ORPHEUS
Object-Based Audio Experience

Object-based broadcasting – for European leadership in next generation audio experiences

D6.1: Dissemination plan and innovation roadmap

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Abstract

This report presents the dissemination plan and innovation roadmap of Horizon 2020 research project ORPHEUS. The document describes the set of actions that will be carried out within ORPHEUS to raise awareness for the objectives, activities and especially the results achieved by the project. It also describes the different pathways that will be taken to ensure that innovations are captured, secured and promoted.

[End of abstract]

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Executive Summary

This report presents the dissemination plan and innovation roadmap of Horizon 2020 research project ORPHEUS. The document describes the set of actions that will be carried out within ORPHEUS to raise awareness of the objectives, activities and especially the results achieved during the project life cycle. It also describes the different pathways that will be taken to ensure that innovations are captured, secured and promoted.

Dissemination plan

ORPHEUS has defined a consistent plan, which includes the definition of target audiences, communication goals and key measures for achieving these goals. The mix of dissemination and communication activities includes papers, events, and web activities via the project website and social media.

Innovation roadmap

The innovation roadmap includes all steps in the generation and management of innovations. In order to facilitate a structured process, with clear responsibilities, a dedicated Innovation Management Committee has been set up. Innovation activities will particularly include standardisation activities, IPR management, and the individual exploitation plans of partners.

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Abbreviations

BRICs	Brazil, Russia, India, China
DVB	Digital Video Broadcast
EBU	European Broadcasting Union
EC	European Commission
HOA	Higher Order Ambisonics
MPEG	Moving Picture Experts Group
PDCA	Plan-Do-Check-Act Methodology

1 Introduction

1.1 Purpose and structure of this report

This report describes the strategies, approaches for the envisaged dissemination activities and innovation-generating measures of ORPHEUS.

The report consists of two main parts:

The first major part is dedicated to the dissemination plan (chapter 2). It summarises the project's dissemination goals and target audiences, the planning process and the effectiveness of dissemination activities will be measured as well as the description of the planned dissemination activities. These activities mainly consist of online/offline publications and events.

The second major part (chapter 3) presents the project's innovation roadmap. It includes the innovation objectives and roadmapping process, the innovation management, standardization, IPR management as well as impact management and the exploitation plans of the consortium partners.

1.2 Methodology

The ORPHEUS consortium partners apply the proven PDCA method for their planning and implementation measures in the areas of dissemination and innovation. This iterative management method consists of four steps:

1. Plan
2. Do
3. Check
4. Act
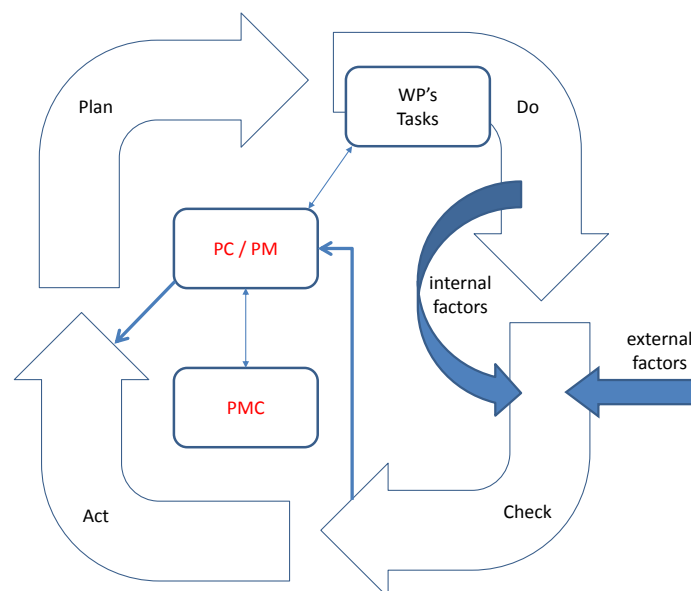
PDCA method for planning and implementing the dissemination activities of ORPHEUS

2   Dissemination plan

2.1   The dissemination activities of ORPHEUS in the context of the overall project goals

The ORPHEUS dissemination activities aim to create and raise awareness for the ORPHEUS project and its results. The dissemination activities are, thus, tightly linked with the overall project goals. This section describes the project context in which the dissemination activities are performed, in order to show in the following sections how the dissemination activities relate to the overall project activities and goals.

The ORPHEUS consortium represents the key actors spearheading object-based audio developments in Europe. The R&D departments of the partners involved in this project, being at the forefront of technical innovation, have laid the foundations of the broadcasting and media consumption landscape in Europe. All partners in the consortium are key players and stakeholders in European media industry, as well as authoritative members of international standardisation organisations. Hence, the road is paved for ORPHEUS' results to become once more a vital and stable fundament for a significant progress in technology and, beyond that, leading to a significant step ahead for the European content and media industry by:

- Forming closer business relationships between the various industry and research partners on a European basis;
- Contributing to further development and growth of the media sector in the EU;
- Adapting and tailoring the principles of object-based audio for the use in broadcasting;
- Excelling in the field of object-based audio beyond the state-of-the-art;
- Giving weight to creative ideas, concepts and standards for the entertainment and media production sector originating in Europe;
- Enabling content providers with the tools and means to design and realise new user experiences, and;
- Improving competitiveness on the worldwide market through reinforcement of innovation in the area of object-based production.

ORPHEUS will also help overcoming obstacles typical to the adoption of new paradigms and formats within the media industry, as content producers are hesitant to change their workflows without a large-enough target audience, while manufactures await the availability of actual content before making large investments. With the end-to-end chain and reference architecture approach of ORPHEUS and the scalable nature of object-based media with its inherent compatibility feature, this cycle can be broken. Thus, the results of ORPHEUS have the potential to create a momentum for a transition progress to the next generation of media production and consumption.

ORPHEUS will strive for the transition to an object-based audio future in Europe. This will lead to new opportunities for the creative industry and to growth, as well as to a stronger competitiveness of the European media sector. The tremendous benefit of object-based audio for end-users in terms of personalisation and accessibility will lead to a wider access to media for all European citizens.

From the business perspective, ORPHEUS addresses a huge market with a Europe-wide economy of scale and the potential to significantly impact the North American, Asian, Australasian as well as emerging markets such as BRICs. The project's outcomes have the potential of affecting most aspects of professional production tools and hardware, approaches to content creation, as well as consumer digital entertainment devices. Hence, ORPHEUS has the demonstrable capacity to revolutionise the way end-users interact with the technologies proposed in this project.

The implementation and utilisation of object-based audio will be transformational for the whole media production and content providing industry. Due to the universal presentation of audio content, producers and content providers do not have to serve several representation formats simultaneously, as it is the case today. The production of multiple versions currently still results in significant additional costs. In the broadcast world, this situation is called 'Simulcast' and implies the delivery of multiple audio signals and versions for one piece of media content at the same time. This can be a 5.1 surround and stereo signals, as well as special audio versions for hearing impaired or for blind people. This issue will be solved by moving to object-based audio which will result in just one single format. Also re-purposing of content will be easily possible. Instead of currently creating a complete new mix for another language, only the dialogue objects have to be replaced. By producing in an object-based audio format, a great amount of costs will be saved by the media industry.

Producing and providing object-based content will not just save costs, it will also result in a competitive edge for media providers such as broadcasters, video-on-demand providers or offline media such as Blu-rays. The great potential of an object-based format for end-users will be a crucial purchase argument and will lead to a competitive advantage for European media providers. Further, the expected impact of ORPHEUS is compatible with plans from other significant European broadcasters such as France Televisions. France Televisions has officially expressed to support ORPHEUS and to push the impact of the results forward.

The object-based approach will also affect the product portfolio of hardware and software manufacturers, targeting both professional users as well as consumers. Considering the impact of object-based audio for professionals, several devices and tools are needed to produce object-based content, e.g. professional mixing consoles, content management systems, playout server or encoder, as well as decoder. At the same time, the consumer electronic industry will be highly affected by a transition to the object-based format. All types of end-user devices, mobiles, portables, as well as fixed, will be re-designed and manufactured for decoding and reproducing object-based audio content.

ORPHEUS will also open up new opportunities for SMEs, or software developing companies in general, with a new market segment of tools and solutions for both professional and end-users. For a successful end-to-end production and delivery chain, several tools will be necessary to guarantee the smooth workflow of object-based content. Affected tools will be professional software Digital Audio Workstations, transcoding tools and editors for the planning of object-based productions.

On the end-user side, a strong impact of ORPHEUS on software solutions is expected. Any device that will reproduce object-based content needs at least a renderer to generate the final audio mix for the device. Moreover, a graphical user interface needs to be provided.

The socio-economic impact of ORPHEUS can hardly be overestimated as the results of ORPHEUS will be a fundamental driving force leading to the adoption of object-based audio production. The commercial implementation of the project's outcomes has the potential to directly enhance the quality of life by providing superior entertainment and socialisation options to users. The consortium will bring the considerable advantages of an object-based format one significant step closer to all European citizens.

Considering the on-going changes of the media landscape worldwide, such as the advent of mobile devices, fast internet access and on-demand services, just to name a few factors, have led to new and various media consumption patterns and consumer expectations. The object-based approach perfectly fits into this new and changing world as it is highly flexible and offers multi-purpose on any platforms. Moreover, the transition to object-based audio will stimulate new forms and ways to create and consume media - anytime, anywhere and anyhow.

The outcome of ORPHEUS will be also highly beneficial in terms of barrier-free access to media contents. This will be especially true for hearing-impaired and also blind people. Current and past studies have shown that speech intelligibility of TV signals is mainly assessed as being insufficient by people who are hard of hearing. The group of hearing-impaired covers not just people with a severe

hearing loss, utilising a hearing aids, but also people with a slight impairment such as elderly. Research has shown that hearing-impaired people would choose to individually control the level of dialogue to non-dialogue signals. This service could be easily realised with an object-based format. Moreover, other enhancement processing can be applied with object-based content that will take the individual impairments and demands of each user further into account.

2.2 Dissemination goals and target audiences

In order to be effective, the ORPHEUS dissemination activities are focused on achieving a number of dissemination goals and on reaching the defined target audiences. This section outlines the dissemination goals and how they relate to target audiences and dissemination activities.

2.2.1 Dissemination goals

ORPHEUS pursues the following dissemination goals:
- Create and raise awareness for the ORPHEUS project activities and results among target audiences.
- Encourage interest and involvement for ORPHEUS project activities among target audiences.
- Influence standardization in the area of audio technologies.

The detailed measures for implementing these goals are described in sections 2.4 and 2.5.

2.2.2 Target audiences

ORPHEUS aims to reach the following target audiences through its dissemination activities:
- Research community in the area of audio technology
- Decision makers and experts at broadcasters in Europe
- Standardisation bodies
- Recipients of broadcasts
- Media, including the trade press
- Policy makers and regulators on European level and at EU Member States
- The interested public

2.3 Planning process and measuring of effectiveness
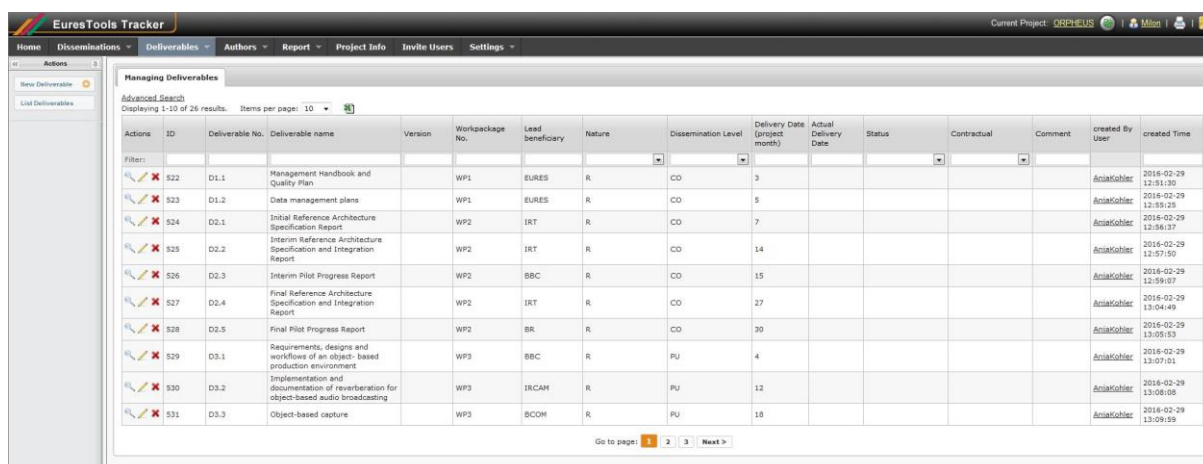
Planning and measuring are of key importance to achieving the dissemination goals.

2.3.1 Dissemination planning process

In order to achieve the dissemination goals defined in chapter2.2, the project follows a generic five-step process:

1. Define/Review communication and dissemination objectives (first iteration already done)
2. Formulate key messages based on the goals and objectives
3. Define target audiences required for achieving the goals and objectives (already done)
4. Plan and implement communication and dissemination activities
5. Evaluate the effectiveness and impact of communication and dissemination activities

2.3.2 Tracking of dissemination activities

As part of the project's PDCA methodology for managing dissemination activities, ORPHEUS is giving special attention to monitoring and tracking dissemination activities. To this purpose, the project is using a specific tool and a related process for dissemination tracking: the EuresTools® Dissemination Tracker is a cloud-based tool for tracking and controlling dissemination activities and results. It provides an easy overview on activities and results, and it facilitates the process of agreeing on dissemination documents. In addition, the tool provides an automated integration of dissemination results on the project website, which significantly shortens time and effort for publishing dissemination documents on the web.

Through an easy-to-use export function, Dissemination Tracker enables the coordinator and the dissemination work package leader (WP6) to prepare up-to-date tables on dissemination activities for the reports to the European Commission. The tool was introduced to the consortium partners for project-internal use in March 2016.

2.3.3 Measuring the effectiveness of dissemination activities

ORPHEUS will define a number of meaningful key performance indicators (KPIs) and targets for measuring the effectiveness of the project's dissemination activities. The monitoring of KPIs and targets will enable ORPHEUS to adapt and improve the effectiveness of its measures according to its planning process.

An initial set of KPIs and targets is presented in Table 1.

Table 1: KPIs for dissemination activities

#	KPI	Target
1	Number of participants at 1st ORPHEUS workshop	60
2	Number of participants at 2nd ORPHEUS workshop	60
3	Number of newsletter subscribers after 1st year	60
4	Minimum number of events in which ORPHEUS will be presented p.a.	5
5	Minimum number of papers submitted by ORPHEUS to scientific journals p.a.	10

The project will ensure that a critical mass having interest for dissemination of the project results and

further related activities can be reached. In order to identify any potential problems, the project will carefully monitor the size of the audience it can attract with the performed dissemination activities. In case of low interest, the project will decide upon suitable counter-measures, e.g. re-focus the target events list or extend it, intensify communication and PR activities as e.g. having press releases, more prominent presence at events etc. All partners were thus requested for their dissemination activities to estimate and report the size of the audience, and to record the information in the Dissemination Tracker (see 2.3.2).

2.4 Publications

2.4.1 Project logo and design

A vital part of a successful dissemination and communication strategy of any project is gaining a unique identifiable visual identity, similar to that of brands or trademarks with 'corporate identity' – even though the consortium does not form an entity. Therefore, the ORPHEUS consortium partners agreed on a corporate logo and design elements for publications and presentations, clearly pushing the project's finely chosen and catchy acronym into the actual technical context.

This was the main task to be achieved through adding an outstanding 'iconic' header – which is also usable as a stand-alone version – to modern lettering design. In addition and to stress the project's unique selling proposition and objectives, the most important keywords of the project's full title were used as subtitling slogan.

The ORPHEUS design world is completed by a complementary background texture.

The design was created by consortium partner BR's graphic design department.

2.4.2 Website

The ORPHEUS website was launched in February 2016, according to project milestone MS17. It serves as the central reference point for all of the project's communication and dissemination activities. Beyond the home page level, it is structured into five sections:

1. About us
2. Publications
3. Standardisation
4. News
5. Contact Us
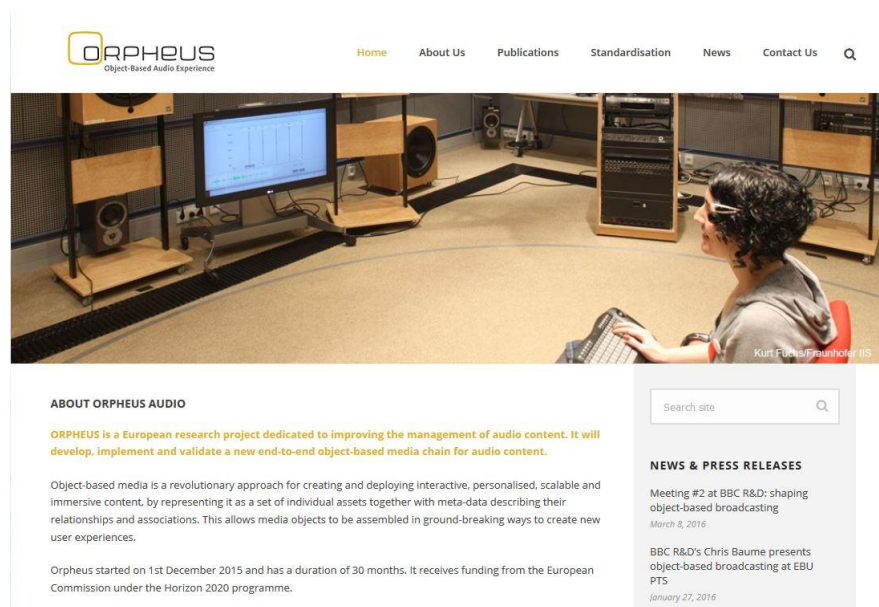
The website is regularly updated. Particularly in the 'Latest News' section, website visitors will

frequently find new items. The latest news items are also directly visible and accessible via the news column, which also contains syndicated news feeds from the ORPHEUS Twitter account.

The website, which is based on a WordPress implementation, is hosted and managed by Eurescom. Via the content management system, different partners have editing access, thus helping to accelerate the publication process.

As a measure of effectiveness, the project will closely monitor and document the number of visitors and the responses elicited by the website. As the website was only online for less a month when this deliverable was produced, the web statistics below do not yet show high traffic. However, the project will build traffic through its dissemination activities.
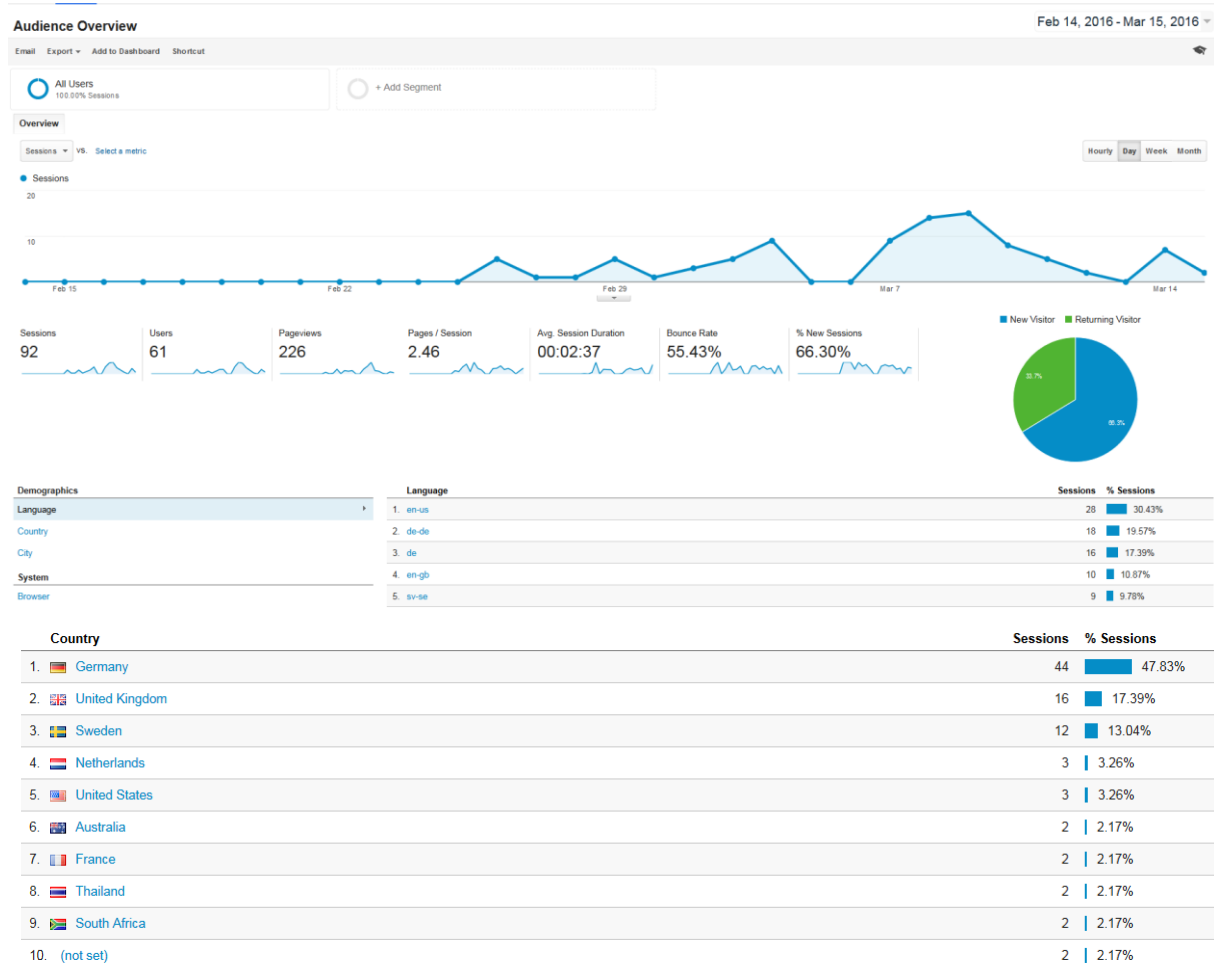
Web statistics for the ORPHEUS project website February/March 2016

2.4.3   Scientific papers

Individual members of the ORPHEUS consortium have previously published scientific papers in field leading journals. It is proposed that their output will continue and the innovations, results and developments will be summited to journals appropriate to the disciplines covered within ORPHEUS. Undertaking the peer-review process required for journal publication will further contribute to the impact and acceptance of innovations, developments and findings undertaken in ORPHEUS. The identified relevant journals where significant results can be published include:

- Journal of the Audio Engineering Society (JAES)

- Acta Acustica united with Acustica

- Journal of the Acoustical Society of America (JASA), and

- Applied Acoustics

Various members of ORPHEUS, including the BBC, IRCAM, IRT, BCOM, and FhG have regularly published scientific paper in the above mentioned journals. Table 2, outlines the proposed number of papers to be submitted for publishing in these journals.

Table 2: Targeted journals

Journal	Targeted no. of papers
JAES	2
Acta Acustica united with Acustica	2
JASA	1
Applied Acoustics	1

In addition, ORPHEUS research will be presented at international, as well as respective national conferences. Conferences are an ideal setting to receive feedback on ORPHEUS and to further communicate ORPHEUS findings within the scientific community, which will inevitably lead to spreading the impact of ORPHEUS not only within Europe but internationally. Possible and targeted conferences are:

- AES Conference (Audio Engineering Society)
- ICSA (International Conference on Spatial Audio)
- EBU PTS (Production Technology Seminar)
- DAGA (Annual conference of the German Acoustics Association)
- Tonmeistertagung (Bi-annual conference of the German Sound Director Association)
- FISM (Forum International du Son Multicanal)

Table 3, **Table 4**, and **Table 5** outline by year the proposed upcoming conferences the research findings, innovations and developments can be presented.

Table 3: Targeted conferences/symposia for 2016

Conference	Date	Location	Frequency	Proposed no. of papers
EBU PTS	January 2016	Geneva	Annual	1
Tonmeistertagung	November 2016	Cologne	Bi-annual	1

Table 4: Targeted conferences/symposia for 2017

Conference	Date	Location	Frequency	Proposed no. of papers
AES 142nd Convention	Spring 2017	Berlin	Annual	1
AES 143rd Convention	Autumn 2017	New York	Annual	1
AES Conference 'Semantic Audio'	June 2017	Erlangen	Annual	2
ICSA	Autumn 2017	Graz	Bi-annual	1
EBU PTS	January 2017	Geneva	Annual	1

DAGA	March 2017	TBA	Annual	1
FISM	Autumn 2017	TBA	Annual	1

Table 5: Targeted conference for 2018

Conference	Date	Location	Frequency	Proposed no. of papers
AES 144th Convention	Autumn 2018	TBA	Annual	1
EBU PTS	January 2018	Geneva	Annual	1
DAGA	March 2018	TBA	Annual	1

2.4.4 Newsletter

The project website is closely linked with the bi-annual newsletter, called 'ORPHEUS Audio News'. The purpose of the newsletter is to inform the above-defined target audiences about activities and results of the project. Envisaged start date of the newsletter is Q2/2016.

The planned structure of the newsletter includes the following sections:

- Editorial
- Project Highlights
- Events
- Imprint/contact

Like for the website, the effectiveness of the newsletter in reaching its target audiences will be closely monitored by capturing the number of recipients and the level of response elicited by each edition.

2.4.5 Social Media

During the last decade, so-called 'social media' have emerged as indispensable elements within an encompassing 360° communication strategy. Various popular social networks as e.g. Facebook, Twitter, Google+, Tumblr etc. as well a more professionally focused portals, e.g. LinkedIn, have exceeded their basic function and intention of 'virtually connecting people' with similar interests and profiles, evolving into influential platforms for immediate and 'viral' action-interaction, spreading and potentiating effects from small like-minded communities up to mass crowds.

Provided with low-entry barriers, being ubiquitously accessible as well as individually configurable, social media 'streams' and 'timelines' offer a real-time, straightforward on-the-go approach to sending and receiving any kind of messages. They range from top-relevant breaking news to mere gossip, inciting public discussion and evoking individual feedback, enabling the sharing and forwarding of knowledge and thus fostering communication and collaboration on basically open and transparent platforms. Yet, a key factor for acceptance is that they are pull media – you deliberately log-on and subscribe to receive or even 'follow', 'like' or actively 'post'.

The partners in ORPHEUS have decided to focus their social media activities on the most relevant within the audio and broadcast community: *Twitter*.

Twitter, established in 2006, is classified as text-messaging service or 'microblog'.

According to various sources, Twitter counts monthly around 320 million users that log-on to the service, with a total 400m tweets generated every day. Although 'engagement rates' for Twitter (as

for all social media) vary throughout the world respectively, with a considerably higher rate in 'emerging countries' (with younger population), the use of Twitter in European countries is estimated between around 20% (Germany, France, Netherlands) to 30% (UK and Ireland), headed by Italy and Spain (40+%) of total internet users.

A typical *tweet* includes and offers these attributes and main functionalities

- *conciseness:* due to the fact that *tweets* were originally contributed via SMS, their length are limited to 140 characters (it is reported that this obsolete technical limitation is to be dropped soon, nevertheless only the first 140 characters are to be displayed in a timeline). So, every message has to be pithy, like a headline, ideally enriched with one or more

- *#hashtag(s)*: representing a key word, acronym or abbreviation, that is used to link to tweets with the same subject or related context, thus enabling to follow a certain discussion

- *retweet/comment*: users can forward tweets from others directly or with added comment into their own following communities, stating their interest, support or even disagreement thus creating word-of-mouth or snowball, or 'viral' effects in news spreading

- *reply*: referring directly to a previous tweet 'in public', with anyone else being informed and encourage to join a discussion

- *link*: tweets quite often are used for marketing and promoting news and up-dates on websites and blogs. In order to be thrifty with the 140 characters limit, link-shortening tools have to be applied (bit.ly, goo.gl, ow.ly, etc. – these tools allow additional analysis of impact)

- *pictures/videos/TwitterCards* can be attached in order to extend the limitations of the text message and increase value of information and attractiveness.

➔ These features appear as optimum for a straightforward dissemination of news about the ORPHEUS project directly to the broad basis of an audio, broadcast and technology minded community.

All company partners in the ORPHEUS project run at least one Twitter account, posting regularly news, promoting activities and events and communicating with their 'followers'.

Partner	Followers	Tweets
Fraunhofer IIS @FraunhoferIIS Fraunhofer-Institut für Integrierte Schaltungen IIS - Forschung und Entwicklung für Wirtschaft und öffentliche Hand - Aktuelles und Themen aus dem Home of mp3	1.725	859
Eurescom @Eurescom Eurescom is the leading European organisation for managing collaborative research, development and innovation in telecommunications.	387	606
BBC R&D @BBCRD BBC Research & Development - exploring technology for the BBC's future.	12.8k	2.617
IRT @IRTpresse Research and development institute of ARD, ZDF, DRadio, ORF and SRG/SSR. Tweets about current media topics and events by Thomas Schierbaum.	361	642
elephantcandy @elephantcandy Elephantcandy is all about Music and Sound. More specific, audio software development for mobile devices.	304	424

Partner	Followers	Tweets
Trinnov Audio @TrinnovAudio Trinnov Audio designs and manufactures innovative preamplifiers and processors for luxury Home Theaters, high-end Hi-Fi, Professional Studios and Movie Theaters	239	126
bcom @IRT_BCom French Institute of Research & Technology dedicated to the future of #hypermedia - faster and smarter #Networks & #eHealth.	3.055	8.728
IRCAM @Ircam IRCAM is the world's largest public research center dedicated to both musical expression and scientific research.	12.4k	3.853
Bayerischer Rundfunk ✓ @BR_Presse Twitter-Account des Bayerischen Rundfunks	Alle Kanäle: br.de/s/SxKt53	Kontakt: br.de/kontakt	22k	9.822
MAGIX Deutschland @magix_DE #MAGIX entwickelt #Software für deine kreativen Projekte. Hier findest du exklusive Produktnews, #Tutorials & #Inspiration. #Audio #Foto #Video #WebDesign #App	2.324	5.107

(all numbers as of March 1st 2016)

The consortium's own Twitter account @ORPHEUS_AUDIO was set up in January 2016. It was agreed that until a fairly final stage of the website www.orpheus-audio.eu was achieved, tweet activities will be restricted to a minium, as traffic generated through that should not land on a site under construction.

By the end of the plenary meeting at BBC R&D in Mancherster (March 7th to 8th 2016) and with a total of 11 tweets generated, @ORPHEUS_AUDIO has gained

- 40 followers - all of them members of the project's specific target group in the audio and broadcasting business
- 2.570 tweet impressions
- 1.027 profile visits

(Twitter Analytics is used to get in-depth information on effectiveness and to contrive further improvements).

Some of the offical Twitter accounts from consortium partners have already started to engange with @ORPHEUS_AUDIO by 'retweeting'.

Members of the consortium are also asked, to promote the various activities and publications of ORPHEUS on their own, by linking, sharing or embedding the URLs on their individually used accounts on social media networks like LinkedIn, XING, Google+ etc. or internal corporate social networks (if operated).

In addition to that, it is intended that specific articles on object-based production and broadcasting will be exchanged, embedded or linked with the existing, very popular blog run by BBC R&D and the emerging blogsite of IRT, thus enhancing the outreach of our website (c.f. 2.4.2).

2.4.6 Videos

Complementary to its social media activities, ORPHEUS will also produce low-cost, fast-generated video material. The video footage will be particularly used to capture and share project activities at conferences, workshops and exhibitions. Video will be either shared live via Periscope (https://www.periscope.tv/) or via YouTube and the ORPHEUS website.

2.4.7 Other publications

2.4.7.1 White papers

ORPHEUS will publish white papers and guidelines for stakeholders, especially broadcasters. These documents are intended to be used as help for other content producers and providers for a successful shift to an object-based workflow. One example is also directly related to milestone M2.8 / MS6: "Guideline published for broadcasters for a successful transition to object-based audio".

2.4.7.2 Press releases

The project will ensure that the innovations and developments of ORPHEUS are made public via press releases to the media. Press releases will be produced whenever something newsworthy can be reported.

2.4.7.3 Flyers and brochures

ORPHEUS will produce flyers and brochures on the project in general as well as on specific results. They will be used as an effective form of information particularly when presenting ORPHEUS at conventions, trade shows or exhibitions.

2.5 Events

2.5.1 Targeted events

The IBC (International Broadcasting Convention) and NAB (National Association of Broadcasters) are especially important dissemination events for ORPHEUS. The IBC is the biggest broadcast event in Europe and all European broadcasters and supporting industries will be present. This event will be important to raise awareness for European stakeholders and adopters.

Furthermore, the NAB exhibition would offer a particular opportunity for reaching American production companies, among them the major players from Hollywood. Their production and distribution process is based on a completely different paradigm: blockbusters are perfectly fitted for cinema and do not especially care about the challenges to adapt and deliver contents on various devices. In this environment the ORPHEUS project would benefit from exposure to this sector, starting a dialogue with US creators and broadcasters on its compatibility with the MPEG standard dedicated to multi-platforms delivery. US shows are also good opportunities to convince American

audio leaders such as Dolby and DTS of the benefits and interest for an open and common format in the range of object-based production, for various kinds of content, with respect to minimal interoperability requirements.

Other events for the dissemination of ORPHEUS developments include Internationale Funkausstellung (IFA), Audio Engineering Society (AES) conventions, Forum International du Son Multicanal (FISM), Tonmeistertagung (the Bi-annual conference of the German Sound Director Association), EBU PTS (Production Technology Seminar), Mobile World Congress, DAGA (Annual conference of the German Acoustics Association), and HIGHEND audio fair.

Event	Date	Location	Audience
IFA (Internationale Funkausstellung)	Sept. 2016	Berlin	Public and Press
IBC (International Broadcaster Convention)	Sept. 2016	Amsterdam	Professional
AES 141st Convention (Audio Engineering Society)	Nov. 2016	Los Angeles	Professional
FISM (Forum International du Son Multicanal)	Nov. 2016	Paris	Professional
Tonmeistertagung (Bi-annual conference of the German Sound Director Association)	Nov. 2016	Cologne	Professional
Consumer Electronics Show (CES)	Jan. 2017	Las Vegas	Professional and Consumer
EBU PTS (Production Technology Seminar)	Jan. 2017	Geneva	Broadcast Professional
Mobile World Congress	Mar. 2017	Barcelona	Professional
ORPHEUS Project Midpoint Workshop	Apr. 2017	Manchester	Professional, Academic and Press
DAGA (Annual conference of the German Acoustics Association)	May 2017	Kiel	Academic
NAB Show (National Association of Broadcasters)	Apr. 2017	Las Vegas	Professional
HIGHEND	May 2017	Munich	Public and Press
AES 142nd Convention	Apr. 2017	Berlin	Professional
IFA	Sep. 2017	Berlin	Public and Press
IBC	Sep. 2017	Amsterdam	Professional
AES 143nd Convention	Oct. 2017	New York	Professional
FISM	Nov. 2018	Paris	Professional
ICSA (International Conference on Spatial Audio)	Jan. 2018	Graz	Academic and Professional
CES	Jan. 2018	Las Vegas	Professional and Consumer
EBU PTS	Jan. 2018	Geneva	Broadcast Professional
Mobile World Congress	Apr. 2018	Barcelona	Professional

DAGA	May 2018	Munich	Academic
NAB Show	Apr. 2018	Las Vegas	Professional
HIGHEND	May 2018	Munich	Public and Press
AES 144nd Convention	Apr. 2018	TBA	Professional
ORPHEUS Final Workshop	May 2018	Munich	Professional, Academic and Press

Table 6: Events targeted by ORPHEUS in chronological order

2.5.2   ORPHEUS workshops

ORPHEUS will organise two dedicated workshops for stakeholders, including broadcasters, content providers, media production houses, and content producers. At these workshops, ORPHEUS project results will be presented, demonstrated and discussed.

These workshops will be an opportunity for the aimed stakeholders to see an end-to-end workflow chain for object-based audio under real-life circumstances. Moreover, we will inform the stakeholders on the advantages of object-based audio and how to implement a transition of existing infrastructures to an object-based future.

The first workshop is planned to be hosted by the BBC R&D in the middle of the project along with the next "Sound Now and Next" event. This two-day event on innovation in sound production and broadcasting will feature talks by inspirational artists, producers and engineers, and demonstrations of state-of-the-art audio technology. It will be an opportunity for radio and TV producers, engineers and technologists to discover how audio content is made today and discuss what it will be like in the future. During this event, ORPHEUS plans to present results of the project and of the first pilot in order to advertise ORPHEUS and to gather important feedback from the professional community.

The second workshop, which shall take place at the end of the project, will be co-hosted by BR and IRT in Munich. It is envisaged to organize this event along with the EBU to demonstrate the ORPHEUS project and the results to broadcasters and other stakeholders. The event will inform about ORPHEUS and the results, especially the developed reference architecture, in presentations as well as real-life demonstrations.

3 Innovation roadmap

3.1 Innovation objectives and roadmapping process

The impact of the innovations in ORPHEUS is proposed to be much wider than just turning research outcomes and inventions into innovations and then into products or improvements to products. The impact of a research and innovation action like ORPHEUS aims to achieve more entrepreneurial type of targets, in addition to managing and fostering the generation of effective academic impact. The approach taken will bring forward the current knowledge and will allow other researchers and development engineers to build on them.

The interdisciplinary ORPHEUS consortium is composed of members ranging from broadcasters, research institutes, hard- and software companies for professional tools, as well as for end-users and consultancy institutions. The intention of this project consortium is to manage the developed solutions that realise the ORPHEUS vision and bring these solutions to the market.

As the main and common exploitation objective, the outcome of this project will allow stakeholders along the end-to-end chain to introduce object-based audio. A reference architecture will be specified and published, preferably on an open-source basis to stimulate and offer new possibilities for content producers and providers. Further, findings from ORPHEUS will be proposed at various standardisation bodies that included the ITU-R, EBU and W3C. Also, the findings will be implemented in commercially available software and plugins that include Sequoia and Spat. The findings will also be exploited with the development of new software that will make possible the capture, editing and post-production of object-based audio, as well as developments in new hardware for content providers and broadcasters.

In order to realise the above-mentioned innovation objectives, the following roadmapping process will be utilised in ORPHEUS:

- Ensure that all innovations made in the project are recorded and their impact potential is assessed;
- Develop, in collaboration with the partner/s proposing an innovation, a targeted impact and exploitation plan;
- Record and follow up on the individual innovations and impact/exploitation plans;
- Support the implementation of the proposed impact plans and, where required, develop a sustainability roadmap to ensure use and exploitation after project end; and,
- Analyse the impact of ORPHEUS on the value chains and business models.

3.2 Innovation management

Innovation management is a process that requires an understanding of both markets and technologies. Both competences are needed if creative ideas are transformed successfully into new products. Fostering innovation in a coordinated and structured way will have high priority in ORPHEUS. In order to facilitate a structured process, with clear responsibility, a dedicated Innovation Management Committee (IMC) has been setup. Its main goal is to foster and steer innovation and exploitation of project results, ensuring their application e.g. for launching new products. As innovation management is a key task, the Project Coordinator will chair the IMC, with participation from all industry and SME partners but also academic partners.

The IMC will meet at least quarterly, physical meetings or teleconference, to review the exploitation potential of the technologies, based on the market opportunities, individual partner plans and technical progress achieved by each of the partners.

In more detail, the IMC will also be responsible for:

- The management of all IPR whether Foreground or Background IPR. This responsibility includes oversight of the commercial assessment and protection of any Foreground IP generated by the project and negotiation of licence agreements to enable the transfer of technology also outside the consortium. External services e.g. IPR helpdesk or a European Patent Attorney might be recruited.

- Generation and Management of the Exploitation Plan, IPR strategy, commercial approach, and will consider the business plan and the market evaluation analysis developed.

- Negotiation and co-ordination of Exploitation Agreements in a manner to satisfy the interest of all consortium members. The agreement will formalise exploitation restrictions, licensing arrangements, protection of IPR.

3.3   Standardisation

Contributions to standardisation will enable the project to achieve broader recognition of its results by a wide industry community. They also stimulate higher levels of interoperability and thus contribute to establish economies of scale for ORPHEUS devices and applications. Moreover, close coordination between research projects and standardisation organisations is an important mechanism to exploit results and to stimulate innovation. Standardisation of the findings can help to maximize compatibility, interoperability, and quality.

Thus, findings from ORPHEUS will be proposed at various standardisation bodies that included (among others) the ITU-R, EBU and W3C.

The **International Telecommunication Union (ITU)** is the main standardisation body in terms of visibility, and specifically to lead to the adoption of open ideas. The **ITU Radiocommunication Sector (ITU-R)** is in general responsible for radio communication. Especially the Study Group 6 (SG6) is relevant for ORPHEUS, which deals with radio communication broadcasting, including vision, sound, multimedia and data services, principally intended for delivery to the general public. BBC and IRT, as well as FHG are active members in many study groups and especially follow works related to broadcasting, spatial audio and audio evaluation and are therefore able to bring ORPHEUS findings to the sub-working groups on audio-related topics in the Working Parties 6B and 6C of SG6, as well as to multiple rapporteur groups. Joint contributions of the relevant ORPHEUS partners will maximize the input.

A possible contribution to the ITU-R WP6B is a proposal for a report on the practical use of the metadata and file formats defined in the ITU (namely ADM in ITU-R Recommendation BS.2076 and BW64 in ITU-R Recommendation BS.2088) for object-based broadcasting. ORPHEUS findings may also be reflected in revisions of the mentioned recommendations, if requirements for further metadata or extensions of the file format arise during the project runtime. The recommended streaming of the ADM format will be also a possible outcome document of the ORPHEUS project. Another relevant topic is loudness measurement and loudness management of object-based content, which is covered by WP6C. Possible contributions are reports on the usage of loudness measurement procedures, loudness management and loudness metadata in the practical implementation of an object-based broadcasting chain. If new loudness measurement algorithms are developed, they may also be proposed to the ITU. Further, the work on an ITU-R Baseline Renderer takes place in WP6C. BBC, FHG and IRT are active contributors of this Rapporteur Group. This effort will finally result in a new Recommendation for the standardized interpretation of ADM metadata (ITU-R BS.2076). Moreover, the subjective evaluation of object-based content will be also part of WP5 and might result in contributions in the relevant Rapporteur Group of WP6C.

The **Moving Picture Experts Group (MPEG)** deals among others with standardisation of video and audio compression, as well as container formats and transmission. MPEG is a working group that was formed by ISO and IEC (ISO/IEC JTC1/SC29/WG11). MPEG also works on the topic of object-based

audio, especially in the context of MPEG-H. MPEG-H 3D Audio, specified as ISO/IEC 23008-3 (MPEG-H Part 3), is an audio coding standard supporting coding of audio as audio channels, audio objects, or higher order ambisonics (HOA). MPEG-H enables means for interaction, as well as adaptation to the listener environment. FHG technology has been selected as Reference Model technology for major parts of MPEG-H.

FHG will continue to stay involved with MPEG standardisation. FHG and IRT will propose and present relevant ORPHEUS results to the MPEG audio community. Possibly relevant topics may be streaming of object-based audio in MPEG-H in the broadcasting context, transport of uncompressed object-based audio and ADM metadata in MPEG containers, as well as the delivery of MPEG-H over IP-based systems.

Another relevant body is the **EBU**, the **European Broadcasting Union**, which is an alliance of public service media entities. Even though the European Broadcast Union is not a standardisation body, it however offers to the public broadcasters and associated members a vital assistance to disseminate information associates. The EBU technical department (EBU Tech) considers any advanced work on audio, video and data to be discussed and potentially pushed as a common published recommendation or report, covering topics from HDTV to digital radio. BBC, IRT, BR, MAGIX and BCOM are part of EBU Tech groups, such as the IA (Immersive Audio), BWF (Broadcast Wave File), PLOUD (Loudness Measurement) or FAR (Future Audio Formats and Renderers) and are therefore actively taking part in the standardisation efforts and are able to bring ORPHEUS findings to the EBU.

Possible contributions are reports on ORPHEUS findings with respect to loudness measurement and loudness management for object-based audio, as well as the use of file-formats and metadata for a practical implementation of an object-based broadcasting chain. The standardisation work in the ITU and EBU will be coordinated with the relevant partners, such that a very high compatibility is retained.

The **ETSI-DVB** (Digital Video Broadcasting) is a family of standardized technologies designed to facilitate broadcasting of images, sound and multimedia by the European Telecommunications Standard Institute. The standards provide for delivery of the programme content by terrestrial, cable, satellite and mobile communication systems. In DVB, it is currently being worked on formats for object-based audio delivery together with several vendors for their next generation systems. IRT, FHG and BBC are involved in DVB work, in DVB's Next Generation Audio sub-group of the Commercial Module (CM-AVC-NGA). The group is tasked with developing commercial requirements for audio and video encoding formats for Contribution and Distribution applications within broadcast and broadband environments. Further, the technical decision and solutions are discussed in the Technical Module (TM-AVC-NGA) where BBC, FHG and IRT are active contributors as well.

The **Society of Motion Picture and Television Engineers (SMPTE)** is an internationally recognised standardisation organisation working, among others, on standards for audio recording, information technology, and television transmission formats and physical interfaces. FHG and BBC are active in SMPTE standardisation. For example the SMPTE technology committee TC-25CSS, dedicated to cinema sound, works on standards for digital sound delivery, new sound measurement techniques and sound reproduction. This includes work on object-based audio (metadata, transport and rendering) in the context of digital cinema sound. Besides, SMPTE Working Group 35PM50 works on an interchangeable master file format (IMF) as a distribution and interchange format. Both topics are related to the work in ORPHEUS and it is therefore considered to bring ORPHEUS finding to the SMPTE if relevant. One possible contribution would be the participation in the definition of requirements for audio metadata in an interchange format.

The **International Electrotechnical Commission (IEC)** is the international standards and conformity assessment body for all fields of electro-technology. FHG is active in IEC standardisation, e.g. in the work of IEC TC100/TA4 on digital system interfaces and protocols. As digital audio and multimedia interfaces are relevant during the implementation of the object-based audio chain in ORPHEUS, it is considered to bring ORPHEUS findings to the IEC is relevant.

The **World Wide Web Consortium (W3C)** is the main international standards organization for the World Wide Web. The W3C Audio Working Group is developing specifications for advanced audio capabilities with a new WebAudio API. The API will support the features required by advanced interactive applications including the ability to process and synthesize audio streams directly in script. The relevant W3C consortium is co-chaired by the BBC. The developed platform will play a key role in implementing object-based broadcasting based on IP delivery. As the topic of IP-based delivery of object-based content is also part of the work in ORPHEUS, results from the ORPHEUS project will be brought to the attention of W3C. IRCAM is also an active member of this group and will support BBC to submit ORPHEUS results.

The relevant standardisation bodies, their relevance, the involved partners and envisioned contributions are summarized in Table 7.

Standardisation body	Relevance	Involved partners	Envisaged contributions
ITU-R	High	FHG, BBC, IRT	Proposal of a report on object-based broadcasting Contributions on the streaming of ADM Contributions for the baseline renderer Contributions on loudness measurement and loudness handling
MPEG	Medium	FHG, IRT	Streaming of object-based content, transport, IP delivery
EBU	High	BBC, IRT, BR, MAGIX, BCOM	Proposal of a report on object-based broadcasting, contributions on loudness measurement and loudness handling
ETSI-DVB	Medium	IRT, FHG, BBC	Contributions for the next DVB specification that will be capable of object-based audio delivery
SMPTE	Medium	FHG, BBC	Participation in definition of requirements for audio metadata in an interchange format.
IEC	Medium	FHG	To be decided yet
W3C	Medium	BBC, IRCAM	Contributions on IP-base delivery of object-based content

Table 7: Targeted standardisation bodies

3.4   IPR management

For the success of the project it is essential that all project partners agree on explicit rules concerning intellectual property rights (IPR) ownership, access rights to any Background and Foreground IP for the execution of the project and the protection of IPR and confidential information. The basic principles are defined and summarised in the section below.

The industrial partners of ORPHEUS will especially exploit ORPHEUS' results and developments within their portfolio. Although ORPHEUS will be as close to the real life as possible, the requirements for a professional and complete product are mostly higher, than for an application or implementation in a project such as ORPEHUS. Especially in terms of design of devices or GUIs, the demands are much higher for targeted consumers. Hence, the affected industrial consortium members, particularly TRI, MAGIX, and ECANDY, as well as R&D partners that are also licensing technologies have a strong interest to invest time and money on their own to bridge the gap between project and earliest possible exploitation. Depending on the particular development and the success during the project, individual actions are planned and are described in the individual exploitation plans of the consortium members in Section 3.5.

The IPR management of ORPHEUS will be coordinated by FHG which will include coordination of all IPR-related activities. FHG will be the point of contact for all communication with officials and administration in connection to IPR. The establishment of intellectual property and other aspects of innovation in this project will primarily be done by the respective work packages.

Participants plan to jointly or individually prepare patent applications for new concepts and solutions conceived, respectively jointly by one or more participant or solely by one participant. ORPHEUS aims to have patents filed by one or more partners to protect innovations from the project which have the potential to have a significant impact.

Innovations, concepts and solutions that will not be protected by patent applications by the participants will be made public after agreement between the partners and per the procedure established in the Consortium Agreement, in order to prevent others from blocking usage of these results. Further, the use of the IPR Helpdesk (www.ipr-helpdesk.org) will be promoted to help individual participants and partners with questions related to the protection of IPR.

A procedure has been established to inform all other partners in the project when results of the project will be made public (e.g. in a conference paper). This allows partners to protect IPR before publication would make that impossible. FHG will maintain a record of all related documents and discussions. This could later be used as a base for resolving conflicts related to IPR filings. These procedures ensure that intellectual property will be secured in the interest of project partners.

In order to ensure a smooth execution of the project, the project partners agreed to grant each other royalty-free Access Rights to their Background and Foreground IP for the execution of the project. The Consortium Agreement further details the Access Rights after the duration of the project to Background and Foreground IP.

The full details of the legal framework for the project related to the work, IP-Ownership, Access Rights to Background and Foreground IP for the duration of the project and any other matters of the consortium's interest has been defined in the Consortium Agreement.

As outlined in section 2.4.3, the project aims for submission and publication of consolidated results to international journals and magazines, in particular aiming at open access publications. The most important ones will be following a gold standard open access publication approach to be published in open access journals or hybrid journals. The second level publications are foreseen for green standard open access to be deposited in a repository.

In line with the above outlined strategy each partner will be involved in exploitation activities according to their expertise. The individual exploitation plans of ORPHEUS consortium members are listed below.

3.5   Consortium members' exploitation plans

3.5.1   Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. (FHG, Partner 01)

The Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V. maintains 66 institutes and research units. Fraunhofer Institute für Integrierte Schaltungen IIS is the Fraunhofer Institute carrying out the work in this project.

Fraunhofer IIS will be able to directly propose findings from ORPHEUS to the ITU-R, as Fraunhofer IIS is very active in the standardisation of object-based audio in the ITU, especially in the Study Group (SG) 6 of the ITU-R, which deals with radio communication broadcasting, including vision, sound, multimedia and data services, principally intended for delivery to the general public. Sub-working groups on audio-related topics in the Working Parties 6B and 6C of SG 6, as well as rapporteur groups on audio quality assessment have been and are currently chaired by members of Fraunhofer IIS as German delegates. Fraunhofer IIS has taken a very active part with work on the revision of the Recommendation on the MUSHRA listening test, on a new Recommendation on an ITU version of the object-based metadata format ADM (audio definition model), as well as in the work on Recommendations on a new wave-based file format for long-form audio content including the possibility to transport object-based ADM metadata.

Fraunhofer IIS also has experience with demonstrations on trade shows. These include the IBC, AES Exhibitions, the Mobile World Congress, CES, SMPTE, PT/EXPO and other major tradeshows on telecommunications, electronics and audio technology.

Besides, Fraunhofer IIS plans to exploit the results of ORPHEUS by the establishment of intellectual property rights (IPR), including the distribution of software with licensing the IPR for others to use, as well as patents for transfer of scientific results into industry. Fraunhofer IIS has been working in compressed audio technology for more than 20 years and is universally credited with the development of mp3 and co-development of AAC (Advanced Audio Coding) as well as technologies for the media world of tomorrow, including MPEG-H and EVS (Enhanced Voice Services). Through the course of more than two decades, Fraunhofer IIS has licensed its audio codec software and application-specific customizations to at least 1,000 companies. Fraunhofer estimates that it has enabled more than 5 billion commercial products worldwide using its mp3, AAC and other media technologies.

3.5.2   Eurescom (EURES, Partner 02)

Eurescom, having the mandate from its shareholders and members, among others, to advance technology for the benefit of the telecommunications industry provides advice for the exploitation of the project results by its shareholders and members who all have a business interest in the telecommunications market. This is achieved via bi- and multi-lateral exchanges or by the organisation of targeted workshops. Additionally, Eurescom is advising its shareholders and members in the definition of further joint collaborative undertakings that cover all emerging issues in the context of new services over future networks and media. Eurescom will also use its strong involvement in the New European Media (NEM) ETP, NetWorld2020 ETP and 5G PPP.

Eurescom will also use the results of ORPHEUS to strengthen its position as a hub for collaborative research in telecommunication networks and media in Europe by acquiring knowledge in the innovative area of object-based audio. The change in media consumption patterns over the last years has a strong impact on telecommunication operators' networks and is therefore of high interest to Eurescom and its shareholders. Eurescom's main intention for the exploitation of the ORPHEUS results is to gain knowledge on object-based audio and to exploit that for consulting, strategic discussion with

the European network operator community and contributing and influencing directions in the New European Media (NEM) ETP. ORPHEUS will also help Eurescom to advise the European telecommunications operators on market opportunities and business aspects arising from the ORPHEUS concepts

3.5.3 British Broadcasting Corporation (BBC, Partner 03)

The BBC has pioneered work towards an object-based IP end-to-end broadcasting system. Based on the results of ORPHEUS the BBC will invest into the standardisation work for object-based audio in the EBU namely the BWF group which is currently chaired by the BBC. Up to three groups have been chaired by members of the BBC Audio Research Group to date already. This has led to the development of the ADM, which is the foundation for further investigations in ORPHEUS. Results from ORPHEUS will be the foundation for further standardisation activities of the BBC within the ITU in SG6. In parallel the BBC has developed and released software to use and demonstrate these new standards and development. Examples are the Software suite for using ADM files and example BWF files. These are open and freely available from the BBC R&D website and software repositories. It is planed that the work. In ORPHEUS will develop this software further and new parts of a future broadcasting chain will be made available as open source software from bbc.co.uk/rd to stimulate the European market and enable adoption by manufactures and other broadcasters. The systems developed as part of the BBC lead tasks and work packages will contribute to a future IP based broadcasting system as part of the BBC wide activities towards IP based production and delivery.

The BBC currently co-chairs the W3C consortium working on the upcoming standard for the WebAudio API. This platform will play a key role in implementing object-based broadcasting based on IP delivery. Results from ORPHEUS will directly be put forward into this international and very important standardisation body. Also, further public trials on the BBC Taster platform will likely be based on the work in ORPHEUS.

In order to facilitate industry wide adaptation and move towards an object-based broadcasting system, the BBC has made substantial investments to present the concept of object-based broadcasting and key application examples to the industry at the IBC 2014. The results of pilots and system design work will be presented in a similar way in similar upcoming events. In 2015 the BBC is hosting the new conference, Sound: Now and Next. This unique event brings together content creators, technologists and researchers. It is a unique opportunity and a key communication platform to enable transformational changes in the industry such as the object-based broadcasting concept developed in ORPHEUS. It is expected that this event will continue biannually and be used as a key platform to communicate the results from the project to key influencing representatives and wider production staff. In summary the results from ORPHEUS are exploited in the following ways:

- Informing the developments and implementation of BBC's next generation audio infrastructure for and IP based end-to-end broadcasting system;

- Open source software release of key elements of an object-based broadcasting chain;

- Contributions to ITU, EBU, W3C standardisation activities

- Influencing the industry through trade shows and publications at AES, EBU Production Technology Seminar and others, and;

- Making the outcome of ORPHEUS a major topic in the Sound: Now and Next (2017) Conference.

3.5.4 Institut für Rundfunktechnik GmbH (IRT, Partner 04)

IRT is a research and innovation-focussed SME with non-commercial and commercial activities covered by an overall non-profit charter. One of the primary objectives is providing services to its associates, the public broadcasters of Germany (ARD, ZDF, DRadio), Austria (ORF) and Switzerland (SRG/SSR), which jointly have a total annual budget of over 10 billion €. IRT supports these broadcasters in providing cost effective and cutting-edge multimedia and broadcasting services – eventually to the benefit of the general public in Europe. To achieve this, IRT develops and assesses new technologies before these are put into operation and participates in technological and strategic decision processes. Jointly with representatives from broadcasters, IRT has identified object-based audio as a topic with high potential for future workflow updates. IRT is also a major contributor to the technical work of the European Broadcasting Union (EBU). Via EBU, important project results can and will be made available to the broadcasting community and the related industry, world-wide.

In addition, the commercial branch of IRT is offering, among other things, vendor-independent consulting, planning and testing services. Customers are mostly active in the A/V media sector, including manufacturers, public and commercial broadcasters as well as technology solution providers.

For IRT, specific exploitation potential for ORPHEUS results is seen in the following domains:

- Providing the project outcomes to broadcasters and media companies to guide them in the transition process to object-based audio broadcasting and to offer tailored accessibility solutions for end-users on a wide range of devices. With increasing cost pressure, it is important that such new "beyond state of the art" services are made sustainable and cost effective by basing them on open standards. This stimulates the evolution of a competitive horizontal market and avoids proprietary niche solutions.

- Contributing ORPHEUS results such as the baseline renderer or loudness measurement algorithms to important standardisation bodies such as the EBU or ITU, preferably on an open-source basis.

- Marketing tailored solutions for an object-based workflow – to IRT's associates, as well as to commercial customers, and;

- Offering services for subjective and objective evaluation of object-based rendering solutions, as well as supporting interoperability testing.

3.5.5 Guppies in the Dark B.V. (ECANDY, Partner 05)

Guppies in the Dark's officially registered trade name "Elephantcandy" specialises in mobile apps for music and sound, developing both complete apps, as well as components that can be integrated by third parties.

Radio listening on mobile is already huge in Europe; In Germany 16% and in Italy a staggering 34% of all people in 2014 listened to the radio on their mobile phones. Object-based audio and mobile apps are a perfect match, as there are many opportunities for the creation of innovative audio rendering and user-interfacing technologies. At the same time there is a large demand for customisation of the audio consumption experience, be it to adapt to certain environments (at home or on the go) and network limitations or to personalise the length and content of the media. According to our business model we see two very realistic possible opportunities:

- As licenses to (pro)consumer app manufacturers or publishers. We anticipate to sell 20 licenses representing over 50 M downloads and 1M € yearly income;

- As producer of apps we expect to serve a range of customers, such as radio stations representing a 500k € yearly income.

Being involved in the development of object-based audio and being among the first to have working implementations of the standard is of significant commercial interest. Elephantcandy plans to develop apps that highlight specific features of object-based audio, as well as release an object-based audio rendering engine for integration by third parties. Having convincing mobile implementations of object-based audio will also contribute to the adoption of the standard, as the flexibility of software distribution and the ubiquity of powerful mobile devices makes it feasible to expose a large audience to the new technology.

ECANDY plans to derive two product classes from the R&D carried out in ORPHEUS; licensing object-based audio components for integration by third parties and the development of custom apps for clients, such as broadcasters and music publishers. To be able to license software components (libraries), we will need to develop an SDK on top of the software that's developed in ORPHEUS. For custom apps, typically a sub-section of the object-based audio capabilities will be required, and new user interfaces and infrastructures derived from the ORPHEUS implementations and designs.

3.5.6   Trinnov Audio (TRI, Partner 06)

Trinnov Audio is a company developing advanced technologies for sound recording and reproduction. Our target markets are broadcast and home audio. As a result, ORPHEUS is a unique opportunity to prepare the new generation of Optimizer (Digital Room Correction) and remapping (adaptation to speaker placements) technologies, in the specific context of object-based audio. ORPHEUS software and hardware architecture will be the base for our next generation of products. According to our business model, the new technologies will be proposed under three possible forms:

- As products for broadcast studios. Trinnov will develop audio rendering/monitoring processors for broadcast studios. We believe that object based audio requires a new generation of audio processor with specific features. We anticipate to sell 200 to 500 processors per year generating a 1M€-2M€ yearly income;

- As products for hi-fi and home theatre enthusiasts. Trinnov will incorporate ORPHEUS results in a next generation of home cinema products. We anticipate to sell 500 to 1000 units per year generating a 1.5M€-3M€ yearly income, and;

- As licenses to consumer electronics manufacturers. We anticipate to sell 200 000 licenses representing a 2M€ yearly income.

Such products will achieve a strong dissemination of object-based audio across the entire broadcast chain through to the end user, as well as a strong development of Trinnov Audio.

Trinnov plans to commercialise the results of ORPHEUS as new products for broadcast studios, high-end audio and licences to consumer electronics manufacturers. To achieve the commercialisation after the prototyping effort conducted in ORPHEUS, Trinnov will document the electronic boards to be produced by our manufacturing subcontractor and will setup the production method. The first units to be produced will be deployed into pilot installations and then by early adopters; these installations will be followed carefully and clients' remarks taken into account to implement into the production units. For the licensing activities, the algorithms will be adapted to run on a DSP environment.

3.5.7 b<>com (BCOM, Partner 07)

BCOM (www.b-com.com) is a technology research institute created in France in 2012 which resulted from the French strategic program called « Investments for the Future ». BCOM's mission is to deliver innovation in three main areas: (i) next generation networks, (ii) hypermedia and (iii)e-health. BCOM's core values are: collaborative, proactive, and tangible results. The delivered innovation is intended to sustain the competitiveness of SMEs, to foster the creation of start-ups through a rich catalogue of commercially viable technologies and knowledge dissemination. With these goals in mind, BCOM pays a lot of attention not only to advancing the technology, but also at ensuring that proper enablement conditions are addressed so that the developed technologies ultimately reach the market and generate value. While BCOM is a young organisation, it has already built a world-class team of researchers and engineers, hiring and gathering together junior and senior talents from large companies, SMEs and academics. Among those talents are people with international reputations in advancing, enabling and delivering audio technologies.

BCOM's ambition for its hypermedia activities is at creating, delivering and rendering immersive experiences, with a holistic approach combining technology and content. Our vision is that we have now entered a post-digital era for which all is going to be about experiences, taking full benefit of digitalisation. We strongly believe that the European industry has the capability to be at the forefront of that new era and we want to be part of it, making those new experiences happen through the technologies we will deliver. The focus for our immersive audio activities is at investing into the development of an end-to-end environment in order to design and deliver 'as if you were there' experiences, on the basis of high order ambisonics technologies: capture systems, production/post-production plug-ins, rendering engines. The ORPHEUS project perfectly fits our ambition and vision by playing a critical role in the achievement of our goals.

In general, BCOM plans to derive professional grade plugins for content production (sound capture) and post-production (sound design, edit/manipulation, mixing, reference rendering) focusing on implementing the use of the high order ambisonics format into the object-based frameworks developed by ORPHEUS, enabling truly immersive and personalised sound experiences. The targeted market is mostly the content creation industry, such movies/series, TV shows, sports, and music. Such plugins will be commercialised as licensing software products; they will be able to be incorporated into market reference workstations.

3.5.8 Institut de Recherche et Coordination Acoustique/Musique (IRCAM, Partner 08)

IRCAM has very early pioneered work on object-based approach applied to sound spatialisation for musical creation. Exploiting this concept, the IRCAM Spat~ software library dedicated to real-time sound spatialisation is able to support a large variety of rendering setups, from headphones to massively multichannel such as HOA or WFS rendering, and contexts (live performance, post-production, virtual reality). Beyond privileged relations with musical creation community, IRCAM is now willing to tighten links and share expertise on the development and promotion of an object-based approach with broadcast partners at national (cf. BiLi project) and European level. ORPHEUS offers a unique opportunity to pursue this common goal.

Regarding exploitation, IRCAM will integrate object-audio metadata formats such as ADM in the future Spat~ software release, especially under its professional plugin implementation developed by a third party company Flux. Indeed, supporting object-based audio format is definitely considered as an asset or even a mandatory feature of future audio plugins to guarantee their commercial success in the broadcast, as well as film industry.

IRCAM also wants to develop means for web-based access of its musical repertoire, which makes extensive use of spatial effects. The interaction and personalisation capabilities provided by object-based audio approach also represent an interesting approach for designing specific content and tools dedicated to musical pedagogy. The collaborative experiments and technical work packages of ORPHEUS will foster these developments.

IRCAM is licensing its spatialisation and reverberation technologies to several industrial third parties. Supporting object-based audio for these third parties' products will indeed represent an important added value. In order to facilitate this technological transfer, IRCAM will integrate the authoring and rendering components developed during the ORPHEUS project in a new release of its Spat~ software (API).

3.5.9   Bayerischer Rundfunk (BR, Partner 09)

Bayerischer Rundfunk as a member of ARD, the association of German public broadcasters, has a proven leading role in developing and pushing forward new broadcast technology in practice. Within ARD, several high level committees and boards work upon technical and content standards, discuss and agree upon the commitments for implementations of new developments. Therefore, the operational results of the ORPHEUS project are also to be regularly regarded, presented and reviewed by the top-level management of all German broadcasters, thus inevitably becoming subject for discussion and consideration for strategic decisions. These might lead to an adaptation of the object-based audio format and principles in the future to offer added value through object-based features to the German audience.

In addition, outcomes and conclusions are to be feed directly into:

- Training programs and workshops for BR employees in technical and editorial departments;

- Developing training schemes at ARD/ZDF-Medienakademie, the central training facility of German public broadcasting.

3.5.10   MAGIX (MAGIX, Partner 10)

Sequoia is a Digital Audio Workstation (DAW), developed by MAGIX, which has been an integral part of public European broadcasters (such as ARD, HRT, Radio Sverige, RTSI, ORF, ZDF), classical music productions, universities and theatres, as well as leading mastering studios around the world (including Sony Music, Sterling Sound New York, Air Studios London). In contrary to other DAWs, the technological core of Sequoia has always been the object-based audio engine.

In cooperation with the project partners, Sequoia will be developed as the main audio production tool in the ORPHEUS project. The prototyping, standardisation and research process and the market tools development process is aimed to lead to a 'ready to use' solution for our content production customers. With our contribution, we are able to offer the production heart of the tool chain of audio content production.

For MAGIX, specific exploitation potential for ORPHEUS results is seen in the following domains:

- Extending Sequoia to a standardised object based workflow. This will give broadcasters and other content creators an important tool for object-based content creation. We believe that the advantages of object-based audio can have the power to change the audio production market. We think that offering such a tool from the beginning will lead to new customers. So it

will hopefully raise the revenues of Sequoia;

- Working together in the ORPHEUS project with customers and users will lead to implementations based on their real needs;

- The frequent exchange of information in the network of the project partners helps us to rate the upcoming technologies in the audio market, and;

- In the future we will adopt the results of the ORPHEUS project also to our video products.

Sequoia has the chance to be a standard for many European broadcasters and production companies. In this case we expect 1000-2000 new installed units which will lead to a revenue increase of 2-4 M € and an increase of the yearly income of 500k-1000k €. Based on the new technologies we see a chance to extend our market also to simple audio workstations typically used by journalists. That can lead to an increase of revenues also of 2-4 M €. The most positive case is that the technology is also adaptable to the consumer software market and brings strong user stories. In this case our revenues can have an increase by several million Euros.

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