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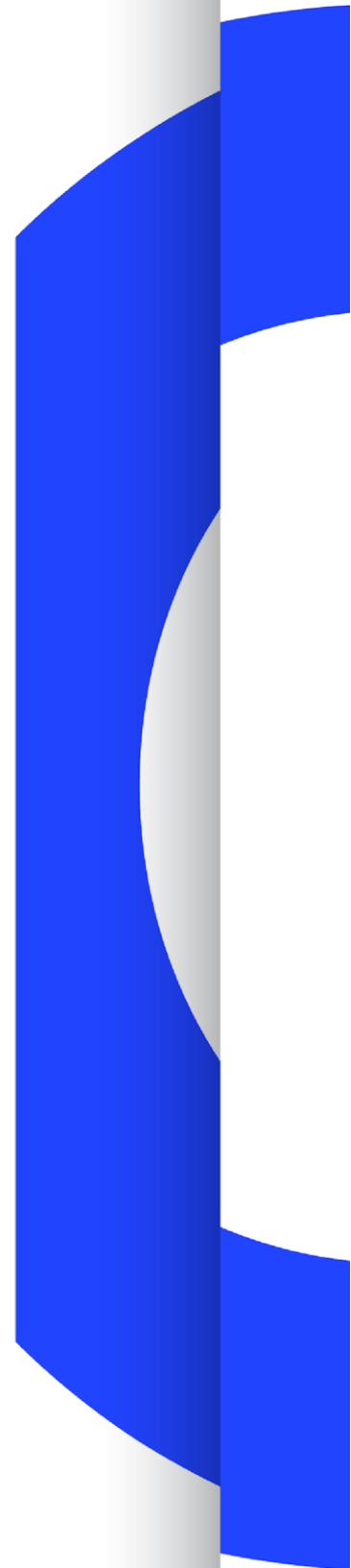
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**OPPORTUNITIES AND CHALLENGES
FOR PUBLIC SERVICE MEDIA IN VR,
AR AND MR**

EBU TECHNICAL REPORT

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Opportunities and Challenges for Public Service Media in VR, AR, and MR

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1. Introduction

There has been much recent activity in 360-degree video and VR, and much speculation about emerging AR activities. This has involved all relevant sectors, including device manufacturers, games companies, audio-visual content suppliers and service providers, and has covered application areas both inside and outside the media and entertainment industries. Rather than attempting to summarise or duplicate the many industry reports and discussion documents that have arisen around VR and related technologies, this report focuses on one particular application sector, public service broadcast (PSB).

The potential applications of VR technologies in public service broadcasting are shaped by the unique combination of needs and constraints of this area, which include:

- An overall mission that is (in general terms) to inform, educate and entertain
- The provision of services that are free at the point of delivery
- A need to cater for the needs of a diverse audience
- A well-established broad portfolio of services, largely in the form of TV and radio channels and a predominantly linear (scheduled) model, but with a growing set of services based on IP delivery (including websites, mobile and IPTV apps)
- A largely fixed income model, making it difficult to charge for or otherwise obtain funding for things that fall outside the usual model for programme commissioning
- Justifying the benefits of engaging people with content through improving measures of how the overall public purposes are met, rather than through measures such as increased viewing of advertising or additional subscription income
- A need to deliver content to a large audience in a cost-efficient way, possibly also including point to multipoint mechanisms
- Ideally low entry barriers for exploiting new experiences

The goal of public service broadcasting is to provide a balanced service of entertainment, information, and education, usually to fulfil a national public service mission to provide a national, regional, and local identity for all the population. This means providing a mix of programmes that are unique and challenging.

Different types of content bring into play a different type of viewer experience. For example, we often watch sports content or a rock concert and wish we could be physically present at the event. The situation is quite different for historical drama where we wish to be ‘observers’ to the events that take place in the past, viewing with the benefit of distance. PSBs have to provide a spectrum of content that covers all of these types of content and more.

There have been claims that viewing Virtual Reality via head mounted display will eventually replace television viewing via a conventional screen. VR does follow the fashionable trajectory of ‘personalisation’, allows stereoscopic viewing which normal TV does not, and a VR headset may use

less energy resources than a television. It can be said to be an efficient form of media consumption. It is also a very involving experience, which probably makes it more memorable to the viewer, and provides a greater sense of reality for the viewer. If indeed, VR were to become a replacement or substitute for television, then clearly public service media would need to provide their content via VR.

But equally, we can be cautious about the claim that it could fully replace television. Wearing the necessary HMD is not something that viewers seem to want to do for long periods. Viewing stereoscopic material via an HMD will be subject to the same limitation of the convergence/accommodation conflict as 3D TV was, though it should be a better 3D experience than watching 3DTV. Currently, it seems that viewers prefer to use an HMD for a maximum of about 20 minutes. The VR experience is also an ‘involving’ experience, and this may not suit all types of content, or indeed all types of viewers. This suggests that VR content will need to be ‘short-form content’ suitable for only some types of programme content. Thus VR seems likely to be an adjunct to television rather than a replacement.

This report, based on input from six public-service broadcasters covering Europe, Japan and South Korea, gives an insight into how the opportunities and challenges of VR and related technology are being viewed against this background. It summarises the kind of tests and trials that have already been conducted, discusses what has been learned from these, and concludes by summarising future activities that are currently foreseen and the roles that PSBs could play together in further developments.

Additionally, **Annex 1** contains the presentation “What does VR/360 represent for broadcasters?” given by Graham Thomas (BBC) at the EBU Production Technology Seminar in January 2017.

2. Definitions

2.1 VR, AR and MR

For the purpose of this report, the following definitions will be used:

VR	Virtual Reality includes 360-degree video as well as rendered interactive graphics (e.g. from a games engine). Where useful in this report, this term is sub-divided into:	
	360 video	when the content is primarily video-based
	CG VR	Computer-Generated VR, when the content is primarily rendered from a 3D model, in real time in the user’s device
	360/VR	used when needed to make explicit that both 360-degree video and CG-based content is being discussed.

There are various definitions for AR and MR; for example The Foundry¹ suggests differentiating between these technologies as follows:

AR	Augmented Reality is an overlay of content on the real world, but that content is not anchored to or part of it. The real-world content and the CG content are not able to respond to each other.
MR	Mixed Reality is an overlay of synthetic content on the real world that is anchored to and interacts with the real world—picture surgeons overlaying virtual ultrasound images on their patient while performing an operation, for example. The key characteristic of MR is that the synthetic content and the real-world content are able to react to each other in real time.

By this definition, AR would include overlays that add additional information about a displayed scene (e.g. labels that are placed near real objects but are not rigidly attached to them). If those

¹ “VR? AR? MR? Sorry, I’m confused” <https://www.thefoundry.co.uk/solutions/virtual-reality/vr-ar-mr-sorry-im-confused/>

labels become tightly-overlaid to real objects (moving as they move), then arguably we would be moving into the area of MR, particularly if the overlays also interact with the scene by, for example, casting shadows. However, the amount of activity in AR/MR in areas relating to public-service broadcasting is currently sufficiently small that an accurate sub-division into these categories is unlikely to be needed.

We are only considering applications where the viewer can experience VR, AR or MR interactively, with a minimum level of interactivity being changing the orientation of the viewer (generally three degrees-of-freedom (3DOF): left/right, up/down and rotation about the direction-of-view). We will include content that is either viewed through a PC or TV screen (browsing with a mouse or other interactive means), or a tablet/smart phone screen (browsing with touch, or by moving the device around as a so-called ‘magic window’), or via a headset. We are not considering uses purely at the production side (such as in a virtual studio or ‘tied to pitch’ sports graphics) which would be viewed through a normal TV broadcast.

2.2 *Types of VR HMD*

There are two main categories of virtual reality headsets today, which are termed Type A and Type B in a recent DVB report². Type A HMDs, such as the Google Cardboard and many others, rely on using a smart phone in a container. Type B headsets, such as Oculus Rift, rely on specially-designed headsets. There is a plurality of Type A headsets, which call for different image and sound formats that suit the smart phone concerned. There are also several different Type B devices. The DVB has concluded that Type A systems will vastly outsell Type B systems in the next five years.

Part of the public service mission is ‘universality’, and thus it seems that if VR is to have a place in public service offerings in the near future it will need to be via Type A systems, which will have much wider public usage.

2.3 *Types of audio*

Although this report is structured around different ways of presenting visual information, it should be remembered that audio also plays a crucial role in immersive experience. The general term “360 audio” will be used to indicate audio with some form of spatial or directional enhancement, usually responsive to the viewer’s orientation. This may be delivered using approaches such as Ambisonics (representing the sound field at the viewer’s location, as is available, for example, in 360-degree videos on YouTube), and/or object-based audio (where sound sources have specified locations). Headphone audio may be rendered using straightforward stereo (or even mono), or using binaural processing that provides an immersive experience.

3. What trials have been conducted and what have we learned so far?

This section summarises the kinds of trials that PSBs have carried out so far, and the feedback they have received. It considers the conclusions that can be drawn from these trials, in terms of the programme genres most likely to benefit, the impact on storytelling, and the relevance of live delivery.

3.1 *Trials already conducted*

3.1.1 360-degree video

All the PSBs surveyed for this report have conducted trials in which 360-degree video content was distributed on-line. Most of these were in the form of trailers, additional content, or short behind-the-scenes programmes in connection with mainstream TV/Radio programmes. They covered a range of genres including:

² DVB Project. Virtual Reality - Prospects for DVB Delivery. Report of the DVB CM Study Mission on Virtual Reality, October 2016.

- News / Journalism (BBC, KBS, NHK, RAI, VRT)
- Natural History (BBC, ZDF, KBS, NHK)
- Music / Entertainment (BBC, ZDF, KBS, NHK)
- Talk show (BBC, KBS)
- Sport (e.g. Rio Olympics app provided by OBS and used by BBC and NHK)

Links to some examples are included in **Annex 2**.

These productions used a range of camera technology (including clusters of GoPros, e.g. in a Freedom rig or Panoera 360 rig, Ricoh Theta, Samsung Galaxy Gear360, Kodak SP360 4K) and stitching software (including Kolor Autopano video and VideoStitch Vahana VR for live use). Much of this work was conducted by the R&D departments of the broadcasters, with the production work increasingly moving to 3rd parties.

Distribution has primarily been via YouTube and Facebook, although KBS have the ‘*myK*’ app that includes 360 delivery and NHK have used the *krpano* web-based viewer. NHK’s group company, NHK Media Technology, has also demonstrated immersive video in an ‘8K VR Theatre’ installation: a large-screen stereoscopic projection system for events (like 3D cinema, but the large screen size makes the experience more immersive, akin to projection-based VR).

3.1.2 CG VR and AR/MR

A small number of trials involving public distribution of CG VR applications have also been conducted:

- Journalism (e.g. “We Wait”, BBC)
- Storytelling (e.g. “The Turning Forest”, BBC)

CG VR technology is also being used for broadcast programmes, where a user is seen experiencing VR and virtual studio-type techniques are used to show the user immersed in the VR world (VRT).

VR and AR/MR have also been used by public-service broadcasters at various events, including:

- VR installations at film festivals to gauge viewer reaction and raise profile of VR for non-gaming applications (BBC)
- ‘Augmented TV’ trial, providing AR augmentation in the room around a TV (NHK)
- ‘8K VR Theatre’ installation - large-screen stereoscopic projection system for events (like 3D cinema, but large screen size makes the experience more immersive, akin to projection-based VR) (NHK)
- Sports VR event: experience various sporting events in VR in a sports week (NHK)
- AR forms an element of the BBC’s ‘Venue Explorer’ prototype, in the form of overlays added to elements of a panoramic scene that a viewer can explore through a non-immersive web browser interface.
- Painting in 3D environment with Tilt Brush, HTC Vive set up: During a gaming event, we put a 3D avatar of a popular character (Kaatje) in Tilt Brush. Children could walk around this avatar and draw on or around her in 3D space.(VRT)

3.2 *Feedback from users*

Feedback from these trials has generally been very positive:

- 360 video is heavily dependent on content and quality, and ratings and engagement reflect this (BBC)
- Particularly good feedback has been received for Natural History content (BBC, KBS)
- CG VR pilots have received very good feedback. Particularly effective areas include current affairs, and historical topics. (BBC)
- Positive feedback has been received from people viewing 360/VR at events, even after a 30-minute wait to see it (VRT)
- Using a headset (as opposed to just viewing using the screen) dramatically improves people's enjoyment of CG VR experiences on a smartphone. Conversely, there isn't that trend with 360 video, and users are as happy with a smartphone-only 360 experience, compared to one with a Cardboard / smartphone headset. (BBC)
- 360 video is still largely seen as a 'snack culture', with many of the largest viewer engagements happening in brief periods when the appearance of celebrities was shared on social networks (KBS)
- Some users commented on the need for improved resolution and fewer compression artefacts in 360 video, and the importance of avoiding the risk of motion sickness (NHK).

3.3 *What have these trials told us about applicability to programme genres?*

3.3.1 **360/VR**

- Genres that align best to the strengths of 360/VR probably include Learning, Factual and Natural History, with Music and Entertainment also having some alignment. (BBC)
- Genres that appear to have less alignment with 360/VR may include News, Drama, Comedy and Films, although more experimentation is needed to explore areas such as Drama where new kinds of genres and techniques might be enabled by VR. (BBC)
- Sport seen has a relevant genre by some (particularly sports broadcasters, but these tend not to be public service)
- 360/VR seems good for "experience". When producing VR content, we usually focus on how we can "transfer" "the way we can experience it" (KBS)
- Travel shows (Journalism) received very good audience feedback, especially flight cam video (KBS).
- Concerts can be a good use case but it is hard to feel "the touch" and "the sound" of the event in 360 video. (KBS)
- Location-based programmes such as housing/cooking/reality tv shows, where you can experience the location for yourself. E.g. Wonen.tv, building a webvr player for a housing tv show, where viewers can go online and experience the interior of a house at their own pace. (VRT).

3.3.2 **AR/MR**

- **VR/AR:** Games seem likely to be the most popular use, although educational content with some gaming concept (interactivity) also looks promising (KBS)
- **MR:** may have potential to help in pre-production stages, also potential to provide a more immersive and realistic experience to end users; to push creative storytelling (RAI).

3.3.3 How might VR technologies impact on storytelling?

- **Viewer at the centre:** 360/VR is likely to need a new approach to storytelling. Deliberately placing the viewer at the centre of the action appears to be important in delivering the emotional engagement and empathy that VR is capable of, but this requires re-thinking the storytelling and filming/production process.
- **Interaction, presence and agency:** Interaction of the viewer with the scene needs to be considered carefully: believable VR includes the user seeing himself in the scene; ideally being able to interact with it or influence it. Achieving this within the technical constraints of the medium and the editorial constraints of the 'story' is not easy.
- **Directing attention:** VR lacks one of the basic tools for film storytelling - the "shot", i.e. the possibility to explicitly show (or hide) some element of the scene. This can make storytelling very problematic, requiring careful directing and editing. This does not mean that it would be impossible to make a full-length length 360° drama production, but a proper language still needs to be developed.
- **Navigation:** When we enjoy VR, we really want to move forward, not just look around. But 360 video itself does not allow the viewer to control their movement, leaving it up to the director to determine how the viewer moves and what can be seen.
- **Exploiting interesting locations:** 360 video particularly adds value when the location itself is interesting, and the viewer can enjoy exploring it through head movements. Removing the need for a controlled camera also allows cameras to be placed in locations where it would be difficult to use a manned or remotely-operated camera. This will impact on storytelling because we can tell a story in places that are currently impractical. On the other hand, many locations currently used for storytelling (e.g. a studio) may not work for 360 video if there are places that the viewer is not intended to see.

3.3.4 Is 'live' important?

Most of the best-suited content does not have to be live, but some journalism and sport applications would need live delivery, and 'second screen' applications synchronised to a live broadcast need synchronisation (as well as potentially live) capability. There are some plans for providing VR content as one of the ATSC 3.0 additional services (KBS).

The VRT is one of the partners of ImmersiaTV, a H2020 project with different takes on mixing traditional TV broadcasting with virtual reality. The project is preparing a live pilot, synchronising a live sport event with a 360 video experience. Viewers can watch the sport event on TV and jump to certain places live in the field, with the HMD.

4. Future activities

This section summarises the plans that PSBs currently have for activities in 360/VR and MR/AR, building on the experiences above, and goes on to look at the roles that PSBs could carry out jointly.

4.1 Plans for future activities and expected timescales

Plans for R&D activities amongst the PSBs surveyed include:

- Exploring the importance of the user needing to see their body or have the environment react to their presence (BBC)
- Exploring the social side of VR - how users will connect with each other (VRT)
- Approaches for creating interactive/non-linear experiences using 360 video on the web (BBC)
- Trials of MR applications for both programme makers and viewers, e.g. prototypes using the Hololens (BBC, IRT, KBS, RAI)
- Exploring WebVR, as it is the most easy way to distribute vr content to large audiences.(VRT)

Plans for larger-scale public-facing trials include:

- Continuing the release of 360 videos, supported by better 360-degree production tools and production/distribution pipeline (all)
- Trials to test audience reaction to VR technologies in new genres (BBC)
- Trials involving the release of CG VR content through public VR stores, to understand routes to market, licensing and distribution challenges and also to help gather feedback more widely, and understand the costs of porting between headsets and any impact of meeting the technical requirements for commercial use (BBC)

Regarding timescales, the following comments were made by the PSBs surveyed:

- Short-term uptake to a useful proportion of the audience will be for 360 video, mostly on phone-based headsets or via a scrolling window on a mobile, tablet or PC browser.
- Bullish projections suggest that, in 2-5 years, higher-end headsets (PC/console-based) could be in as many as one third of households, dependent on the right market conditions, and phone-based systems will start to become capable of delivering high-end CG VR experiences that currently require a high-end PC. This kind of VR technology is already becoming important at events, though.
- However, it is still hard to tell how much of the current activity is ‘hype’ and how much will become part of the ongoing mainstream activities of viewers.

Overall, it seems likely that VR has the potential to give us exciting and impactful new ways of delivering public service content, particularly given its apparent ability to convey emotion, empathy and drive memorability.

However, as everyone knows, the audience is quite small at the moment, and time will tell on how significant the size of the opportunity will be. This makes cost a critical factor, and the BBC has found that for CG VR experiences, the cost per hour of production is currently at the same order of magnitude as high-end TV dramas.

As such, PSBs are working closely with partners to experiment in this new medium, to unpick and understand what this type of experience can do to inform, educate and entertain.

4.2 The role that public service broadcasters can play in VR

The following activities were suggested as things that PSBs could do together, for example in the EBU BTF-VR group:

- Standards-related activities, such as:
 - Sharing views on any requirements for standardisation, for example whether there is a need for “one to many” broadcast formats
 - Joint input to the relevant bodies (e.g. DVB and MPEG)
 - Interoperability tests around production formats could be a useful part of this activity
- Holding workshops and other events to share experiences and best practice on topics such as VR journalism, 360-degree audio, and the current state-of-the-art of compression and delivery technologies
- Investigation of issues around health, safety, and accessibility, such as policies regarding age restrictions, photosensitive epilepsy assessment & warnings, and best practice in subtitling
- Creation and management of different focus groups: one formed by operational production people (e.g., directors, directors of photography, sceneographers, etc) and the other made of (home) users. These groups could give advice and feedback on potential applications and usage of technologies.
- Ideation and management of creative ‘hackathons’/context to discover new ideas and

broadcast formats enabled by these emerging technologies.

5. Conclusion

This report provides a snapshot of recent activities and future plans in the area of VR from a group of six public-service broadcasters. All broadcasters had experimented with, and had conducted public trials with 360° video, and some have also conducted experiments and public trials of CG VR.

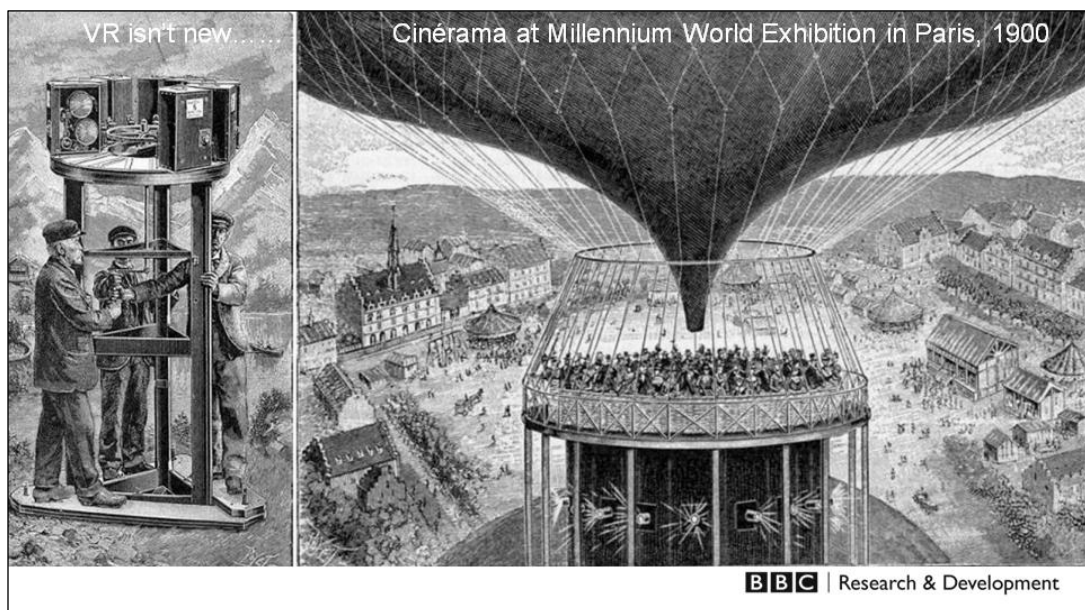
A smaller number of AR/MR experiments have also been conducted. 360 video is seen as the most relevant technology going forward in the short term, and suggestions for joint activities to support future developments have been given.

Annex 1: “What does VR/360 represent for broadcasters?”

The video of this presentation is available to Members from the following page:

<https://tech.ebu.ch/cms/render/live/pts2017>

[Please note that purely textual slides have been included as text to minimize file size]



Summary of talk

- Characteristics of PSBs that affect their use of VR
- Thoughts on most applicable genres
- Challenges in the use of VR
- Future plans and possible roles for PSBs

Key takeaways

PSBs contributing to this work

- BBC (UK)



- KBS (Korea)



- NHK (Japan)



- RAI (Italy)



- VRT (Belgium)



- ZDF, BR (Germany)



Characteristics of PSBs affecting the introduction of new services

- Fit in with well-established portfolio of services
- Free at the point of delivery - hard to charge extra
- Need to justifying the benefits by meeting public purposes rather than increased revenue
- Reach large audience in cost-effective way, with low barrier to entry

Genres of PSB trials

360 trials have included:

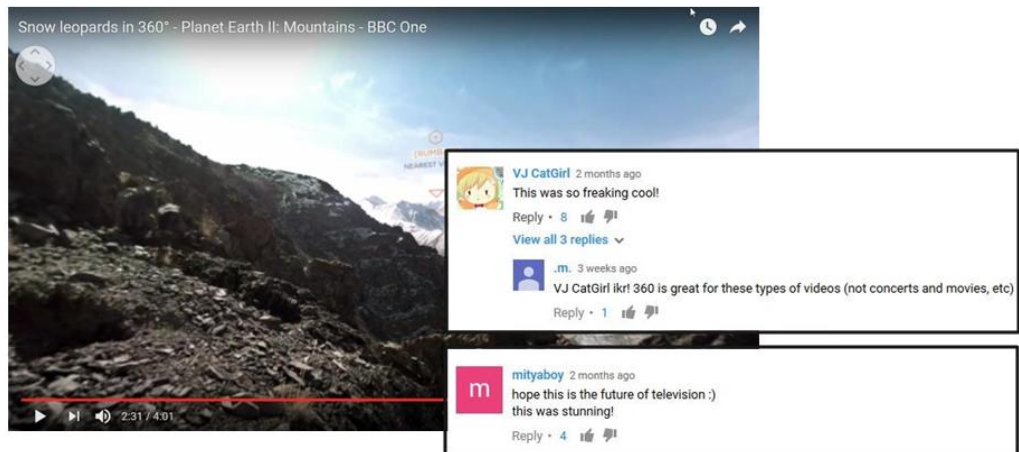
- News / Journalism
- Natural History
- Music / Entertainment
- Talk show
- Sport

Example: Journalism – Architecture programme (RAI)



BBC | Research & Development

Example: Natural History – Planet Earth 2 (BBC)



BBC | Research & Development

Example: Music / Entertainment (ZDF)



BBC | Research & Development

Example: Talk show (KBS)

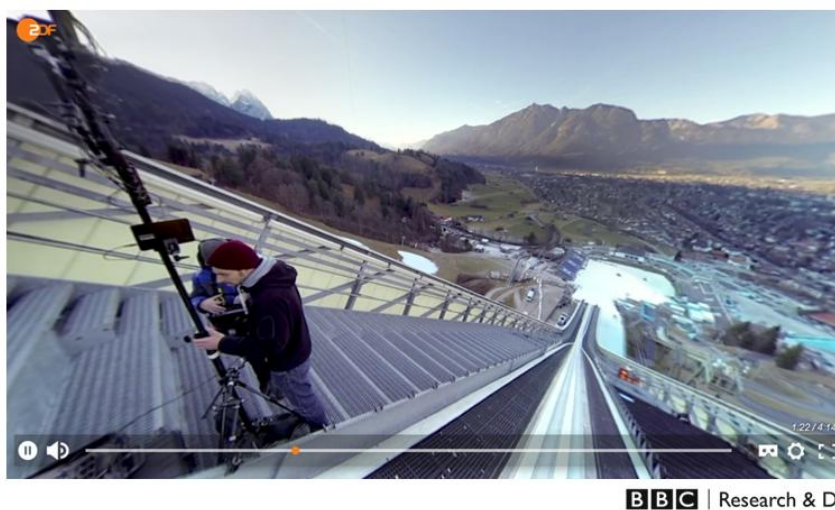


BBC | Research & Development

Example: Sport (BBC)



Example: Sport (ZDF)



Genres of PSB trials

CG VR trials (rendering in the user's device) have included:

- Journalism (e.g. "We Wait", BBC)
- Storytelling (e.g. "The Turning Forest", BBC)

CG VR trials (rendering before broadcast for 360 video or using VR technology) have included:

- Journalism (e.g. "Darwin", NHK)
- Game show (e.g. virtual studio using Tilt Brush, VRT)

Example: Journalism - We Wait (BBC)



BBC | Research & Development

Example: Storytelling – The Turning Forest (BBC)



BBC | Research & Development

Genres of PSB trials and how they benefit from features of VR

	Factual / Journalism	Learning	Natural History	Music / entertainment
Emotional impact: Interaction, presence and agency	✓	✓		
Emotional impact: Viewer at the centre	✓		✓	✓
Free curiosity: ability to look round	✓	✓	✓	
Convey sense of place, scale, "experience"	✓	✓	✓	✓

BBC | Research & Development

Some comments on what was learned

360 video is heavily dependent on content and quality, and ratings and engagement reflect this

360 video is still largely seen as a 'snack culture'

CG VR pilots have received very good feedback. Particularly effective areas include current affairs, and historical topics

Positive feedback has been received from people viewing 360/VR at events, even after a 30-minute wait to see it

For CG VR experiences, using a headset (as opposed to just viewing using the screen) dramatically improves people's enjoyment, but for 360 video, users are just as happy without a headset

Some users commented on the need for improved resolution and fewer compression artefacts in 360 video

BBC | Research & Development

Challenges for storytelling in VR

- **Placing viewer at centre** requires new approach to storytelling



Ryad's War (VRT): speaking directly to the viewer

BBC | Research & Development

Challenges for storytelling in VR

- **Interaction, presence and agency:** believable VR includes the user seeing themselves in the scene and ideally being able to interact with it or influence it

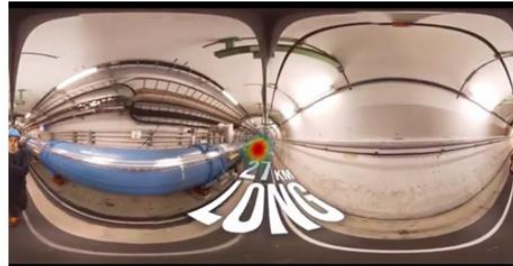


Home (immersive spacewalk experience) (BBC): uses controllers on HTC Vive for interaction

BBC | Research & Development

Challenges for storytelling in VR

- **Directing attention:** VR lacks one of the basic tools for film storytelling - the “shot”, i.e. the possibility to explicitly show (or hide) some element of the scene



Heatmap of view centres

Inside the Large Hadron Collider (BBC):
movement and graphics draw the eye

BBC | Research & Development

Challenges for storytelling in VR

- **Navigation:** 360 video itself does not allow the viewer to control their movement, and any moves the camera makes can lead to nausea



Paralympic athlete's view
(NHK): steady movement
is not a problem

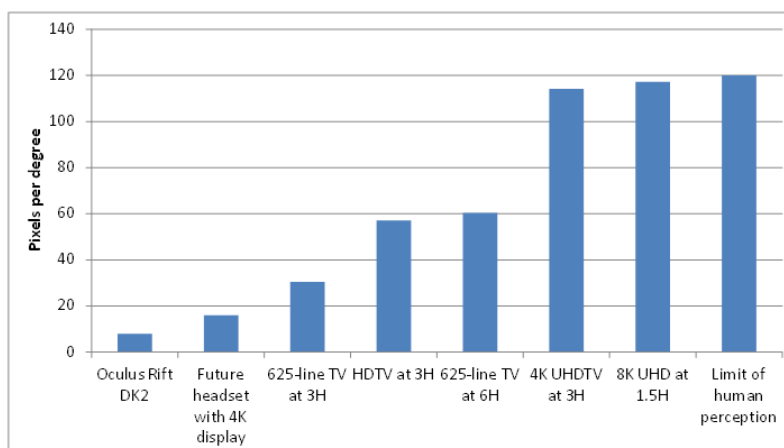
BBC | Research & Development

Challenge: TV content viewed in a headset - Display resolution



BBC | Research & Development

Challenge: TV content viewed in a headset - Display resolution



BBC | Research & Development

Is 'live' important?

- For most genres considered, live is not important, but...
- Some journalism and sport applications would need live delivery
- 'Second screen' applications synchronised to a broadcast need synchronisation (as well as potentially live) capability, for example:
 - ImmersiaTV project (VRT)
 - VR content as one of the ATSC 3.0 additional services (KBS)

Example of live 360: New Year Fireworks (BBC)



BBC | Research & Development

Example of synchronisation: ImmersiaTV project (VRT)



BBC | Research & Development

Examples of future R&D activities amongst PSBs

- Exploring the importance of user needing to see their body or have the environment react to their presence
- Exploring the social side of VR - how users will connect with each other
- Approaches for creating interactive/non-linear experiences using 360 video on the web
- Trials of MR applications for both programme makers and viewers, e.g. using the Hololens
- Exploring WebVR, as an easy way to distribute VR content to large audiences

Examples of future public-facing trials

- Continuing the release of 360 videos, supported by better 360-degree tools and distribution pipelines
- Trials to test audience reaction in new genres
- Trials involving the release of CG VR content through public VR stores, to
 - understand routes to market
 - understand licensing and distribution challenges
 - gather feedback more widely
 - understand the costs of porting between headsets and any impact of meeting the technical requirements for commercial use

Timescales?

- Short-term uptake to a useful proportion of the audience will be for 360 video, mostly on phone-based headsets or via a scrolling window on a mobile, tablet or PC browser
- Bullish projections suggest that, in 2-5 years:
 - higher-end headsets (PC/console-based) could be in as many as one third of households
 - phone-based systems will start to become capable of delivering high-end CG VR
- However, it is still hard to tell how much current activity is 'hype' and how much will become part of the ongoing mainstream activities of viewers

Roles that PSBs could play

- Standards-related activities
 - Sharing views on requirements for standardisation
 - Joint input to standards bodies
- Share experiences and best practice
 - Hackathons?
 - Focus groups for advice and feedback?
- Investigation of issues around health, safety, and accessibility

Key takeaways:

- VR has the potential to give us exciting and impactful new ways of delivering public service content
 - particularly given its apparent ability to convey emotion, empathy and drive memorability.
- However, the audience is small at the moment which makes cost a critical factor
 - BBC has found that the cost per hour for CG VR experiences is currently the same order of magnitude as high-end TV dramas.
- As such, PSBs are working closely with partners to experiment in this new medium, to unpick and understand what this type of experience can do to inform, educate and entertain.

Annex 2: Links to examples of PSB VR/AR/MR content.

The following are a few selected examples of content produced by the PSBs that contributed to this report.

BBC:

Most of our 360/VR material is released via our Taster website:

<http://www.bbc.co.uk/taster/categories/virtual-reality/>. Some specific examples include:

- **Planet Earth 2:** e.g. <http://www.bbc.co.uk/taster/projects/planet-earth-2-360-mountains> (Natural History)
- **No Small Talk:** <http://www.bbc.co.uk/taster/projects/no-small-talk> (aimed at female youth audience)
- **We Wait:** <http://www.bbc.co.uk/taster/projects/we-wait> (VR linear documentary about migrants, available via the Oculus store)
- **The Turning Forest:** (audio-rich VR fairytale) <http://www.bbc.co.uk/taster/projects/turning-forest>, available for Google Daydream on the Android store: <https://play.google.com/store/apps/details?id=uk.co.bbc.turningforest>
- **New Year fireworks:** streamed live during the event and also available for viewing afterwards: <http://www.bbc.co.uk/taster/projects/new-years-eve-fireworks-360>
- **‘Venue Explorer’ prototype:** incorporating AR elements in a zoomable/pannable panoramic image: <http://www.bbc.co.uk/rd/projects/venue-explorer>
<https://www.youtube.com/watch?v=oljhgGh3amw>

ZDF/BR/IRT:

- **ZDF:** 360° in “mediathek” available (<https://vr.zdf.de/>)
- **BR:** experimental VR (360° 3DOF) integrated in regular and operational BR24 App service (see <http://www.br.de/mediathek/video/sendungen/nachrichten/br24-360-grad-100.html> audio German only ...)

KBS:

- **Sumteo VR (Korean Grand Nature VR) -**
https://www.youtube.com/playlist?list=PLos9uai98eEg1DWEapKjZ-sjoB_qbVrIR
 - Ullung-Do: <https://www.youtube.com/watch?v=FA5ICd3tWZk>
 - Mt. Sollak: https://www.youtube.com/watch?v=-di_GmWDj1o
 - Dok-do: <https://www.youtube.com/watch?v=QVXyrOQQSdg>
 - Mt. Juwang: <https://www.youtube.com/watch?v=bFT3BKHHPVE>
- **Talk show:** <https://www.youtube.com/watch?v=yKy5mM7E6Rs>
- **Travel Documentary:** <https://www.youtube.com/watch?v=lNcwLmzLIC4>
- **VR Journalism:**
 - News show: <https://www.youtube.com/watch?v=FFQAT0TQeME>
 - Artist Baek Nam-Jun: <https://www.youtube.com/watch?v=AgURJawBFv4>
 - Candle Demonstration: https://www.youtube.com/watch?v=XdsUpK_LvEs
 - Election : <https://www.youtube.com/watch?v=pqOiC6Vb0No>
- **Music concert:** <https://www.youtube.com/watch?v=Gf3b1FPmGSI>

NHK:

- **“NHK VR News”:** The service is available at <http://www.nhk.or.jp/d-navi/vr/>
- **“Document 72 hours”:** A VR programme is available at <http://www.nhk.or.jp/d-navi/vr/72h/>

- “Document 72 hours: Opening music live”: <http://www.nhk.or.jp/d-navi/vr/72h-2/>
- Sports VR event: <https://pid.nhk.or.jp/event/nsipo/detail/event19.html>
Rio Paralympics athlete’s view in VR: <http://www.nhk.or.jp/sg-project/seed2/pa-2016/vr/>
- Historical Drama Studio VR: <http://www.nhk.or.jp/sanadamaru/special/vr360/index.html>
- Natural History VR1 (Darwin): <http://www.nhk.or.jp/d-navi/vr/darwin/>
- Natural History VR2 (Cosmic): <http://www.nhk.or.jp/d-navi/vr/cosmic/index.html>
 - Additional information: <http://orihalcon.co.jp/cosmicfrontnext-vr/>
- Storytelling: <http://www.nhk.or.jp/d-navi/vr/oyasumi/>
- “8K VR Theatre”: http://www.nhk-mt.co.jp/information/press/2016/09/8kvr_aoi_-.html
- MR example: “Augmented TV”: <http://www.nhk.or.jp/strl/augmented-tv/en/>

RAI:

- <http://www.raisport.rai.it/dl/raiSport/Articoli/Rio-VR-360-f8b482ab-06ea-4636-bd99-2cd8b5d27345.html> - The 360° videos of Rio 2016 on the page of RAI Sport
- <http://www.voyager.rai.it> - The home page of this documentary programme contains links to several 360° videos on Italian architecture

VRT:

- Our 360video youtube channel:
https://www.youtube.com/channel/UC2QYY0sFGjn0_K0Y_6Bv18g
- Immersiatv: <http://innovatie.vrt.be/home/2016/9/29/immersiatv-toont-eerste-resultaten-op-ibc> (in Dutch, or a small movie in English) <http://www.immersiatv.eu/>
- Wonen.tv: This housing programme will air in January 2017. It has an online platform with a lot of extra content (<https://www.een.be/wonen-tv>). With a 3rd party we make an online 360° experience where the audience can look at the houses after the show, with extra portals to media such as audio/photo/plans.