that is adequate for more than one platform and allows the addition of metadata which can consequently be used in the HBB4ALL multiplatform workflow.

HBB4ALL will provide a guideline document on how to use EBU-TT in the authoring context and define additional metadata that can be used in the different pilots. Extensions of WinCAPS Qu4ntum could be implemented to support EBU-TT as an export format. In addition an open source software module will be provided that transcodes the currently used EBU STL format into EBU-TT (see 2.2.6). Additional EBU-TT transformation modules are implemented to add pilot specific metadata to an EBU-TT document.
Depending of the requirement analysis a prototypical preview feature will be provided to verify the presentation of created subtitles on different platforms. This could be done in WinCAPS and/or an external EBU-TT preview tool that simulates various presentations with web technologies (HTML, Javascript and CSS). For Live Subtitles a replacement of the NewFor protocol could be defined. This could be a part of the preparation tool and/or could be handled by an external module that expects NewFor as input and provides a stream of EBU-TT documents as output.

Standards and Technologies

- Tech 3350, EBU-TT Part 1 Subtitling format definition, Version 1.0
- TECH 3360 MAPPING EBU STL (TECH 3264) TO EBU-TT SUBTITLE FILES, Draft for Comment, Version 0.9
- Tech 3264-1991 EBU subtitling data exchange format
- Timed Text Markup Language 1 (TTML1) (Second Edition), W3C Recommendation 24 September 2013
- Newfor Protocol for Teletext Subtitles (various proprietary specifications)

Contribution

The Contribution part of the subtitle workflow covers the exchange and the transmission of subtitling information before it gets distributed to end devices. Some of the formats from the authoring context (EBU STL and Newfor) are also used here and therefore all implementations for the authoring part can also be used in the contribution part.
Current technologies that are used for the in-band transmission of subtitle information (VBI in SDTV and VANC in HDTV) have to be considered. It is unlikely that this operational part of the workflow will be changed in HBB4ALL although the transport of EBU-TT documents in the VANC could be tested dependent of the support of vendor tools. Contributed subtitles information for the transmission of teletext and DVB subtitles have to guarantee that these services are fully supported.
To distribute subtitles for broadcast content to an HbbTV application, a system must contribute subtitle information to a MPEG2-TS multiplexer. A system that is currently used by RBB for this purpose is the iScheduler of the company MIT-xperts. The contribution of live subtitles information for broadband distribution may require a mix of existing technologies that cannot be fully be specified at this point in time.

Standards and Technologies

- Tech 3350, EBU-TT Part 1 Subtitling format definition, Version 1.0
- TECH 3360 MAPPING EBU STL (TECH 3264) TO EBU-TT SUBTITLE FILES, Draft for Comment, Version 0.9
- Tech 3264-1991 EBU subtitling data exchange format

- EN 300 472 - V1.3.1 - Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams
- EN 300 743 - V1.5.1 - Digital Video Broadcasting (DVB); Subtitling systems
- EN 301 775 - V1.2.1 - Digital Video Broadcasting (DVB); Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams
- TS 102 796 - V1.2.1 - Hybrid Broadcast Broadband TV
- TS 102 796 - V1.1.1 - Hybrid Broadcast Broadband TV
- ST 291: 2011 Ancillary Data Packet and Space Formatting
- SMPTE 2031-2007 - Carriage of DVB/SCTE VBI Data in VANC
- World System Teletext Technical Specification
- Timed Text Markup Language 1 (TTML1) (Second Edition), W3C Recommendation 24 September 2013
- Newfor Protocol for Teletext Subtitles (various proprietary specifications)

Distribution

Technologies that prepare subtitle information for broadband connected end device applications and the implementations of these end device applications are within the core developments of HBB4ALL.

The main format that is used as distribution format is EBU-TT-D. To obtain subtitles in the EBU-TT-D format, a transcoder will be implemented (see 2.2.6).

Rendering applications for Mobile, PC and HbbTV enabled devices are mostly built with Web Technologies (HTML, Javascript and CSS) (see **¡Error! No se encuentra el origen de la referencia.**, 2.2.4, 2.2.5,2.2.7, 2.2.8, 2.2.9 and 2.2.10). To transport subtitle information different transport mechanisms have to be supported. While standard http protocol is sufficient to transmit file based subtitle information for VoD services other protocols have to be used for the streaming of subtitle information. Solutions based on current technologies such as HDS (Adobe) and HLS (Apple) or new fully specified technologies such as MPEG DASH can be implemented in a test environment. If these services can be rolled out depend largely on the availability of vendor tools.

In general the distribution of streamed subtitle information using MPEG DASH offers a more standardized solution – most likely DASH will be natively supported by HbbTV 2.0. For the support of MPEG DASH a module needs to be implemented that creates the necessary DASH segments from incoming subtitle information and a rendering client application needs to be implemented.

Standards and Technologies

- TECH 3380 EBU-TT-D SUBTITLING DISTRIBUTION FORMAT, Version 1.0
- TECH 3381 CARRIAGE OF EBU-TT-D IN ISOBMFF, DRAFT FOR COMMENTS, Version 0.9
- EN 300 472 - V1.3.1 - Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams
- EN 300 743 - V1.5.1 - Digital Video Broadcasting (DVB); Subtitling systems
- TS 102 796 - V1.2.1 - Hybrid Broadcast Broadband TV
- TS 102 796 - V1.1.1 - Hybrid Broadcast Broadband TV
- SMPTE 2031-2007 - Carriage of DVB/SCTE VBI Data in VANC

- World System Teletext Technical Specification
- Timed Text Markup Language 1 (TTML1) (Second Edition), W3C Recommendation 24 September 2013
- WebVTT: The Web Video Text Tracks Format, Draft Community Group Report 18 June 2014
- Newfor Protocol for Teletext Subtitles (various proprietary specifications)
- ISO/IEC 23009-1:2012 - Information technology -- Dynamic adaptive streaming over HTTP (DASH) -- Part 1: Media presentation description and segment formats
- MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks
- ISO/IEC 14496-30:2014 - Information technology -- Coding of audio-visual objects -- Part 30: Timed text and other visual overlays in ISO base media file format
- HTTP Live Streaming - draft-pantos-http-live-streaming-13

2.2.1. Automatic subtitling component (VIC)

2.2.1.1. Overview and expected timing

This component will allow the automatic generation of subtitles from audio within the HbbTV workflow. Discussions on the best integration approach are underway. Its integration into a pilot to be tested at Vicomtech's Digital TV Lab is planned by July 2015 (M20).
State-of-the-art speaker change detection, large vocabulary continuous speech recognition (LVCSR) and automatic capitalization and punctuation will be integrated. Due to technological restrictions, LVCSR will be limited to the broadcast news domain. For testing purposes, the audio language will be English. EBU-TT will be used as the output subtitle format. The generated automatic subtitles will follow the subtitle quality standards accepted by the industry (e.g. Ofcom, BBC, ESIST, UNE153010).

Component Name / Version	Features included	Planned Availability
Automatic subtitling v1.0	Basic functionality.	Sept 2014
Automatic subtitling v1.1	Improved transcription, capitalization and punctuation, timing and splitting modules.	March 2015
Automatic subtitling v1.2	Final release.	July 2015

2.2.1.2. Technologies and standards used

- TECH 3350 EBU-TT SUBTITLING DISTRIBUTION FORMAT, Version 1.0

- Ofcom Guidance on Standards for Subtitling
- ESIST Code of Good Subtitling Practice
- AENOR: UNE 153010:2012

2.2.1.3. Potential cross pilot usage

This component is specific of the subtitling pilot.

2.2.2. Machine Translation Component (VIC)

2.2.2.1. Overview and expected timing

This component will allow the automatic translation of subtitles within the HbbTV workflow. Discussions on the best integration approach are underway. Its integration into a pilot to be tested at Vicomtech's Digital TV Lab is planned by July 2015 (M20).
State-of-the-art machine translation technology will be integrated. Due to technological restrictions, the domain will be limited to be that of broadcast news. For testing purposes, automatic subtitle translations will be generated from English into Spanish. EBU-TT will be used as input/output subtitling format.

Component Name / Version	Features included	Planned Availability
Machine translation v1.0	Basic functionality.	September 2014
Machine translation v1.1	Improved model combination and quality estimation.	March 2015
Machine translation v1.2	Final release.	July 2015

2.2.2.2. Technologies and standards used

- Moses SMT 2.1.1
- ACL 2013 MT shared task News Commentary, News Crawl and Common Crawl corpora
- TECH 3350 EBU-TT SUBTITLING DISTRIBUTION FORMAT, Version 1.0

2.2.2.3. Potential cross pilot usage

This component is specific of the subtitling pilot.

2.2.3. Live Broadcast-Internet subtitle viewer and synchroniser (VIC)

2.2.3.1. Overview and expected timing

This component will allow the user to consume automatically generated live subtitles using HbbTV in a hybrid broadcast-Internet environment. Discussions on the best integration approach are underway, but it is expected to create specific timestamp mechanisms to match the broadcasted video with Internet-based subtitle delivery and create a JavaScript library to be used in an HbbTV application to consume the subtitles provided by de component for live TV. Its integration into a pilot to be tested at Vicomtech's Digital TV Lab is planned by July 2015 (M20).
It will be created over HTML and JavaScript technologies based on the HbbTV standard and using web communication protocols such as Websockets. NTP or similar protocols will be used for the synchronisation of the broadcast and Internet channels.

Component Name / Version	Features included	Planned Availability
Live Broadcast-Internet subtitle viewer and synchroniser v1.0	Basic functionality	March 2015
Live Broadcast-Internet subtitle viewer and synchroniser v1.1	Final release	July 2015

2.2.3.2. Technologies and standards used

- HTML
- JavaScript
- HbbTV 1.0 and 1.5
- NTP

2.2.3.3. Potential cross pilot usage

This component is specific of the subtitling pilot.

2.2.4. Subtitle interpretation tool for browsers (UPM)

2.2.4.1. Overview and expected timing

This technical component will be able to interpret EBU-TT-D subtitles and it will be based on web technologies. In this way, this component will provide synchronized subtitles for a video file decoded in the browser. Functionalities such as fast forward or fast rewind are supported. The tool will also support the required style information (e.g., several colours to distinguish characters).

Component Name / Version	Features included	Planned Availability
Subtitle interpretation tool, first version	Basic functionalities. It interpreters EBU-TT-D files in the browser embedded in HbbTV terminals	July/August 2014
Subtitle interpretation tool, second version	It interpreters EBU-TT-D files for PC browsers and other IT terminals. It requires integration in a web server environment	Dec 2014
Subtitle interpretation tool, third version	It integrates live content and customization	July/August 2015

2.2.4.2. Technologies and standards used

- JavaScript
- XML
- CE-HTML
- HbbTV (ETSI TS 102 796)

2.2.4.3. Potential cross pilot usage

The tool could be used in other pilots that require web subtitling. In fact, the use has been identified for the MOOC case-study in WP5.

2.2.5. "HbbTV-based customisable subtitles for VoD playback" (RBB)

2.2.5.1. Overview and expected timing

The existing RBB HbbTV on-demand video systems will be enhanced with subtitle features by new technologies derived in HBB4ALL. The integration of subtitles in the on-demand portal will be based on a subtitle playback system for HbbTV devices. This technical component will be able to interpret EBU-TT-D subtitles and will be based on web technologies. It will provide synchronised subtitles for video files decoded in the HbbTV browser of the end device. Functionalities such as fast forward or fast rewind are supported. The first phase of the pilot will feature non-customisable subtitles as a baseline (until March 2015), the second phase will result in functionalities for an end-user customisation of the subtitle representation (until August 2015).

Component Name / Version	Features included	Availability
Subtitle playback system	non-customisable subtitles for web	11/2014
Subtitle playback system	non-customisable subtitles for HbbTV	03/2015
Subtitle playback system	end-user customisation of the subtitles for HbbTV	08/2015
HbbTV2.0 Showcase	*Showcase based on HbbTV2.0 (planned)*	09/2015

2.2.5.2. Technologies and standards used

- EBU-TT
- HbbTV V1.2.1 (ETSI TS 102796)
- ECMAScript JavaScript implementation (ISO/IEC-16262)
- HTTP State Management Mechanism (RFC-6265)

2.2.5.3. Potential cross pilot usage

Low: The component will be specifically tailored and integrated in the standard ARD/RBB environment for their VoD services. A cross pilot usage within HBB4ALL seems not very likely.

2.2.6. Subtitling Format Conversion Framework (IRT)

2.2.6.1. Overview and expected timing

This component, developed by IRT, will be able to transcode subtitles having the EBU-STL format (EBU Tech 3264) into EBU-TT Part 1(EBU Tech 3350). Furthermore conversions from EBU-TT Part 1 to EBU-TT-D (EBU Tech 3380) will be provided. Additional output formats are planned (e.g. WebVTT).

Component Name / Version	Features included	Planned Availability
Closed Beta	Basic features that are needed for partner review	August 2014

2.2.6.2. Technologies and standards used

- Python
- XSLT
- XPROC

2.2.6.3. Potential cross pilot usage

The component could be used in other pilots that require web subtitling. In fact, potential usage has already been identified for the MOOC case-study in Pilot C.

2.2.7. 'IPTV subtitle publishing system' (TVC)

2.2.7.1. Overview and expected timing

Subtitle publishing system that exposes subtitles to IPTV systems, usually an HTML engine with some playback mechanism though more native components can be used mainly in mobile environments. Subtitles are published in a specific format (SRT, EBU-TT-D, etc.) and are made available to the playback mechanism and playback synchronisation system (typically Javascript) using the HTTP protocol. Included here as subtitle publishing interoperability between platforms is key for HBB4ALL as it does not make sense to replicate infrastructure components across platforms.
The system needs to be in place before start of pilot A in Spain and will use the EBU-TT-D format.

Component Name / Version	Features included	Planned Availability
Subtitle publishing system	Available and feature complete	Q4 2014

2.2.7.2. Technologies and standards used

- Apache Http Server Project from the Apache Foundation
- CentOS 6.x Linux system
- HTTP 1.1 transmission protocol (RFC 2616)

2.2.7.3. Potential cross pilot usage

High: subtitles need to be exposed using http to be accessed by HbbTV and any other platforms for interoperability. However, the actual infrastructure deployment itself will differ across pilots.

2.2.8. 'HbbTV device and version detection' (TVC)

2.2.8.1. Overview and expected timing

Using dynamic user agent detection, a JavaScript component to detect the device capabilities, specifically its HbbTV standard version to ensure any features used are compatible with the viewing device. The system needs to be in place before start of pilot A in Spain.

Component Name / Version	Features included	Planned Availability
Closed Beta	Internal testing	Q4 2014
Pilot-A ready version	Feature complete	Q1 2014

2.2.8.2. Technologies and standards used

- ECMAScript JavaScript implementation (ISO/IEC-16262)

2.2.8.3. Potential cross pilot usage

High: device detection is key for all the HbbTV applications in the different pilots.

2.2.9. Component 'EBU-TT HbbTV personalised subtitle playback'(TVC)

2.2.9.1. Overview and expected timing

Subtitle playback system on HbbTV devices using the EBU-TT-D format. Actual synchronisation depends on transport being used but the first implementation will use JavaScript time-based synching on Video on Demand MPEG-DASH content. JavaScript will also be exploited to allow for end-user personalisation and recovering end-user default settings using cookies. Non-personalised subtitles are just the default presented to viewers.
The first phase of the pilot will feature baseline non-customisable subtitles and the second phase will allow for personalised persistent subtitle settings.

Component Name / Version	Features included	Planned Availability
Closed Beta	EBU-TT-D format playback testing	Q4 2014
Pilot-A ready version	Non-customisable playback	Q1 2015

Pilot-A ready version	Customisable playback	Q2 2015

2.2.9.2. Technologies and standards used

- EBU-TT and EBU-TT-D
- ECMAScript JavaScript implementation (ISO/IEC-16262)
- HTTP State Management Mechanism (RFC-6265)

2.2.9.3. Potential cross pilot usage

High: subtitles need to be played in this pilot using the same EBU-TT standard so sharing potential is significant. Moreover, any interoperability with other devices can share work with this component (for instance, in the case of subtitle playback on desktop Web IPTV systems).

2.2.10. vSubtitle: Adaptive subtitle rendering (VSX)

2.2.10.1. Overview and expected timing

The vSubtitle component is a sub-component of vsonix' vPlayer. It handles the synchronisation, rendering and adaptation of subtitles. vSubtitle exists as integrated part of vPlayer (see 4.2.6) and communicates with it through suitable means such as API functions exposed by vPlayer and callbacks provided by vSubtitle. Periodic events and interval-based timers make sure that both vPlayer and vSubtitle stay synchronized in order to make sure that each subtitle is shown for the correct duration without time shifts between subtitles and media playback. Especially, events such as buffers underruns or stream switches (cf. adaptive bitrate streaming) that require vPlayer to interrupt media playback, need to be handled gracefully by the vSubtitle component by extending or delaying the display of subtitles accordingly.
The component will be realized in collaboration with UPM. A first release is planned at the beginning of 2015 for the first integrated version of the MOOC showcase provided by vsonix.

Component Name / Version	Features included	Planned Availability
vSubtitle "Adaptive Subtitle Renderer" 1.0	Basic subtitle adaptation and rendering features included	Mid 2015
vSubtitle "Adaptive Subtitle Renderer" 2.0	Advanced subtitle adaptation and rendering features included	End 2015

2.2.10.2. Technologies and standards used

- EBU-TT
- GUIDE Open Source Framework
- XHTML/CE-HTML (CEA-2014, ETSI HbbTV v1.5)
- CSS TV-Profile (W3C CR-20030514, ETSI HbbTV v1.5)
- ECMAScript JavaScript implementation (ISO/IEC-16262)

2.2.10.3. Potential cross pilot usage

High: The vSubtitle component will use the EBU-TT standard that is implemented by other Pilots in WP3 as well. The EBU-TT interpreter used by the component will be provided by UPM as part of their subtitle rendering component. The sharing potential is significant. The subtitle rendering component from vsonix will also be used in Pilot C as part of the online learning (MOOC) application. The adaptation of the subtitles will be based on user profiles/preferences, which are created and managed by the GUIDE based accessibility service (see 4.2.1) targeted in WP5. The user initialisation application (see 4.2.2) of the GUIDE framework will be extended to create the personalized rendering parameters for individual users.

2.3. Customisation and personalisation from a user perspective

As described above, Objective A-2 is about providing "HbbTV-based VoD services allowing users to add subtitles and also **to customise** them for large scale provision and testing. One subtask of Task 3.1 consequently covers "specifying customisation features".
In this early project phase two different customisation approaches for WP3 have been decided to be followed:

1. Customisation by means of the user selecting from various rendering options on offer in an HbbTV application. This approach has been introduced into the project by RBB and will be followed by RBB for its HbbTV-VoD subtitles. The corresponding knowledge is being provided to TVC and TXT for their HbbTV-Subtitle applications for VoD. There has been no decision yet, whether they will adopt RBB's approach.
2. Profile based customisation. This approach has been introduced by VSX into the project and will be applied by RTP and UPM in cooperation with VSX when RTP implements their Pilot **"**PC based subtitles for multiple channels".

On 1: The background is as follows: In the project DTV4ALL RBB tested DVB-subtitles in a comprehensive weekly trial from February 2009 until November 2009 with 50 hearing impaired and deaf testers. RBB wanted to find out what would be the optimum look-and-feel of these new type of subtitles from the user point of view. We tested five different fonts in at least three different sizes. "Small" was modelled on the teletext standard size, "medium" meant twice the size of this standard size and was equal to the teletext size currently used by RBB and the other ARD affiliates. "Large" was defined by offering the largest possible size so that all letters would actually fit on the screen. In five instances/test weeks "in between sizes" were tried out. Also, five different font types were tested five weeks each and each of these were tried out in at least three different sizes and in

combination with a vast number of subtitle background options, mainly variations of “box”, “band” or “outline” style. In the end the best variation chosen by the users was a solution that features a medium size Tiresias font in the output style of a normal box with a transparency factor of 60. This result became our recommendation for DVB-subtitle configuration and was officially adopted for the whole ARD by its “Production and Technology committee” as a result. However, in the focus group sessions with the users at the time it became quite clear that they wanted further options because there is not “the one user” but that there are individual demands in a heterogeneous group and also context-dependent needs. With the introduction of HbbTV addressing this user demand became a possibility and RBB created an HbbTV- application which allows for configuring and rendering the subtitles on the screen. The user can choose from a simple unified menu the different options. By using the arrow keys and the [OK] button on the remote the user can navigate through the menu and choose the different settings, which will be applied right away. The application is signalled along with the TV service bouquet of a broadcaster and available via an application launch bar. All settings are stored persistently so that they are available automatically when the user tunes into the bouquet / program. The settings or customisation parameters offered to the user were carefully selected based on our results from the described DTV4ALL test results for DVB-subtitles. The idea was to have a simple and straightforward application which is of help to the (often elderly) user without confusing him or her.

1. The subtitles can be placed on top or bottom of the screen.
2. There are four different font sizes available. (One additional small one as result of one of our three user tests of the application)
3. The background can be chosen from white font with black border, white font in black box as TV overlay and white font outside the TV picture, with a resized broadcast signal, the final option also a result of the user test.
4. An inline help can be turned on and off by pressing the button. The help dialog will remain at the same position and adjust its description according to the focused element.
5. There is a preview option for the user.

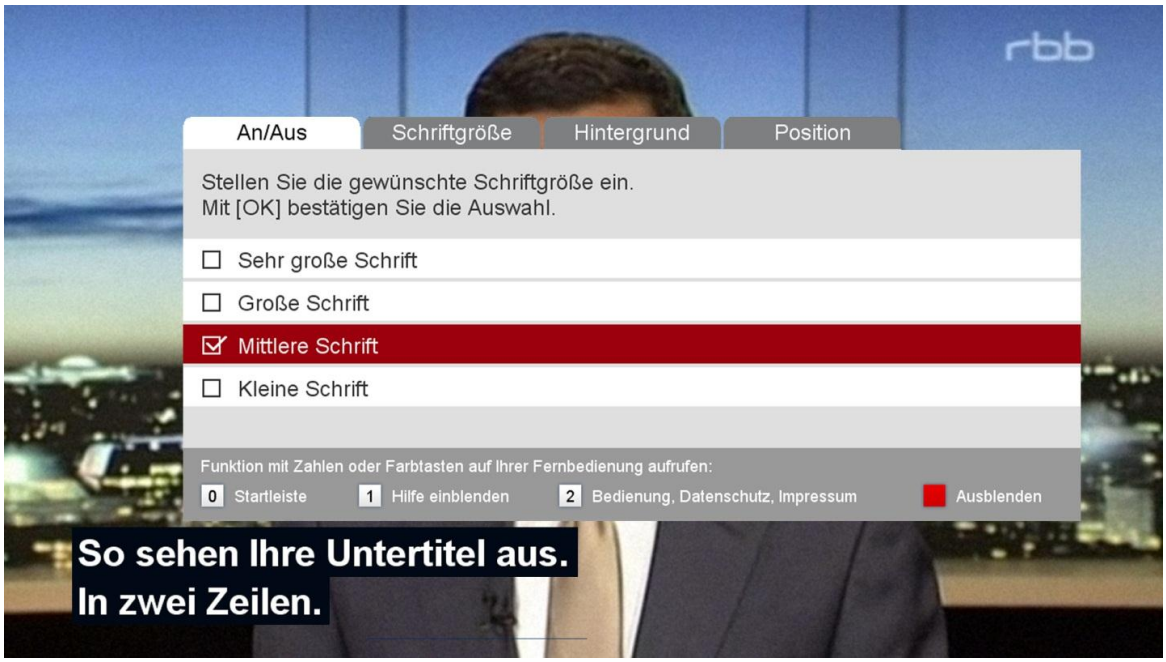

***Figure 1**. Options for subtitles – font sizes for selection*

The application as part of a use case of an IP/DVB-synchronisation demonstration application for HbbTV2.0 underwent three rounds of user testing in the project FP7-HBB-NEXT and, given the very positive general user feedback, also certain options were added and improvements were made to the app in accordance with the user test results as mentioned above. The application has been on air test-wise on RBB since 2012. The next step will now be to create an application for VoD subtitles based on this app for Live TV.

On 2: The subtitle component (vSubtitle) provided by vsx for PC and mobile applications is able to apply a defined set of adaptations to the given subtitles based on both the current user and the device in use. Adaptations are organized into profiles for user-device combinations. Profiles are established through the User Initialization Application (see chapter 4.2.2) by a series of user tests. vSubtitle accesses these profiles through the GUIDE API in order to retrieve adaptation information relevant to subtitle display. Parameters related to subtitle adaptation include minimal font size, font color, background color, opacity of the background (transparent, semi-transparent, opaque), and subtitle position (top, bottom).

3. Pilot B – "Alternative audio production and distribution"

3.1. General overview

The Pilot B activities aim at providing and evaluating additional audio services to allow improved access to TV content for various user groups (specifically the hard of hearing). The developments for Pilot B focus on the implementation of the relevant production-sided components for the creation of the appropriate audio signals. Both current production workflows and the realization of the required delivery towards the end user are taken into account. The latest evolutions in Internet technology and connected TV receivers allow additional audio tracks to be transmitted via IP, saving data in the broadcast channel by doing so. As far as achievable within the project, end users will be allowed access to the additional services via of-the-shelf HbbTV-capable receivers. Alternatively, applications will be made available for the evaluation on a PC (running e.g. in a web browser).

The following audio services are targeted within Pilot B:

- "Clean Audio" (CA) service, aiming at enhancing the dialogue intelligibility of TV programs, which is a key criterion for the hard of hearing. For various reasons, the intelligibility of current audio mixes in TV programs is often assessed as insufficient by many people[1] including elderly, non-native speakers as well as hearing-impaired people. The CA service will allow an end user to adjust the dialogue intelligibility to his personal preference (at least to a certain extent).
- Audio Description (AD, providing a description of the action mixed with the dialogue) and spoken subtitles, automatically generated from text to speech synthesis. This allows vision-handicapped users to better follow the action and storyline in a more effective way than by hearing only the dialogue.
- Additional audio channels for multi-language transmission (e.g. for non-native speakers) which also assist in language learning.

It should be noted that the three services can potentially be mixed for an improved effect, for instance, AD could be further enhanced by CA for better intelligibility of the AD track itself. Also CA could potentially be used in language learning for non-native speakers to enhance the track in the viewer's non-native language.

Two large-scale pilots are being planned: a personalized CA service (in Germany and Catalonia) and multiple audio services (in Catalonia). Furthermore, lab tests and small-scale trials will be carried out to gather requirements and additional feedback regarding technical feasibility, e.g.:

- Evaluation of potential algorithms for the generation of CA (by audio engineers and experts).
- Verification of a (limited) number of parameter combinations for the CA service (by friendly users).

[1] Menneer, Peter - Voice of the Listener & Viewer: VLV Audibility of Speech on Television Project - Research Summary, 2011

- Evaluation of potential AD generation methods (e.g. AD generation from text-to-speech by means of human voice compared with synthetic voices or AD generation by spoken subtitles).
- Multiple audio support in MPEG-DASH and HbbTV, evaluating the support of these technologies to advanced audio features.

3.2. Technologies and standards used for the planned implementation of the Pilot

To achieve the goals described above, the WP4 partners will implement and / or enhance appropriate components. For CA and AD algorithms and tools will be evaluated and developed for deployment in the respective large-scale pilot.

For the generation of a CA signal solutions will be developed and tested by audio engineers at IRT, working on different ways of audio processing with the aim of improving speech intelligibility and considering options to allow adjustability of the service parameters to an extent which is useful and manageable by the end user.

For AD and spoken subtitles both the automatic text-to-speech system and the recorded AD systems will be evaluated, especially in the context of IPTV in general and HbbTV in particular. The text-to-speech system at TVC has been internally developed by TVC and its partners and is able to produce speech in the Catalan language which is a strict requirement for TVC's broadcasting. The system will be further tested by UAB to identify additional specific parameters such as the gender of the AD itself or the suitability of synthetic voices for AD.

Different language transmission is a prime example of delivering multiple audio tracks to viewers. It can leverage many of the technologies used in the pilot to aid in language learning which is an important requirement as Spain is mainly a dubbing country. TVC plans to use broadcast content that has multiple language soundtracks (mainly in English) and – rights permitting – deliver them using HbbTV over IP in a seamless manner. Complementary tests will be done by UAB such as testing the impact of CA on language learning.

For all services (CA, AD as well as multi-language transmission) specific technical solutions for the delivery of audio streams via IP towards HbbTV- as well as PC-based receivers will be evaluated. Moreover, appropriate HbbTV-components to select (and personalise where appropriate) will be developed to make the services available to users and allow them to select languages, AD options, etc.

3.2.1. Clean Audio

For the realization of a CA signal, the HBB4ALL partners have identified three possibilities:

1. Implementation on a client, in which case the receiver should be provided with separate audio streams (most likely via IP) for "speech" (containing the dialogue) and "atmo" (containing the remaining audio signals, including music, sound effects etc.). These separate streams would then be mixed in the receiver to generate the CA signal based on the user's personal preference and adjustments.

2. A pre-generated CA signal could be provided as an additional audio stream, either via IP or DVB. This solution would not offer any personalization capabilities as it would simply replace the regular DVB audio stream.
3. Render a speech enhanced signal on a server (allowing computational intensive processing). This rendering could (at least to a certain extent) be personalized on demand for an end user via IP, to allow potential adaptations in real-time based on user interaction via the back channel.

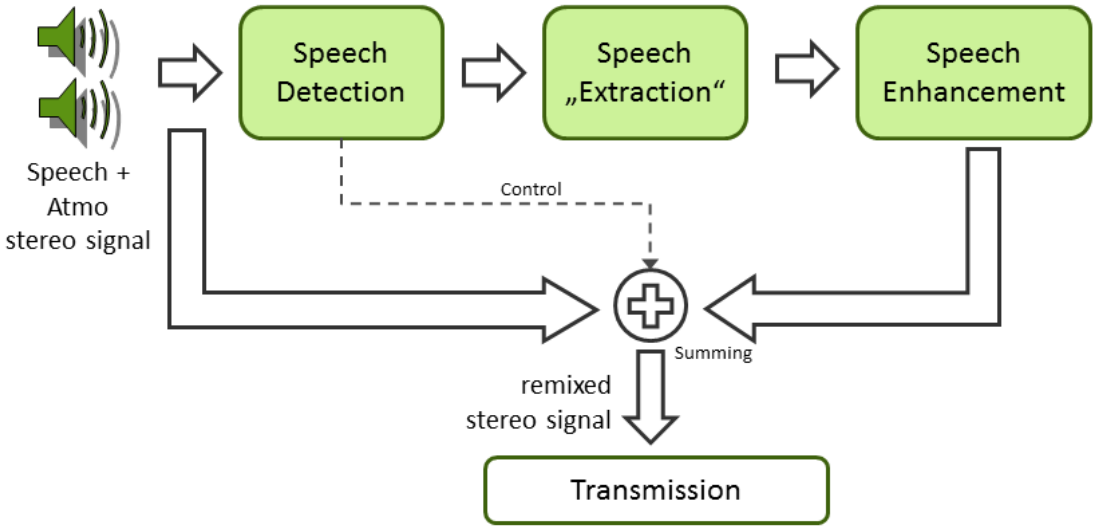

***Figure 2**. Schematic overview Clean Audio solution (server side)*

IRT implements the CA service and currently focuses on a server-sided software-based solution which is schematically depicted in **¡Error! No se encuentra el origen de la referencia.**. For a client-sided solution, multiple (at least two) audio decoders would be required in the TV-receiver. However, since (most likely) only a single audio decoder will be mandatory in HbbTV 2.0, a large-scale pilot with a client-sided mixing of audio signals, based on an HbbTV installed base, is unrealistic at this point in time. Labtests or small-scale trials may be possible with a specific brand or prototype HbbTV receivers; the extent to which this can be realised is to be decided. Alternatively, labtests with a PC-based client-sided solution may be appropriate.

3.2.1.1. Overview and expected timing

CA generation

As can be seen in **¡Error! No se encuentra el origen de la referencia.**, it is currently foreseen to feed the CA implementation with a stereo mix signal at its input. As the “speech” and “atmo” audio tracks are not always available from the audio production workflow (mainly due to cost issues), the foreseen solution for the CA generation should not rely on this. In case the separate “speech” and “atmo” audio tracks are available separately from the production workflow, the steps performing

Speech Detection and Speech Extraction in **¡Error! No se encuentra el origen de la referencia.** can be skipped. The output of the CA implementation should also be a stereo mix signal.
From the stereo signal, the speech part needs to be extracted for those timeslots where speech is detected (Speech Detection module). This is done by the Speech Extraction module, by means of signal processing. The Speech Enhancement module is optional: even without this step, combining the extracted speech with the original signal is expected to result in better speech intelligibility. The Speech Enhancement would add additional signal processing, which may make the speech even stand out more with respect to the remainder of the audio signal.

Before Transmission, the (enhanced) speech signal is combined with the original stereo signal again (or alternatively, with the "atmo" part of the original signal, in case this would be separately extracted – this is not shown in **¡Error! No se encuentra el origen de la referencia.**); it must be made sure that this is done in a way which preserves the enhanced intelligibility of the speech and prevents audio distortions at the same time.

All CA generation modules in **¡Error! No se encuentra el origen de la referencia.** will be realized by means of dedicated software components implemented and/or tested by IRT audio engineers. Currently, the following potential solutions are taken into consideration:

- Speech Extraction:
    - Upmix: a state of the art method to generate e.g. a 5.1 channel audio signal from a stereo signal. The "center" channel in this Upmix ideally constitutes the speech / dialogue. IRT has own software readily available that can carry out this task. This software will be tested and if required adapted for the HBB4ALL purposes. It is also planned to test other upmix algorithms and/or algorithms that can isolate the central components of the incoming signal, to verify if one of them could produce a better center signal.
    - Downmix: in a simulcast situation (at least in European broadcasts), stereo as well as 5.1 surround signals are broadcasted simultaneously. Normally, the 5.1 produced signal should contain most or rather all of the dialogue in the center signal. Obviously, the speech could then be easily separated. Applying a downmix algorithm to the remaining channels (L, R, Ls, Rs, LFE) would result in a stereo version of the audio signal without the dialogue. These separated signals could then (after the speech enhancement) be mixed again with a personalized ratio.
- Speech Enhancement:
    - Adaption of the dynamic: IRT has software available that is able to apply both a compression and an expansion of the audio signal. Depending on the dynamic (ratio of the loudest and the softest part) of the speech signal, it might be helpful to either apply a compression if the dynamic is too high or to apply an expansion if the dynamic is too low. Considering usual TV audio signals, the expansion might be more important as the audio signals are quite often strongly compressed.
    - Filtering: using a filter to weigh the relevant frequency parts of a speech signal could be helpful for the target group. It has to be tested which kind of filter with which weighing factors are the most reasonable for hearing impaired people.

- Speech Detection:
  - Dolby Dialogue Intelligence: this algorithm (which is available in the form of a software API (Application Programming Interface)) can be applied to detect whether there is speech within the audio signal or not.
  - Several other potential algorithms are available as open-source library or software modules that could be applied. It is planned to test which of them is the most suitable for the CA pilot.
- Summing: IRT has software readily available to perform "Audio Summing", which is able to minimize the number of potential artefacts.

Transmission

For transmission of the audio signal over IP, HTTP streaming will probably be used. To allow a certain amount of adaptation for an end user's preferences, even with a server-sided created signal, it is foreseen to use an adaptive streaming format; MPEG-DASH is the most likely candidate for this (see section 6.1). It is foreseen that the CA implementation generates a limited amount (e.g. 4 – 5) of differently parameterized CA signals, which are combined into a single adaptive audio stream which is provided to the receiver by means of MPEG-DASH. By doing so, a small set of different "CA profiles" will be available from which the end user can choose. Obviously, in preparation of the large-scale pilots, meaningful "CA-profiles" will need to be evaluated.

Expected Timing

Component Name / Version	Features included	Planned Availability
CA generator / lab implementation	CA generator in semi automatically operating lab version	31/07/2014
CA generator / first draft implementation	Automatically operating Speech Extraction and Speech Enhancement module	30/11/2014
CA generator / second draft implementation	Improved Speech Extraction and Speech Enhancement; Speech Detection added	28/02/2015

The draft implementations of the "Speech Enhancement" and "Speech Detection" modules are currently in planning.

3.2.1.2. Technologies and standards used

For the realisation of the components, the following potential technologies, tools and standards are taken into consideration:

- "Center Cut" algorithm
- Upmix software – any commercially available product e.g. SoundField X-1
- Downmix software ("IRT Downmix" – commercially available Downmix implementation)
- Dynamic audio compression / dynamic audio expansion software modules (IRT implementation)
- Software modules for additional audio signal filtering – to be defined
- Dolby Dialogue Intelligence
- Further (Open source) software modules for Speech Detection – to be defined
- IRT "Audio Summing" implementation
- Rec. ITU-R BS.775-3: Multichannel stereophonic sound system with and without accompanying picture, 08/2012
- ISO/IEC 23009-1:2012 - Information technology -- Dynamic adaptive streaming over HTTP (DASH) -- Part 1: Media presentation description and segment formats
- MPEG-DASH Profile for Transport of ISO BMFF Based DVB Services over IP Based Networks

3.2.1.3. Potential cross pilot usage

Potentially, the CA generation software modules could be used to feed other applications as well. In case subtitles or sign language would be automatically generated from speech / dialogue, and depending on the quality of the extracted speech, the output of the Speech Extraction software module could possibly be used for that. However, this is currently not in the scope of the project.

The usage of MPEG-DASH for adaptive streaming will most likely be pursued by Pilot A, Pilot B and also Pilot D. It seems appropriate to share know-how and developments on MPEG-DASH amongst all pilots (see also section 6.1).

3.2.2. "Text-to-Speech Generation in Catalan language" (TVC)

3.2.2.1. Overview and expected timing

TVC will further evaluate its text-to-speech system to generate AD using spoken subtitles to deliver them over IP on HbbTV. Generation will be fine-tuned according to any relevant tests results from UAB, (e.g. allowing the gender of the synthetic speaker to be selected). The suitable video assets will be generated in MPEG-4 format for inclusion as option to be played by HbbTV devices though cross-device interoperability will be also evaluated as there is a lot of reutilisation potential on different platforms.

Component Name / Version	Features included	Planned Availability

Pilot-B testing	Catalan text-to-speech in Catalan from subtitles	Q4 2014
Pilot-B ready version	IPTV asset generation	Q1 2015

3.2.2.2. *Technologies and standards used*

- Internal TVC implementation using proprietary technologies
- CentOS 6.x Linux system as backend deployment platform

3.2.2.3. *Potential cross pilot usage*

Low: The component only generates speech in the Catalan language and is tightly integrated in the TVC broadcast and IP delivery chain.

3.2.3. *"Multiple audio asset generation" (TVC)*

3.2.3.1. *Overview and expected timing*

TVC will develop and integrate in its existing IPTV delivery workflow a system to generate assets having multiple audios. Interoperability with the production and delivery chain is key so the content is appropriately tagged and relevant metadata is included (i.e., content in English of a particular programme is tagged as just a version of that programme in a different language and not as a separate entity which would be incorrect). Content will be transcoded to MPEG-4 ISO file format and encoded using H.264 and AAC. The system will take into account that content will need to be sent in MPEG-DASH encapsulation format for better interoperability with HbbTV (though results can potentially be reused for other platforms).

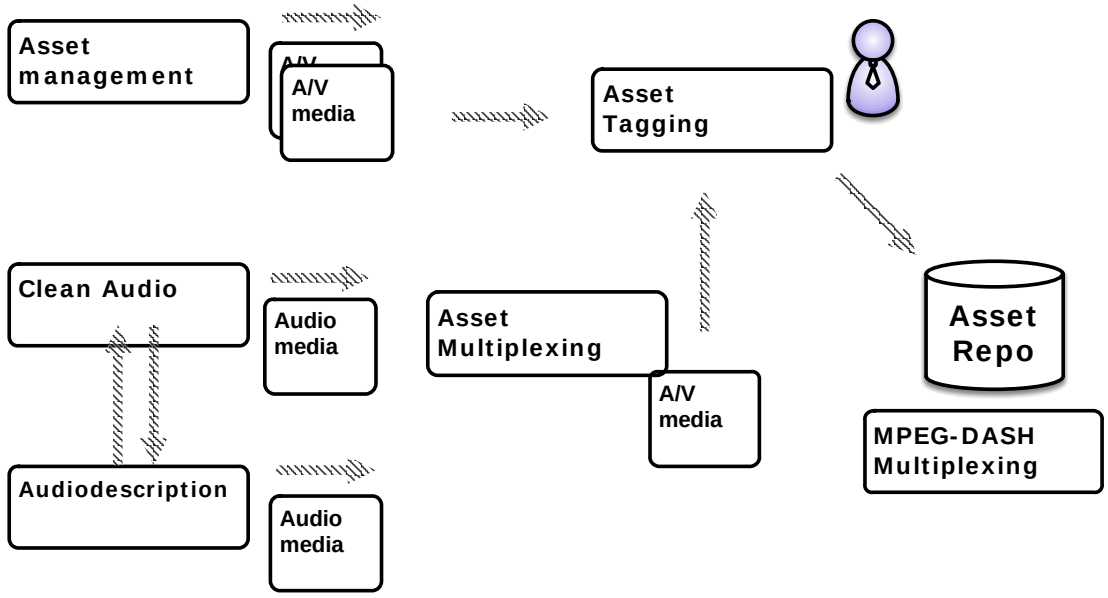

Figure 3. Simplified overview of the audio workflow (server side)

Component Name / Version	Features included	Planned Availability
Pilot-B testing	Generation of the appropriate assets and files	Q1 2015
Pilot-B ready version	First version	Q2 2015

3.2.3.2. Technologies and standards used

- MPEG-4 part 1 (ISO/IEC 14496-1)
- MPEG-4 part 12 (ISO/IEC 14496-12)
- MPEG-4 part 14 (ISO/IEC 14496-14)
- MPEG-4 part 15 (ISO/IEC 14496-15)
- MPEG-4 part 3 (ISO/IEC 14496-3)

3.2.3.3. Potential cross pilot usage

Low: The component is tightly integrated with TVCs delivery chain and is completely dependent on its metadata structure.

3.2.4. "HbbTV audio options selector for TV3Alacarta" (TVC)

3.2.4.1. Overview and expected timing

TVC will develop a selector for the different audio options available during the pilots (such as multiple languages, Audio Description, etc.) that will enable users to access the pilot's functionality. The final version will depend on the specific options ultimately developed (such as the level of CA functionality exposed), therefore it is expected that the selector will need to evolve somewhat during the course of Pilot B. In this case the functionality could be enabled to run onHbbTV 1.5 and 2.x devices even due to using MPEG-DASH. However, if content is also made available using plain HTTP download on separate MPEG-4 files, some of the functionality would also be exposed to HbbTV 1.1 devices. The implementation will use Javascript to expose required functionality which will be further described in deliverable D4.2.

Component Name / Version	Features included	Planned Availability
Pilot-B testing	Beta of audio selector	Q4 2014

Pilot-B ready version	Finalised audio selector	Q1 2015

3.2.4.2. Technologies and standards used

- ECMAScript JavaScript implementation (ISO/IEC-16262)

3.2.4.3. Potential cross pilot usage

Low: The component integrates with the existing HbbTV VoD service TV3Alacarta by TVC.

3.3. Customisation and personalisation from a user perspective

For Clean Audio it is currently foreseen to offer a limited set of "CA profiles" to the end user, from which he can select the one that best suits his requirements. The selection of this setting should be offered in a clear and transparent way via an appropriate user interface (ideally an integrated part of the respective HBB4ALL HbbTV application) and could also be part of an end user's overall personalisation profile. The user profile based personalisation approach can be realised using the GUIDE Framework and its user profiling service (see 4.2.1).

4. Pilot C – "AUTOMATIC UI ADAPTATION"

4.1. General overview

The general strategy for Pilot-C is the realization of an UI adaptation service that will allow the provision of personalized accessibility features for HBBTV and web based video on demand services. The online service will be based on the UI adaptation framework that was developed in the EU project GUIDE "Gentle UIs for elderly people" by vsonix together with other partners and which is now further maintained as an open source project. The Software as a Service (SaaS) platform provided by Vsonix will include APIs and functions for user management, profiling as well as the necessary mechanisms for UI adaptation. The adaptation parameters provided by the service will include e.g. font size, type and color, optimized color schemes for people with different kinds of visual impairments, as well as screen reader functionality. To determine the adaptation parameters the SaaS platform of Vsonix will include a user initialisation application.

The online accessibility service will be integrated in two different Pilots realized by Vsonix and SCREEN in collaboration with UAB, IRT and PPG that will include personalized accessibility features for users in Germany, Spain and the UK. Based on content of UAB, vsonix works on an online video based learning application ("MOOC"), which is planned to be provided as a webcast service for Spain as well as for Germany. In Germany, vsonix will work in collaboration with a German Technical University to provide the necessary lecture video content. The MOOC showcase will act as a cross-pilot showcase addressing Pilot-C and Pilot-A, where the GUIDE based online accessibility service will be used for personalized subtitle rendering. Beside the web based video learning application, Vsonix will work on an HBBTV version in collaboration with PPG based on their TVAppBox Framework (see 4.2.6) and IRT. Beside the online learning application provided by Vsonix, SCREEN will integrate the accessibility features within a prototypical media on demand service based on their HBBTV publishing system. The refined technical objectives of Pilot C could be summarized as:

- The realisation of an online accessibility service based on the GUIDE framework providing functions for user management and profiling as well as a web based API (javascript)
- Extension of the GUIDE user profiles to support additional parameters for UI adaptation that are addressed by the HBB4all services such as the screen reader functions, audio feedback as well as personalized subtitle parameters as required in Pilot-A
- The provision of a user initialisation application by vsonix to determine the necessary adaptation/personalisation parameters for the user / device based profiles (based on GUIDE User initialisation application).
- The realisation of a MOOC application as webcast service for PC based and mobile platforms targeting Spain (using content from UAB) and Germany (using content from the technical university of Darmstadt
- The realisation of a media on demand service by Screen using the UI adaptation framework for the provision of personalized accessibility features

4.2. Technologies and standards used for the planned implementation of the Pilot

In the following we will describe the different technologies and standards used for the realisation of the prototypes used for the pilots and its related components and services. This includes the GUIDE based adaptation service including the GUIDE API, the user initialisation application to create the user profiles, the online text to speech service as well as services for user management and access. Those services will be integrated by the MOOC application that is realized based on existing software developed by vsonix. An HBBTV version of the MOOC application will be realized using the TVAppBox SDK provided by PPG. SCREEN will use the features of the GUIDE service within their HBBTV publishing system for a demo application.

Vsonix has already started the technical work including the identification of relevant parts of GUIDE as well as the migration of parts of the existing UI adaptation framework to become an online based service. A first version of the online service API is planned to be ready in August 2014. From the beginning of the second year a first version of the online accessibility service will be ready to be used by Vsonix and SCREEN within their applications. The aim is to use a first version of the MOOC application as a basis for additional user trials conducted by Vsonix in collaboration with UAB. Further testing and integration work will be performed before small scale Pilots of the online learning as well as media on demand applications will be deployed at the end of the second year. In collaboration with PPG and IRT, Vsonix is planning to deploy a HBBTV 1.5 based version of the MOOC service in Germany until the end of the project.

4.2.1. GUIDE based UI adaptation service (VSX)

4.2.1.1. Overview and expected timing

The GUIDE based adaptation service will provide the necessary functions that application developers need to adapt their UI to the requirements of an individual user. The adaptation will be based on user profiles that are derived based on the user initialisation application described in 4.2.2 Application developers can access the GUIDE API through a JavaScript function call which will be provided and can easily be included in any website by adding a short code snipped in the <head>-section of the HTML code. As soon as the code snippet has been included in the HTML code, API call can be made and recommended adaptation values specifically established for the current user on the current device may be retrieved by issuing several API function calls.

The application developer may query the GUIDE API for recommendations for specific aspects of the UI by using the appropriate function call:

```
GUIDE.getUIRequirement("MinimumFontSize");
```

This function call returns the value of the "MinimumFontSize" adaptation that has been previously defined for the current user on the current device using the User Initialization Application.
Certain GUIDE API functions exist which allow application developers to obtain meta-information about the adaptation information which can be queried. This allows users to use the API more effectively and make a priori assumptions about the data obtained by API function calls. One example for meta-information is the following function call:

GUIDE.getUIRequirementType("MinimumFontSize");

This function call returns information about the data type of the value that will be returned by GUIDE.getUIRequirementType for the "MinimumFontSize" adaptation value. Table 1 lists all supported adaptation parameters of the GUIDE API.

Component Name / Version	Features included	Planned availability
GUIDE based UI adaptation service 1.0	Online user profile service with basic adaptation functionality, API definition	Beginning 2015
GUIDE based UI adaptation service 2.0	Online user profile service with all adaptation functionality including subtitle adaptation	Mid 2015

Table 1. Available Adaptation Parameters of the GUIDE API

Adaptation Constant	Value
MinimumFontsize	<Integer>
Smallest font size which the user is capable of reading. The value returned by this function is to be interpreted in Pixels.	
ColourScheme	"Normal", "BlackWhite", "YellowBlue", "BlueYellow"
Combination of colors which is best suited for the user to operate the UI.	
Language	"English", "German", "Spanish"
Native Language of the user.	
SubtitlePosition	"top", "bottom"
User's preference regarding subtitle position. "top" refers to the top of the screen, while "bottom" references the bottom of the screen.	
SubtitleBackground	"transparent", "semi", "opaque"
Specifies how subtitles should be rendered. "none" specifies that subtitles should not have any background and may be rendered directly on top of the video. "semi" specifies that subtitles should be rendered on top of a semi-opaque background (transparency set to 50%), and "opaque" specifies a background without any transparency.	
SpeechSpeed	"slow", "normal", "fast"
Specifies the maximum speed of spoken word which the user is able to follow. The TTS system will adapt to this setting.	
SpeechGender	"male", "female"
Specifies the gender of the speaker that the user prefers for spoken word.	
SpeechVolume	<Integer> [0 – 100]
Specifies the volume of the speaker for the TTS system.	

4.2.1.2. Technologies and standards used

- GUIDE Open Source Framework
- Apache Tomcat 6 Java Servlets
- Java 7
- Apache Shiro

- Hibernate Persistence Framework
- Java Persistence API (JPA)
- HTTP 1.1 Transfer Protocol (RFC 2616)
- HTTP State Management Mechanism (RFC-6265)
- XmlHttpRequest (W3C WD-2007027)
- JSON Data Interchange Format (ECMA 404)
- ECMAScript JavaScript implementation (ISO/IEC-16262)

4.2.1.3. Potential cross-pilot usage

High; The GUIDE accessibility service including the javascript API and its user profile creation, and management functions has the potential to be used by all the Pilots in the project as a basis for personalized accessibility services. In WP3 vsonix will use the service for the provision of personalized subtitles also in the context of the MOOC application. In principal the service could be extended to support the adaptation and personalisation parameters of other pilots as well including those of WP4 and WP6.

4.2.2. User Initialization Application (VSX)

4.2.2.1. Overview and expected timing

Adaptations values are stored in per-user-per-device profiles. For each combination of user and device a profile needs to be established before adaptations can be accessed through the API. This process is subject of the User Initialization Application, which through a series of tests and questionnaires classifies the user's needs and preferences for adaptations. One sample test is the colour blindness test depicted in Figure 4. Answering this test enables GUIDE to return adaptation values that recommend to application developers to adapt colours in their UI. The user initialisation application can be extended to include all the necessary tests needed by the different accessibility services including preferences for subtitle size, position and speed. After the profile has been established it is stored securely in a database and may be accessed through the API function calls.

Component Name / Version	Features included	Planned availability
User Initialization Application 1.0	1st version including tests for UI adaptation and personalized subtitling	Mid 2015
User Initialization Application 2.0	Advanced version providing templates that could be used by other modalities	End of 2015

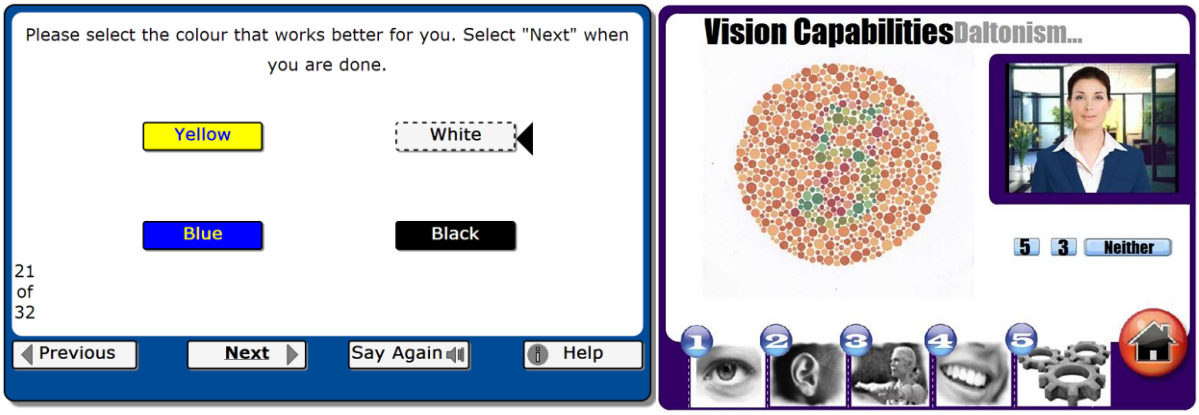

Figure 4. *Sample Tests of the User Initialization Application*

4.2.2.2. Technologies and standards used

- HTTP 1.1 Transfer Protocol (RFC 2616)
- HTTP State Management Mechanism (RFC-6265)
- XmlHttpRequest (W3C WD-2007027)
- ECMAScript JavaScript implementation (ISO/IEC-16262)
- XHTML/CE-HTML (CEA-2014, ETSI HbbTV v1.5)
- CSS TV-Profile (W3C CR-20030514, ETSI HbbTV v1.5)
- GUIDE user initialisation application

4.2.2.3. Potential cross-pilot usage

High: The user initialization application can be used by all pilots using the GUIDE accessibility service to provide personalized UIs based on user profiles. It can be extended to include the necessary tests needed to derive the adaptation parameters of other services, such as the personalized subtitle service provided by vsonix in WP3. Whereas this extension is already planned, the application also has the potential to support the services of other pilots as the audio rendering service in WP4 as well as the sign language service in WP6.

4.2.3. User management (VSX)

4.2.3.1. Overview and expected timing

Adaptations stored in profiles are specific to a combination of user and device. Consequently, a single user may have several adaption profiles, each of which is valid for one device only. Device-based distinction is necessary because users may have different adaptation requirements based on the capabilities of each device they operate. An example may make this point more clear: TVs are typically operated at a much higher distance than tablet devices, so that the smallest readable font size may differ for the user based on the device they are currently using. Users are required to authenticate against GUIDE so that the framework knows which adaptation recommendations to return through its API. Different ways of authentication exist depending on the concrete use case of

the application and device. In a shared multi-user environment our API provides typical username/password-based access control which is established at the end of the user profile generation process, while in other contexts a token-based authentication is possible, which requires the user to enter a well-defined token only. The user management function will be released in accordance with the GUIDE UI adaptation service (see 4.2.1).

4.2.3.2. Technologies and standards used

- Apache Tomcat 6 Java Servlets
- Java 7
- Apache Shiro
- Hibernate Persistence Framework
- Java Persistence API (JPA)
- HTTP 1.1 Transfer Protocol (RFC 2616)
- HTTP State Management Mechanism (RFC-6265)
- JSON Data Interchange Format (ECMA 404)

4.2.3.3. Potential cross-pilot usage

As part of the GUIDE based adaptation service, the component has the potential to be used by all pilots.

4.2.4. Text-to-Speech Rendering Service (VSX)

4.2.4.1. Overview and expected timing

Targeted primarily towards visually impaired users, we will provide application developers with a flexible text-to-speech-service. When instructed with a given text snippet, GUIDE will render the text according to the current user's audible preferences stored in their user profile (voice gender, speed, volume) and return a URI to the application developer. The URI will point towards a temporary file which features the rendered output in an HTML-compatible audio file format such as PCM WAVE, MP3 or Ogg Vorbis for HTML5. The URI may then be used in the application by e.g. hotlinking or playing it using html controls or native interfaces.

Component Name / Version	Features included	Planned availability
Text-to-Speech Rendering Service 1.0	Server sided text to speech rendering service with basic functionality	Mid 2015
Text-to-Speech Rendering Service 2.0	Server sided text to speech rendering service with basic functionality	End 2015

4.2.4.2. Technologies and standards used

- Apache Tomcat 6 Java Servlets
- Java 7
- Apache Hadoop Framework for distribution
- Nuance Loquendo API
- Java Native Interface API (JNI)
- HTTP 1.1 Transfer Protocol (RFC 2616)
- JSON Data Interchange Format (ECMA 404)

4.2.4.3. Potential cross-pilot usage

As part of the GUIDE based adaptation service, the component has the potential to be used by all pilots.

4.2.5. MOOC Service (VSX)

4.2.5.1. Overview and expected timing

The MOOC service will be realized as an integrated service for PC based and mobile platforms. It will be integrated based on components provided by vsonix. This will include vPlayer, a rich media player for presentation content playback on PC and mobile platforms as well as vManager, a content management system for webcast content. In the following we will describe the two components.

vPlayer

vPlayer is a rich media player based on web standards that can be seamlessly integrated into a client's web page. By offering both an Adobe Flash based as well as an HTML5 based version it enjoys a wide compatibility and acceptance across all desktop operating systems, including Windows, Linux and MacOS X and mobile platforms (iOS, Android, Windows Phone).
One of the key features of the webcast player is the synchronized playback different media channels including video, slide and text (subtitle) content, which is combined with various intuitive search and navigation features: in particular, end-users can choose between navigation via video timeline, via slides (based on titles and thumbnails) or via a full-text search field. When interactively working through presentation content, these utilities complement each other.
vPlayer is designed to be easily integrated into existing or newly authored web content and design elements can be readily adapted to the corporate-design requirements. Furthermore it is possible to add custom functionality such as integration in site-wide search indices or manual addition of keywords by experts using quality-assuring workflow. In the context of the MOOC service provided by vsonix, the vPlayer is the essential component for the playback of the online learning content. In collaboration with PPG vsonix plans to realize a HBBTV version of the player with a limited set of features. This should be available at the end of 2015.

vManager

vManager is an integrated solution for editing, managing and analyzing webcast content. It serves as an authoring and post-production tool for video content and includes functions for automatic

video annotation, basic video and audio editing functionality, annotation of video with additional information as slides, text, video and images as well as webcast rendering to different platforms. Additionally, state-of-the-art video analysis tools provide an automatic indexing of presentation slides to achieve chapter navigation using our vPlayer. Since it is accessible via a web front-end, it is platform independent supporting all major desktop and mobile platforms.

Component Name / Version	Features included	Planned availability
vPlayer / vManager	Content Management/Playback System for Lecture Recording / Webcast Content on PC and Mobile Platforms	Today
vPlayer HBBTV 1.5 Version	Migrated HBBTV Version with limited feature set in collaboration with PPG	End of 2015

4.2.5.2. Technologies and standards used

- Apache Tomcat 6 Java Servlets
- Java 7
- Apache Shiro
- Hibernate Persistence Framework
- Java Persistence API (JPA)
- HTTP 1.1 Transfer Protocol (RFC 2616)
- HTTP State Management Mechanism (RFC-6265)
- JSON Data Interchange Format (ECMA 404)

4.2.5.3. Potential cross-pilot usage

The MOOC is realized as a cross-pilot showcase that is addressing Pilot C for the personalized user interface part as well as Pilot A for the personalized subtitle rendering part. In this sense the components listed will also be used in Pilot A.

4.2.6. TVAPPBOX-ConnectedTV and HbbTV application framework (PPG)

4.2.6.1. Overview and expected timing

The TVAPPBOX is an application development framework specifically developed for HbbTV and ConnectedTV devices. It fully conforms to the ETSI HbbTV standards v1.0 through v1.5 and is compatible with all major HTML, CE-HTML, HTML5 platforms.
It abstracts the application development process from underlying device specific implementations that exist in the market today.

Component Name / Version	Features included	Availability
TVAppBox	HBBTV application development toolbox	Today

4.2.6.2. Technologies and standards used

- HTTP 1.1 transmission protocol (RFC 2616)
- XHTML/CE-HTML (conform ETSI HbbTV v1.5)
- Javascript (conform ETSI HbbTV v1.5)

4.2.6.3. Potential cross pilot usage

High: Potentially all HbbTV application development efforts benefit from a framework:

- Reducing development time / time to market
- Reducing costs
- Wide array of devices supported

4.2.7. HbbTV Interactive Application publishing system(SCREEN)

4.2.7.1. Overview and expected timing

Interactive application publishing system that is usable on HbbTV systems using an HTML engine. Applications are designed within Plasma Gold which publishes them as HTML and Javascript and are made available to the HbbTV system using either the HTTP protocol or DSM-CC in a DVB transport stream.

Component Name / Version	Features included	Availability
Plasma Gold Hbb4All publisher v0.1	Proof of concept GUIDE profile integration	February 2015
Plasma Gold Hbb4All publisher v1.0	Font size and colour adaptation from GUIDE profile settings	August 2015

4.2.7.2. Technologies and standards used

- Microsoft Windows Server
- Plasma Gold from Screen Subtitling Systems Ltd.
- HbbTV specification 1.2.1 (TS 102 796)

- DVB-DATA specification (ETSI EN 301 192)
- HTTP 1.1 transmission protocol (RFC 2616)

4.2.7.3. Potential cross pilot usage

The HbbTV interactive application publishing system by SCREEN will only be used in Pilot C.

4.3. Customisation and personalisation from a user perspective

Pilot C addresses UI personalisation and adaptation from a user perspective based on user profiles. Those aspects will be analysed by the user trials planned in the project. The aim of the trials will be to test the different features of the UI adaptation framework from accessibility as well as from usability aspects. This includes different standard parameters for the UI adaptation part including font types or colour schemes, advanced parameters such as different types of audio feedback, e.g. while browsing through the content, screen reader parameters such as voice type, speed of speech output, latency aspects, e.g. between user interaction and speech output. It will also include testing of advanced functions of the MOOC application such as a slide magnifier function including aspects of function accessibility and usage as well as aspects of second screen (smartphone and tablet) content rendering and interaction. Regarding the personalized subtitling features of the MOOC application, aspects such as subtitle position, font types, colour and sizes, types of background, as well as synchronized second screen rendering will be tested.

An essential part of the personalisation framework is the user profiling application that will be used to determine the customisation parameters for the individual users. This application needs to be designed in a “one fits all” manner, with very low accessibility barriers for the whole target group as it will be used as an initial step to determine the individual user needs.

5. Pilot D – "SIGN LANGUAGE TRANSLATION SERVICES"

5.1. General overview

The main objective of Pilot D is the deployment of sign language services based on HbbTV, web technologies and the use of the broadband network. Four specific objectives can be distinguished:

Objective D-1 A prototype version of a complete sign language interpretation production workflow chain for broadcasters which enables a variety of implementations for the sign language service based on HbbTV1.0/1.5, HbbTV2.0, web/IP, etc.

Objective D-2 HbbTV and/ or IPTV-based sign language services allowing users to customise the size and positioning of sign language interpretation in an overlaid window for large-scale provisioning and testing in Portugal and in Germany (Berlin-Brandenburg).

Objective D-3 An avatar signing service in Spanish provided by Vicomtech allowing users to access Text-to-Signing for content with a well-defined semantic framework such as weather forecasts.

Objective D-4 Additional user experience testing of various end user-related aspects of sign language interpretation.

Three sub-pilots are being considered:

1. Sign language interpreter all-in-one solution, without customisation (open service) (Berlin-Brandenburg trial)
2. Sign language interpreter customisable, potentially based on HbbTV 2.0 and new hardware capabilities (Berlin-Brandenburg trial)
3. Sign language service for broadband devices (smartphones, tablets, laptop; second screen), for live and CoD (Portuguese trial)

5.2. Technologies and standards used for the planned implementation of the Pilot

In the current state of Pilot D planning, it is not possible to provide a complete list of the identified technical components since implementations are being still designed. The way the signing services are going to be deployed in depends on the features that manufacturers will include in their future HbbTV 2.0 devices (see also section **¡Error! No se encuentra el origen de la referencia.**). In any case, three components have been identified, as detailed in this section.

5.2.1. Signer HbbTV application (RBB)

5.2.1.1. Overview and expected timing

Concerning signer video playback system on HbbTV devices, a pre-mixed picture-in-picture video stream will be offered within an HbbTV application. It consists of a main TV video and a sign

language video area. That playback system gets its input from a video resource like a video server or a web server, where the pre-mixed video is located. Users can launch the signer application from a generic HbbTV launcher bar, which is the standard HbbTV-service offering used by all German broadcasters. A prototypical implementation for the large scale field trials will be ready by August 2015. RBB is considering using IRT's MPEG-DASH video encoding and streaming component as input for the HbbTV signer service.

Figure 5. *HbbTV Signer Application Click-Dummy*

A potential enhancement of this approach would be to create a truly hybrid version of this signing service, meaning the IP-based provision of only the sign language video, then combined on screen with the DVB-based transmission of the main TV video. Both videos would have to be synchronised via the playback module of the application at the end device. Only this approach would allow offering a customizable HbbTV Signer Application. The users could change size and position of the interpreter area on the TV. Furthermore this approach would minimise bandwidth and hosting space. The described solution, however, would require a) a finalised HbbTV standard V2.0 defining synchronisation of different media streams, b) the timeline-based enhancement of both video streams to be synchronised, c) available end devices capable of the needed synchronisation and playback features. At the current moment, however, it looks as if fulfilment of these conditions is highly unlikely until the start of the pilot phase in August 2015.
Therefore the HBB4ALL consortium decided together that the large scale pilot implementation will focus on the all IP solution for HbbTV1.0 and HbbTV 1.5. Because of the potential of a true hybrid solution the project, however, should strive to develop at least a proof of concept showcase together with IRT.

Component Name / Version	Features included	Availability
HbbTV Application Click-Dummy	On TV screen simulation of application for user test	06/2014
HbbTV Application first draft	HbbTV-conform Application with browser sniffer for MPEG-DASH	05/2015
HbbTV Application	Application integrated in RBB production workflow	08/2015
HbbTV2.0 Showcase	True Hybrid *Showcase (planned)*	09/2015

5.2.1.2. Technologies and standards used

- HbbTV (ETSI TS 102 796 V1.2.1)
- ECMAScript JavaScript implementation (ISO/IEC-16262)
- A/V formats possible:
  - MP4 container (ISO/IEC 14496-14)
  - MPEG-4/Part 10 (ISO/IEC 14496-10)
  - MPEG-4 HE-AAC (ISO/IEC 14496-3:2005)
  - MPEG-DASH (ISO/IEC 23009-1)

5.2.1.3. Potential cross pilot usage

Potential is high, as all the used standards on the A/V side as well as on the provision and on the end user side are openly usable for everyone. Hence, at least parts of this implementation may potentially be shared with other pilots. Only video resources might be blocked for cross pilot usage, due to security, performance and cost reasons.

5.2.2. Avatar based signing component (VIC)

5.2.2.1. Overview and expected timing

This component allows the generation of a 3D avatar that accepts textual input and interprets the text into sign language. Due to restrictions of the translation technology, it has been limited to the meteorological domain (“weather forecast”). The component will be ready by July 2015.

Vicomtech's proprietary 3D avatar and text to sign language translation technology will be used. The translation system is rule-based. The 3D avatar is based on the OpenSceneGraph standard, which allows generating video files or real-time rendering in an OpenGL context.

Component Name / Version	Features included	Planned Availability
Avatar based signing v1.0	Basic functionality	September 2014
Avatar based signing v1.1	Extended sign modelling.	March 2015
Avatar based signing v1.2	Final release	July 2015

5.2.2.2. Technologies and standards used

- OpenSceneGraph 3.2
- OpenGL 1.0, 2.0 and 3.0

5.2.2.3. Potential cross pilot usage

This component is specific of the sign language Pilot.

5.2.3. HbbTV play-out systems for tests (Screen and UPM)

5.2.3.1. Overview and expected timing

Both Screen and UPM have a wide experience in the development of HbbTV play-out systems and applications. This experience can be used in the project to easily deploy HbbTV applications, including lab tests and trial exploitation.

The introduction of an HbbTV application in a digital television stream is based on two prerequisites:

- The generation of specific signalling, according to HbbTV and DVB norms. In fact, the DVB norm specified by HbbTV is conceived for application signalling and carriage in any connected TV system - not just HbbTV. This signalling includes the URL where the hybrid terminal will find the complete HbbTV content.
- The generation of a DSM-CC object carousel to include application data in the broadcast transport stream.

The results of these processes are multiplexed with the rest of audio, video and data components. The hybrid terminal can, based on the information obtained via broadcast, retrieve the complete application data via the broadband network.

Component Name / Version	Features included	Planned Availability
HbbTV/DSM-CC carousel generator	It generates a DSM-CC carousel to transmit an HbbTV launcher	Readily available
HbbTV signalling generator	It generates the required signalling for HbbTV applications, according to HbbTV and DVB (TS 102 809)	Readily available
Multiplexer	It generates an MPEG-2 transport stream that multiplexes all the needed components: video, audio, data, signalling tables and HbbTV AIT	Readily available

5.2.3.2. Technologies and standards used

- HbbTV (ETSI TS 102 796 V1.2.1)
- Javascript and PHP
- DVB-IPTV (ETSI TS 102 809 V1.3.1)
- DSM-CC (ISO/IEC-13818 part 6)

5.2.3.3. Potential cross pilot usage

This component can be used in any pilot that requires actual test in a hybrid terminal.

5.3. Customisation and personalisation from a user perspective

One of the main objectives of Pilot D is the customisation of the signing services which are going to be deployed (objective D2). This characteristic can be seen as an additional feature or enhancement compared to a first basic implementation where the sign service implementation is offered in a closed way (the user enables the presence of the interpreter window). In fact, the implementation in a closed way implies personalization since the user enables the service. With regard to the implementation in HbbTV, the project is considering the possibilities of providing a customisable service even if there are no HbbTV2.0 prototypes with multiple video decoders during the project's lifetime (see section 6).

Customization is explicitly planned in sub-pilot 2 and 3 in the mentioned sub-pilot list. The configurable parameters will at least contain the size and position of the sign language interpreter window; the parameters potentially may become part of a user's profile. The user profile based personalisation approach can be realised using the GUIDE Framework and its user profiling service (see section 4.2.1).

6. Cross-pilot activities related to HBBTV

This chapter highlights aspects and features from current and/or future versions of the HbbTV specification that strongly relate to the cross-pilot activities.

The HBB4ALL consortium strongly supports HbbTV as the main target platform for the HBB4ALL project beside PC based and mobile implementations for some of the targeted services. Within all pilots HbbTV 1.0 or 1.5 based versions of accessibility services are foreseen to be implemented in order to support the already existing and widespread standard. The consortium will also support the upcoming HbbTV 2.0 standard, however at the moment the availability of HbbTV 2.0 devices cannot be guaranteed during the project's lifetime. Therefore the partners will follow a dual strategy: first, HbbTV-based services and applications will be developed in such a way that they are supported by devices that currently are – or in the medium term will be – in the market. Second, to make sure that future accessibility services can make appropriate use of the additional value offered by HbbTV2.0, the partners will gather requirements based on the trials foreseen in HBB4ALL and contact manufacturers to persuade them to implement the applicable features.

In the meantime, HBB4ALL will look at different possibilities to support a migration toward HbbTV2.0. For example, the use of HTML5 will make it easier to develop applications for HbbTV2.0 as well as other platforms (or to port applications between them, as the HTML part will most likely be the same). Also it is considered to use HbbTV2.0 features for "PC based services", and by doing so preparing the server sided infrastructure for HbbTV2.0 end user devices already now.

Some of the HbbTV2.0 features, which seem indispensable to the project, are listed below.

6.1.MPEG-DASH

Delivery of (live) streams to HbbTV terminals via IP will be based on MPEG-DASH in the near future; this technology is a potential alternative for other platforms as well. Version 1.5 of the HbbTV specification[2] introduces support for HTTP adaptive streaming based on MPEG-DASH, initially aiming at improving the perceived quality of video presentation on busy or slow Internet connections. MPEG-DASH can be used for added-on access services in all HBB4ALL pilots requiring (adaptive) streaming via IP, including the subtitle and alternative audio pilots.

Since several years IRT has been cooperating with CDN operators, encoder and terminal manufacturers to improve and deploy MPEG-DASH technology. Early 2014 IRT successfully showed a live transmission from an encoder via a Content Delivery Network (CDN) to an HbbTV 1.5 terminal. Additionally, IRT is in contact with organizations that work on open source tools like mp4box or ffmpeg which support MPEG-DASH or may support it in the future.

[2] See https://www.hbbtv.org/pages/about_hbbtv/HbbTV-specification-1-5_Aug2012.pdf

Currently MPEG-DASH is a rarely deployed young technology, but it is without a real alternative if adaptive live streaming is needed on an HbbTV platform. Therefore it seems to be beneficial for all HBB4ALL partners to focus efforts on this technology and to share know-how and developments. Task 2.3 will support the individual HBB4ALL pilots by sharing know-how, contacts and technology for MPEG-DASH.

6.2. Multi-Stream Synchronisation

HbbTV 2.0 adds the so-called multi-stream synchronisation feature that allows presenting a stream delivered over the Internet with a broadcast service in a time-synchronised manner. Within HBB4ALL Pilot B and Pilot D could make use of that feature to offer a broadcast service with an added-on accessibility feature (audio and sign language respectively) that are delivered via broadband Internet.

Deployments for such multi-stream synchronisation are currently unknown. There were a number of projects in the past in which laboratory prototypes were developed, including HBB-NEXT[3] (this project finished in March 2014). To make this feature available for HBB4ALL, a number of different players like broadcast playout centers, CDNs and terminal manufacturers would have to be convinced to implement it.

Task 2.3 will support the pilots within HBB4ALL with sharing know-how of the relevant specifications, i.e. HbbTV 2.0 and DVB-CSS (Companion Screens and Streams)[4], and by means of coordination activities (or possibly cooperations) with terminal manufacturers and playout centers supporting this feature. However, it must be noted that due to the external dependencies mentioned, this feature might be not or only be partially available in market products (HbbTV receivers) within the runtime of HBB4ALL.

6.3. Common HbbTV application components

The pilots in HBB4ALL will require development of HbbTV application frontends in order to add new features to existing services and to make them available/selectable by the user or simply to perform end user tests. This could include a generic HbbTV library, or sample code on how to control media objects in HbbTV and/or a framework for personalization.

Task 2.3 will support the pilots' developments by identifying useful common components for application frontends, coordinate the provisioning of such components and assist in integrating them for each pilot specifically.

[3] See http://www.hbb-next.eu/
[4] See https://www.dvb.org/groups/TM-CSS