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Contents

Whatever the metaverse *may* be, it *must* be sustainable

Antonio Arcidiacono, Director of Technology & Innovation, EBU

A recent article on the Financial Times website[1] noted that, on an evening in early December, UK internet traffic had spiked at 25.5 terabits of data per second. The result of Amazon Prime live-streaming six football matches simultaneously, it stretched the national infrastructure to the limit. While the networks coped with the spike, the writer went on to put this milestone in the context of the growing hype around the metaverse.

"A fully working virtual world, or even just a real-time, high-definition immersive experience, will require far, far more capacity to transmit data between the consumer and network than is currently available in homes around the world."

This raises the question of what it will take to enable the metaverse in reality and – most importantly – who will pay for the infrastructure.

Providing a truly immersive VR experience would require images going from 8K to the equivalent of 24K resolution, corresponding to a guaranteed end-user bandwidth – considering a unicast fibre connection – in the order of 1 GBPS and a corresponding access network enhanced to 25-50 GBPS.[2]

It is often surprising to learn how little consideration is given to the question of how such services and experiences will be delivered to the general public. A few years ago we visited the 3D production facilities at Intel Studios in Los Angeles. They were very proud of what they could produce in terms of an immersive experience but also worried that they would need gigabits per second for the connection with each individual user. This could not scale for tens or hundreds of millions of users. I immediately commented that they were ignoring the capabilities of broadcast/multicast delivery, if and when combined with unicast low-latency connectivity. They smiled and nodded politely, but they were probably asking themselves *why is he talking about broadcasting*?!

We should recall that users seek an experience that is both personalized and shared. While content must be tailored to individual users, the shared experience relies on simultaneous use of the same media elements by many users.

BROADCAST THE BACKGROUND
An optimal user experience can only be ensured if the delivery requirements are taken into account at the design stage for new applications and by using production strategies that can combine and synchronize data delivered on different IP infrastructures. The metaverse would thus operate on the basis of background content that can be transmitted using broadcast/multicast, with unicast connectivity used to deliver the interactive and personalized content that is demanded by that individual user's current actions.

In reality, the combination of broadcast and unicast is absolutely feasible, even if they are based on different network topologies and infrastructures. An additional and key element is that of using intelligence at the smart edges of the network. If properly conceived, the combination of different types of networks and network elements into a multilayer infrastructure – combining unicast, broadcast/multicast and local smart edges using AI functionalities – will provide a unique set of tools to drastically improve the sustainability of the future metaverse.

All of this is possible using infrastructures and technologies that are already available, from fibre connectivity and cellular networks to terrestrial and satellite broadcast networks. The latter, for example, are today capable of delivering direct-to-edge GBPS-worth of content, in native UDP format, to millions of people with a single transmission. This is part of what we are preparing in the EBU 5G-EMERGE project.

Returning to the question of who should pay, if the metaverse – whatever it turns out to be – is to become a reality, it is essential to develop an infrastructure whose cost can be sustainably shared between those who build the metaverse, the telcos and the end users. It goes without saying, there are also difficult questions around the environmental sustainability of ubiquitous virtual worlds. The use of a multi-layered infrastructure, with its inherent efficiencies, can be one essential part of the answer, preparing to face the implications of an ever more data-hungry world.

1. tinyurl.com/ft-metaverse
2. tinyurl.com/vr-whitepaper
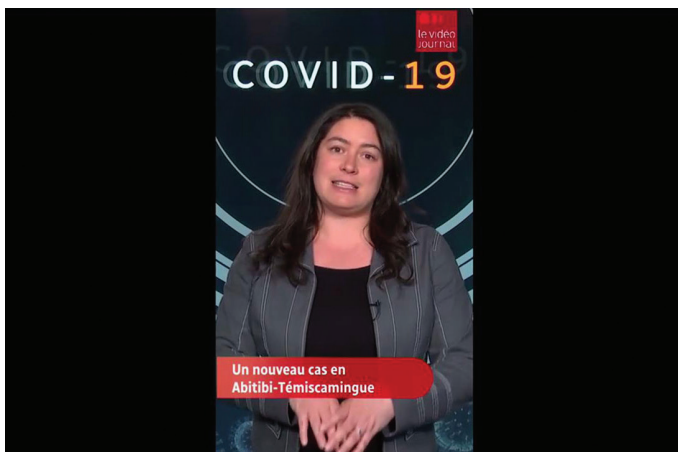
Recommendation for thinking inside the box

A new EBU Recommendation provides guidance for broadcasters and the industry to better deal with the non-traditional aspect ratios that are commonly used on social media platforms. Such aspect ratios are not easily handled in workflows and solutions that have evolved to fit a world framed in 16:9.

Titled *Archival of Vertical Aspect Ratio Video*, the EBU R 155 document outlines best practices to avoid unnecessary degradation and preserve the full resolution of footage recorded in non-traditional (e.g. 9:16) aspect ratios during archival. It also provides guidance for recording 16:9 footage that is destined to be repurposed for other aspect ratios down the line.

This EBU Recommendation was triggered by and created with the help of CBC/Radio-Canada. It draws on the experience gained through the successful launch of services providing local news programming built on user-generated content and using social media for distribution.

"We put a strategic focus on services for regional audiences", said Jonathan Dupras, Director of Architecture and Strategic Development at CBC/Radio-Canada. "Custom newscasts on digital platforms were a way to provide these local services at a granularity that would have been impossible with regular 30 minutes newscasts."

Kayatri Rangarajan, from the broadcaster's Architecture and Strategic Development unit, pointed out that the workflows and archiving practices traditionally used were not suitable for these new services. "We were unable to preserve the content properly, and we quickly found out there was no standard or best practices on how to proceed."

R 155 contains simple-to-follow guidelines and encapsulates the best practices developed by the Canadian broadcaster and their European counterparts. It is directed at broadcasters and content creators as well as vendors seeking to optimize their solutions.

Visit: tech.ebu.ch/publications/r155

Practical guidance for the transition to Next Generation Audio

A recently published EBU Technical Review article aims to help those aiming to deliver the personalized audio experiences that Next Generation Audio (NGA) can provide. Over the last few years, standards have been created for both the metadata to describe NGA experiences and the containers to transport the audio essence along with this metadata.

While the standards ecosystem is largely in place, best practices around implementation are still taking shape. The Technical Review article provides a summary of the challenges ahead and an overview of the status of the underlying open standards. Importantly, it also provides examples of concrete end-to-end live workflows, based on Dolby technology, that have been used in trials and events. These examples illustrate that there are different ways to transition to NGA dependent upon the selected infrastructure strategy.

The article, titled *Practical implementation of new open standards for Next Generation Audio production and interchange*, is particularly useful for broadcasters planning for the transition to NGA. It can help to clarify the extent to which existing infrastructure can be reused, and how much must be renewed, for example as part of a new UHD workflow. *Visit:* tech.ebu.ch/publications (filter for Technical Review)

The EBU Video Systems group has completed version 2.0 of the measurement specification for professional video monitors, EBU Tech 3325. The new release includes detailed descriptions of how to measure HDR (high dynamic range) monitors and suggests how to report the results. The measurement methods form the basis for the EBU Grade 1/2/3 monitor classification scheme defined in EBU Tech 3320.

Also available is a set of test material to carry out the measurements. The new set extends the original (SDR) material with – among others – more demanding colours and the multi-purpose test pattern shown here.

Visit: tech.ebu.ch/publications/tech3325

PTS 2022 in numbers

3 days   >500 registrations

33 presentations   7 round tables   3 keynotes   1 special event

80 speakers   35% female speakers
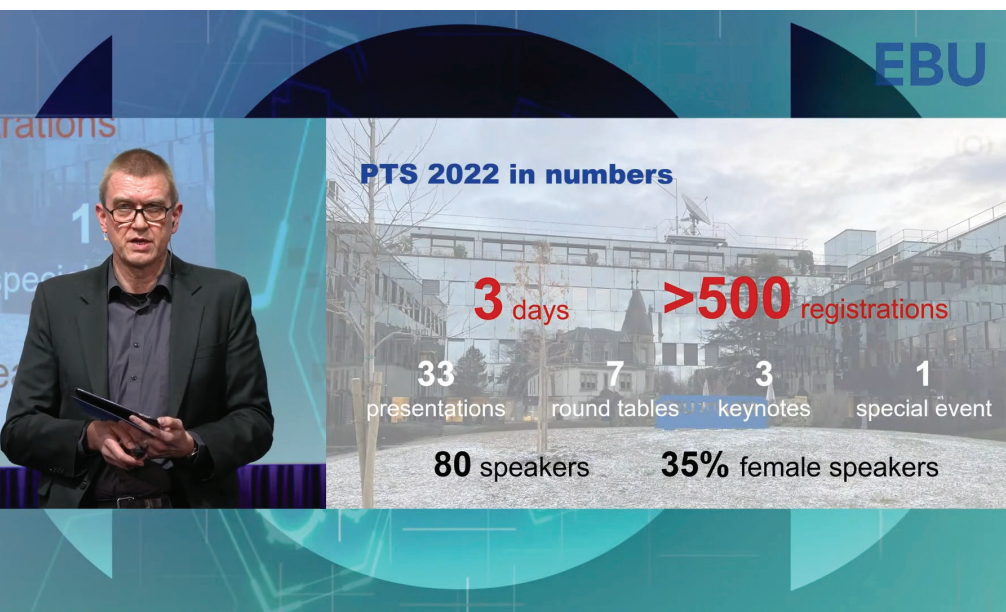
Production Technology Seminar 2022: where did the journey take us?

The unenviable task of wrapping up the Production Technology Seminar 2022 fell to SWR's Stephan Heimbecher, who chairs the EBU Strategic Programme on Production. Unenviable because of the sheer scale of the event: three days, three keynotes, 33 presentations, seven round tables, and 80 speakers, panellists and moderators (of whom 35% were women).

It was the first truly hybrid event from the EBU, produced both for the 500+ people who registered to follow the event online and for the small number of guests and speakers who were able to attend the event in person, as Geneva emerged from the latest pandemic wave.

"PTS 2022 took us on a journey", said Heimbecher. This was not just, as per the event's tagline, from real to sustainable and virtual worlds; "we also travelled to the metaverse, to hyperreality, and beyond."

He highlighted something that the opening keynote speaker, immersive director and storyteller Francesca Panetta had said: "The heart of innovation is the courage to explore. To innovate you have to adventure and you have to take risks." The programme for PTS 2022 took those risks and did explore.

Quoting another speaker, WDR's Lisa Zauner, Heimbecher reminded participants that you need an understanding of the day *after* tomorrow, to stay relevant tomorrow. Reflecting on the ground covered by the conference, he said "we looked into the future but tried to ground ourselves in terms of how those things can be used in today's world."

One of the big takeaways from the three days was that "editorial and tech people need to act together as twins – a message we heard over and over again."

The programme covered innovation strategies, 5G for production, new audio and video technologies, AI-based content generation, IP- and cloud-based production, virtual production, games engines and much, much more. Sustainability was also ever-present, with a check-in at the end of each of the three days to assess the potential impact of the different topics and technologies on environmental issues.

Videos of the presentations from PTS 2022 are available to EBU Members via: tech.ebu.ch/pts2022

Strong finish for the Digital Radio Summit

What might an "audioverse" offer to the radio industry? Is a "digital-first" approach the way forward and what does that mean in practice? Does DAB+ still have a bright future? What's the best way to ensure radio's prominence in connected cars? The recent Digital Radio Summit touched on many of the core questions for the future of a medium that remains popular but still faces much uncertainty. EBU Members can watch the presentations on demand via tech.ebu.ch/drs2022.

Wrapping up the day, the event's host Ben Poor announced that it was the final Digital Radio Summit, following more than a decade of successful events. Radio distribution and platforms will be discussed in other forums going forward, including at a major new EBU event currently in planning (see below).

Coming soon: a new event on distribution, products and platforms

Were you responsible for distribution in your organization? Have you suddenly become a publisher of your company's products (once called services)? You're not alone. Many EBU Members have shifted towards a product focus and a merging of many of the previously discrete distribution channels.

The EBU is planning to launch a new event that combines our previous FORECAST and BroadThinking offerings. We're taking the opportunity to revamp our approach, including the addition of a new networking-focused stream, an element that cannot be satisfactorily replicated in the online environment.

So watch this space for an event in Geneva on 15-17 November 2022. We're ready to try a different approach. Are you?

Satisfy the appetite for personalized media experiences with object-based production

Lauren Ward, a research fellow for extended reality stories at the University of York, explains how object-based media enables the content recipe to be tailored to each individual audience member. EBU Members can view her presentation on this topic via tech.ebu.ch/pts2022.

Linear, or traditional, media is like a many-tiered cake delivered to your home, elaborately decorated and ready to eat. And that's great if it's the cake you wanted. But if you have a gluten allergy or don't have the right tools to cut the cake, then your experience is going to be poor. And because it's a finished product, you can't un-bake it and make it again to fit your needs.

Object-based media is different, sending the ingredients and recipe to your house, where a chef bakes a delicious cake for you. The chef has the recipe to work from but can also take requests:

"I'd prefer it with the chocolate frosting."

"I don't have much time, so maybe just a cupcake today."

No un-baking needed – we make the cake right for you, the first time.

Leaving aside the fact that you may now be feeling hungry, what does this all mean? In tech terms the ingredients are objects: audio, video or graphics assets. These might be partially combined already, a cake that just needs the icing on top, or can be raw ingredients. The recipe is the metadata: data about the objects, which is required to assemble them correctly. Finally, the chef is the renderer, which uses the metadata to assemble and play back the assets. At its most exciting and challenging, this renderer can be designed to take all sorts of requests from the user, the environment and other parts of the playback system.

Object-based media is often discussed alongside Next Generation Audio

VS

codecs or bespoke 'choose your own adventure' narratives but the idea is much broader, and older, than this. One of the longest standing examples of object-based asset delivery and user-controlled rendering is closed captions: subtitling that can be turned on or off by the user.

LAYERS & SEGMENTS
Object-based media can adapt the content to the environment, playback system and user. User personalization is achieved in two main ways: segmentation and layering. Segments break up
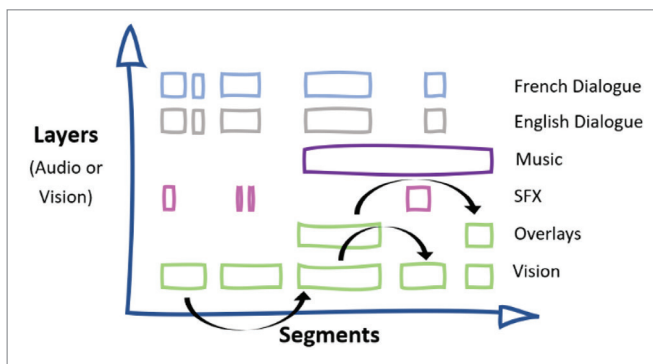
objects in time to allow chunks of the content to be played in a different order, or not played at all to change the content's length. Layering is how objects are grouped in the 'right now', which facilitates everything from switching language tracks to balancing audio objects or adding or removing graphical elements. This personalization can act on more than just user input; it can also use environmental sensors, for example, adapting the mix to background noise levels. By having unrendered assets it makes responsive design to the playback system possible, removing the need to up/down mix to different speaker layouts or create versions for alternate regions.

Theoretically the possibilities are endless – which is an opportunity and a challenge. It can make endless hours of rendering different regional versions a thing of the past but auditioning the many ways a user might personalize the mix a lengthy process.

We can enjoy the benefits while minimizing the challenges, but we need to prioritize. The aim for production must be to maximize the creative and storytelling potential while streamlining workflows. For audiences, systems need to focus on creating more engaging and accessible user experiences without inciting choice paralysis. And this won't be possible without more collaboration and without production staff, broadcasters, technologists and end users talking to each other much, much more.

Maybe over a cuppa, with a nice piece of cake.

Innovation in the fast lane – a new acceleration track for public service media

Tanja Deuerling, Director of Media Innovations at NMA, sees start-ups collaborating with PSM as speedboats, with ideas for the day after tomorrow, always ready for expeditions into the digital future on behalf of the flagship.

Digital transformation and the incredible speed of the market constantly require media companies to change rapidly. This is a huge challenge, especially for public service media (PSM) that are struggling with legacy structures. Public broadcasters are rising to the challenge, setting the pace in terms of innovation through initiatives such as the SWR X Lab, the WDR Innovation Hub or VRT Sandbox. Here, they know that an important part of innovation – especially in the tech sector – is collaborating with start-ups. To facilitate such ventures, NMA (nma.vc) is expanding its established acceleration programme with a new track focused on the needs of PSM.

WHY COLLABORATE?
Since 2015, NMA has been scouting the most interesting media start-ups in Europe and Israel, helping them achieve a higher level of maturity through an acceleration programme and matching them with suitable media partners. The goal is to provide established media companies with the innovations of the day after tomorrow. Suitable start-ups, whose solutions can be integrated at an early stage, are selected from a hand-picked NMA batch. The experienced players benefit not only from the technical solutions themselves, but also from exciting start-up teams with fresh perspectives. The benefits are numerous:

- **Efficiency**. You can't do everything yourself. Start-ups work in an agile, user-focused and error-tolerant way and often deliver concrete solutions faster and more efficiently.
- **On the pulse**. Start-ups work ahead of the curve. They already have solutions to problems that are only just being identified in larger companies. Working with them allows us to keep pace with or even stay ahead of new developments.
- **Inspiration**. "You don't know what you don't know": start-ups not only solve identified problems, but also bring new ideas into the company and foster innovation.
- **Partnership**. Collaboration on an equal footing with the predominantly young start-up teams has proven itself to be a driver for cultural change in large companies.
- **Curated**. Endless numbers of new start-ups appear on the scene every year. NMA scouts those that fit best and bring the most value – and supports the collaboration between start-ups and corporates.

EXAMPLES OF SUCCESS
Collaboration with public-sector players in Germany is not a new chapter for NMA. Since the accelerator's inception, a number of PSM partners have already benefited from working with NMA start-ups.

Ceretai is a start-up focused on the hot topic of diversity. The founders have developed automated diversity and equality analyses for media companies. Their SaaS Diversity Dashboard monitors diversity dimensions such as gender and age, as well as various forms of representation in television content. NDR and Ceretai cooperated to analyse *Tagesschau* to find out how many men and women present the news and what roles they play. Ceretai is now active with other public broadcasters and, with VRT, is developing a tool to analyse ethnicities.

With its software solution Watch Together, the start-up Sceenic turns a television show into a co-viewing experience. NDR and NPO deployed it during the 2021 Eurovision Song Contest, where up to four people could connect via an interface, stream the show and interact live. Sceenic has been on a roll ever since.

For the new PSM track, set to launch this summer, NMA is focusing more than ever on the needs of PSM partners, where topics such as disinformation, public value and regionalization are high on the agenda. The new programme will regularly collect partners' pain points and scout start-ups that are a good fit for PSM. In addition, there will be an expanded range of innovation activities such as events, innovation reports and innovation round tables, always with the goal of supporting PSM, allowing them to continue to operate on the market with a high degree of innovative strength and agility and to remain competitive long into the future.

Tanja Deuerling, Director of Media Innovations at NMA, spoke at the EBU Production Technology Seminar 2022

Automatic monitoring of perceived quality for audiovisual content

Spain's RTVE has been testing a pioneering solution that combines video analytics and AI to automate the complex and time-consuming task of quality monitoring. **Javier Sánchez Pérez** tells the story.

Since the dawn of audiovisual broadcasting there has been the need to monitor the quality of the content produced and broadcast. Until now, the complexity of this task has required human intervention, with technicians viewing and analysing screens with the content on a subjective basis.

Developments in the audiovisual market have seen an unprecedented increase in the quantity and complexity of audiovisual media. As a result, the task of measuring quality has become a problem, as the number of content channels from producers, platforms, integrators, etc., has increased exponentially.

Despite this, quality continues to be checked (selectively and on certain channels at certain times) by human observation.

QUALITY OF EXPERIENCE

Quality of service (QoS) refers to parameters that can be measured objectively. Measurement depends on the availability of the channel and the received signal. Parameters include coverage, continuity of service functionality, reliability, compatibility of devices, and functions involved in service availability.

By contrast, quality of experience (QoE) is the overall quality perceived by the end viewer and so it is a wholly subjective assessment (Figure 1). QoE represents the viewer's perception of how good video looks, how good audio sounds, how well combined audiovisual content is perceived or how well interaction with an audiovisual service works.

Good QoS means that video content is objectively satisfactory, but it doesn't necessarily follow that the viewer's subjective QoE experience will also be positive.
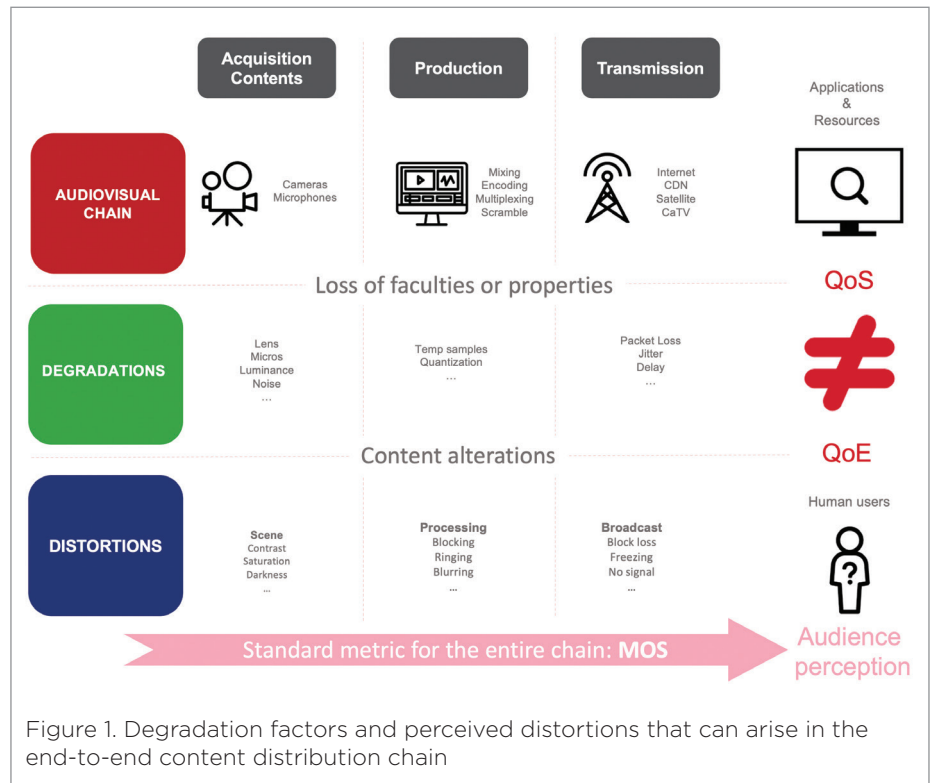

Figure 1. Degradation factors and perceived distortions that can arise in the end-to-end content distribution chain

"The task of measuring quality has become a problem, as the number of content channels from producers, platforms, integrators, etc., has increased exponentially."

MEAN OPINION SCORE

Video quality is usually evaluated subjectively using the mean opinion score (MOS) parameter. The International Telecommunication Union has a recommendation (ITU-R BT.500-11) that sets out criteria for subjective assessment (Figure 2). This method relies on the availability of human technicians to view thousands of channels of content. But it is this human involvement and the special facilities necessary to display content that make the process extremely expensive.

Video–MOS, a technology start-up based in Madrid, has developed a solution to this

conundrum by using pioneering technology that combines video analytics and artificial intelligence (AI). Extensive testing in a real-world environment has shown that it is now possible to remove the need for human involvement in MOS measurement, replacing it with automated tools. These tools can estimate the QoE without reference (i.e., there is no need to have the original pre-broadcast content), performing real-time monitoring of the MOS based on psycho-visual impact and not the difference between images.

AUTOMATED MEASUREMENT

The use of these tools was tested over a period of six months by RTVE and Video-MOS within

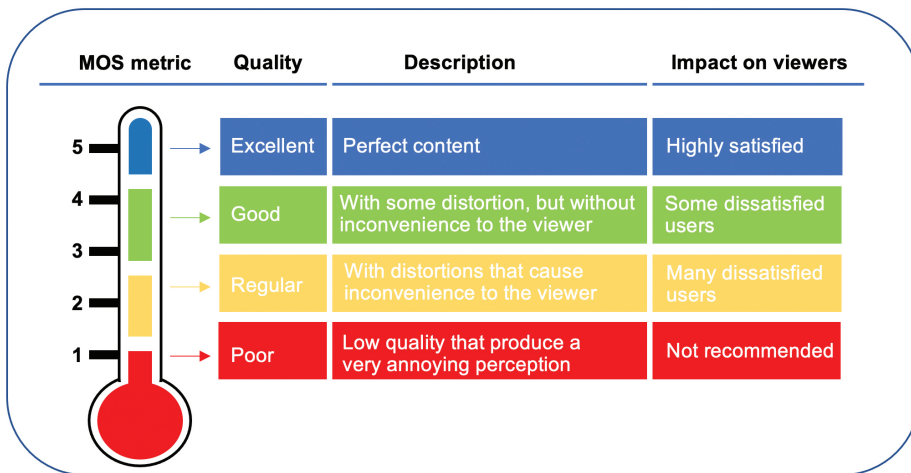| MOS metric	Quality	Description	Impact on viewers
5	Excellent	Perfect content	Highly satisfied
4 / 3	Good	With some distortion, but without inconvenience to the viewer	Some dissatisfied users
2	Regular	With distortions that cause inconvenience to the viewer	Many dissatisfied users
1	Poor	Low quality that produce a very annoying perception	Not recommended

Figure 2. Mean opinion score sets out criteria for subjective assessment of content

the framework of *Impulsa Visión Empresas*, RTVE's sandbox. In these tests, monitoring environments were deployed for three practical situations: monitoring of the distribution chain, monitoring of the programming grid, and analysis of the configuration of the entire Television Española DVB-T multiplex.

There are many areas in which the solution adds value, including:

- **Monitoring**. It is important to measure the quality perceived by users in order to optimize the network. Technology is needed to collect and systematize the measurements, manage the network and monitor the status of the network in a regular, simple and controlled way.
- **Quality control and management**. An online measurement of perceptual quality can be used for control and administration purposes. This information can be fed back to the production and broadcasting infrastructure, so that immediate action can be

taken to maintain QoE.

- **Management of resources**. For premium content or prime-time slots, it is important to measure in real time the perceived quality and estimate how it can be affected during broadcast.
- **Monitoring and control of the quality conditions**. These are usually incorporated in the contract of the service provider.
- **New Developments**. Perceived quality measurements are a necessary tool for the evaluation and development of new systems or algorithms. Having a measurement of the perceived quality that can be performed automatically avoids

having to perform long and expensive subjective tests in the design of new de/encoders, video enhancement algorithms, etc.

The use of a metric as simple as the MOS that is easily understood by technical and non-technical staff, can be used for the entire chain, and is easy to deploy, are clear advantages over the current solutions available. Together, these advantages provide significant efficiency gains in the production and dissemination of audiovisual content.

RESULTS

The Video-MOS tool enables direct monitoring of QoE, differentiating between technical and artistic distortions and allowing complete analysis of the impact on the content as seen by the end users, letting know the impact on some of your programmes (Figure 3).

Real-world testing has demonstrated the considerable benefits that this tool provides in the early detection of negative factors that affect the viewer experience, in addition to the ability to analyse the impact on quality control in relation to different configurations of the distribution network.
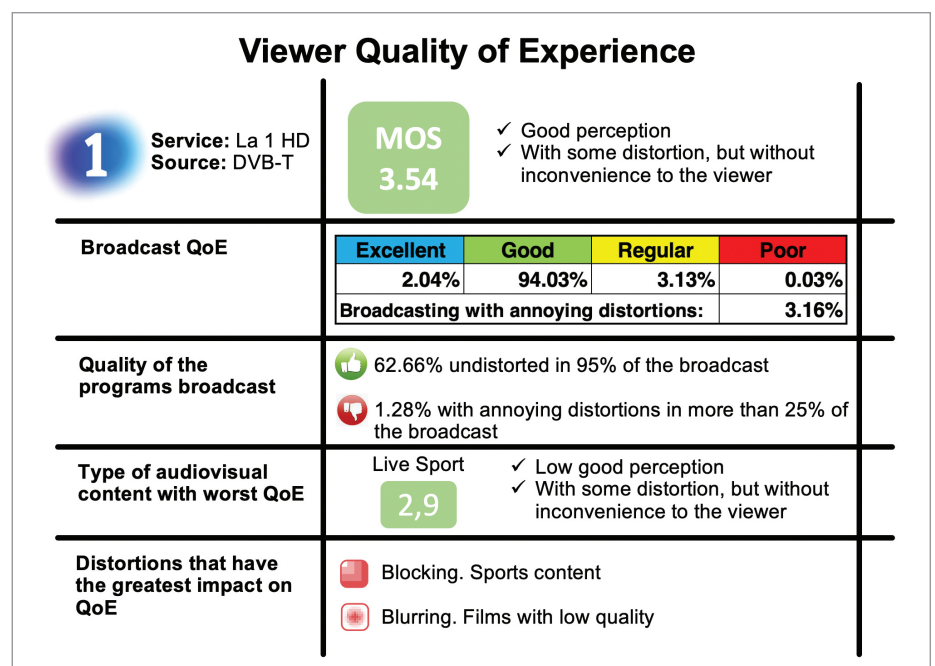
Figure 3. Summary of the results of the automated QoE analysis of RTVE's *La 1 HD* service

Pan-European collaboration to build a smart CG animation pipeline

During 2021, an interdisciplinary team spread across Europe set out to rethink the approach to computer-generated animation, creating transformative workflows in a redesigned production pipeline that uses off-the-shelf tools and game engines.

THE BEGINNING

Paola: It happened that both the EBU and RTÉ approached the IBC Accelerator programme with a similar idea: to leverage game engines, AI tools and collaborative workflows to create a low-cost pipeline for computer-generated animation.

Ultan: IBC connected us and the project took shape, based on a story that I had already developed.

EBU

Paola: We brought three other EBU Members on board: Rai, VRT and Yle. In the end we created two pipelines, one based on NVIDIA's Omniverse and one on Unreal.

Pavlo: The EBU ran the infrastructure to host the collaborative environments. I deployed the NVIDIA Nucleus platform for the Omniverse pipeline and Perforce for the Unreal production.

RAI

Alberto: At Rai, we focused on the Omniverse platform, which had just been launched by NVIDIA. We were involved with the pipeline design, testing and integration, including character creation, body and face animation, cleaning the motion capture data, and doing the cinematics in Machinima.

Davide: For the facial animation we used Audio2Face, an AI-based tool from NVIDIA that can animate a custom face from an audio source. The 3D motion capture was done using RADiCAL, a cloud-based AI tool that can process a video source and output an animated skeleton that can be retargeted directly onto a custom character.

VRT

Steven: As a 3D artist, I worked with Ultan to get the look and feel of the environment and props just right. I also introduced the use of the source control software Perforce to our pipeline – that was a big component in the remote workflow aspect of this project.

All of the setdressing was done in Unreal Engine, and we used a plugin to export the environment from Unreal to Nvidia Omniverse. The ability to work on something this big on my first job is an unreal – pun intended! – feeling and really enabled me to make some great connections in the international industry, both on a professional and human level.

YLE

David: Yle's role was to test and compare the advantages and disadvantages of different video-based motion capture systems. We also added some VFX elements to the final product and created 3D assets for the environment.

Petri: We worked collaboratively with the other broadcasters, sharing the latest updates to the Unreal scene via Perforce. A voice actor made recordings using the iPhone 12, for use with the Respeecher voice cloning software.

RTÉ

Ultan: The Unreal pipeline connected a variety of tools, from digital content creation tools like Maya and ZBrush to Unreal Engine's Metahuman Creator, Marketplace, Quixel Mixer, and innovative mocap solutions like RADiCAL CORE and Epic Games' Live Link Face App. Animations were combined with Mixamo inside Unreal Engine 4's Sequencer for a seamless multitrack solution.

Paul: Our audio workflow aimed to make the whole audio recording and delivery process as simple as possible for remote voice actors and producers. Using the high-quality microphones on the latest iPhone, we could record

broadcast quality voice takes during a standard web video call. Very simple instructions enabled the voice actor to use their iPhone as both the microphone and recording device for capture. To give us wider options for casting we used Respeecher, which meant we could have one person playing multiple characters. Once the actor's voice has been scanned, Respeecher is capable of creating pitch-perfect voice-to-voice swapping models.

Ultan: We needed a technical director to lay out the shots and oversee the virtual production. With special thanks to RTÉ and Epic Games for facilitating it, I had the opportunity to meet this challenge by taking the six-week Unreal Virtual Production Fellowship training programme with Epic Games. This experience empowered us to build the Unreal pipeline, create quality content and collaborate more efficiently with our partners.

WIN-WIN
Gregg: VRT had already been using game engine technology in virtual production pipelines. The know-how we built upon in this project, using real-time animation, will be another step towards what we see as a highly effective future production capability.

Roberto: At Rai, we're working to apply new techniques to animation, especially in the field of motion capture. We'd like our distributed production teams to be able to collaborate in real time, in a shared virtual space, using low-budget equipment and AI.

Jouni: It is very important for Yle to experiment with this kind of technology as it's needed in our productions and digital services. Also, people need to create content live and work in different locations, so being able to collaborate remotely is a must for us in the modern era.

Ultan: RTÉ is keen to embrace

new tools and platforms that can empower the next generation of content makers to tell stories in ever more imaginative ways. This IBC Accelerator project enabled us to build working relationships within the broadcast family while exploring unique opportunities by partnering with internationally renowned companies at the forefront of virtual production.

Paola: This project was just the beginning of a journey to further explore collaborative CG

animation pipelines. We're waiting to hear whether our project will be among the award winners for the IBC Accelerator Programme 2021.

Our next challenge is CG animation in real time, without using mocap suits, to be used during live shows. The EBU is **setting up a new working group** to benchmark the solutions available on the market and integrate the best of them in a live pilot. Get in touch if you'd like to be involved!
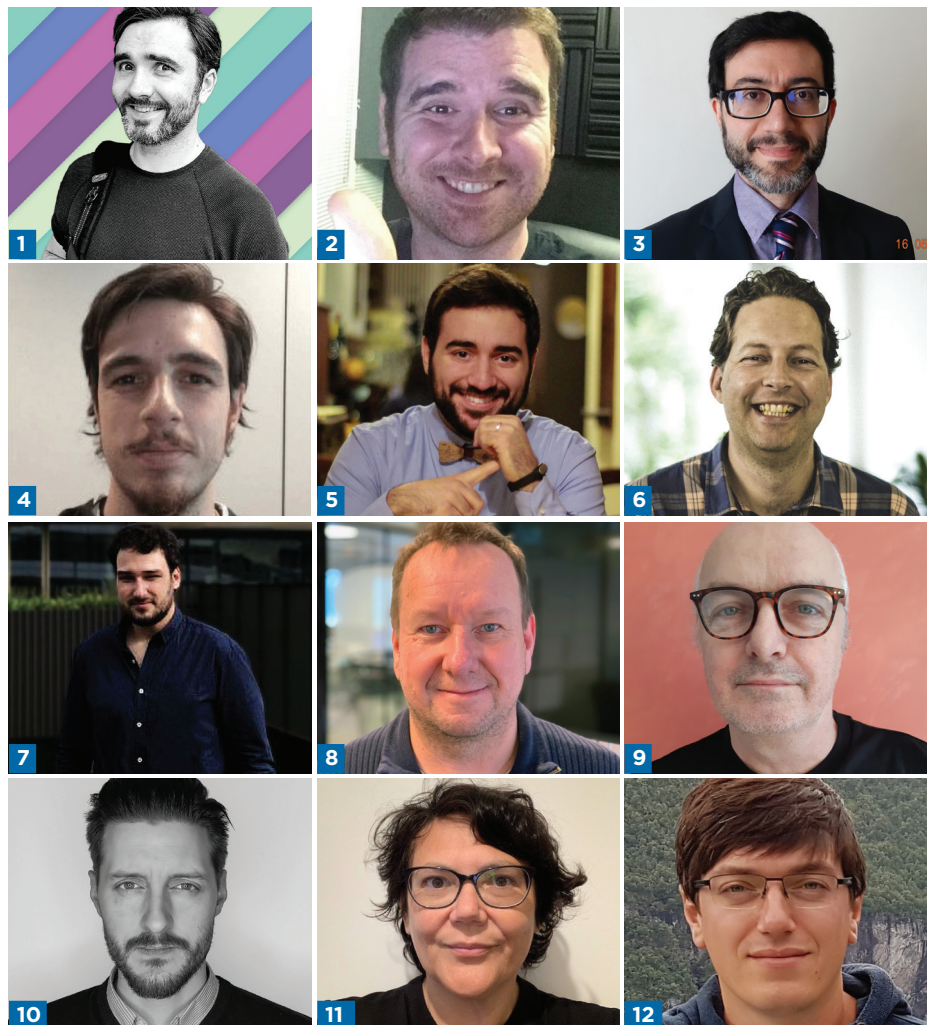
THE TEAM
1. Ultan Courtney (RTÉ) – co-lead, scriptwriter, art lead, director
2. Paul Dowling (RTÉ) – producer, composer and engineer
3. Roberto Iacoviello (Rai) – lead research engineer at Rai
4. Alberto Ciprian (Rai) – computer graphics R&D
5. Davide Zappia (Rai) – research software engineer, AR/VR
6. Gregg Young (VRT) – project manager at VRT
7. Steven Roelant (VRT) – 3D artist
8. Jouni Frilander (Yle) – innovation lead at Yle
9. David Reilly (Yle) – graphic design
10. Petri Karlsson (Yle) – media technology specialist
11. Paola Sunna (EBU) – co-lead, co-coordinator, facilitator
12. Pavlo Kondatrenko (EBU) – IP infrastructure set-up

The essential building blocks for accessibility services

David Wood reminds us that media accessibility relies on having a combination of elements, all of which must be in place.

Media accessibility relies on several building blocks, each one essential to the overall service. If any element in the user journey to being able to share in the experience of the media content is missing or even simply weak, it can negate the value of the service. In planning and implementing media accessibility services, all the elements must be strong.

ACCESSIBILITY TOWER
The elements that allow users to take up the option of accessibility for a given piece of media content are shown in Figure 1, the "accessibility tower".

The base level is the *capability of the users' equipment*. This might be, for example, a particular type of TV set or software. Can the accessibility services be decoded by the equipment that those in the identified user group have available to them? The capabilities of the TV set can also influence how well the services are finally displayed or heard in upper level of the diagram.

The next layer represents the *availability of accessibility services* from the broadcast or broadband provider. Will or could the services be regularly made available by the content provider, given any economic or delivery constraints?

Built on this layer is the *range of services* that are provided. There are a range of needs for accessibility services, which can even differ from nation to nation. Will the totality of services offered match, with proportionality, the range of needs of your users?

Above this is a '*findability*' layer. It can be easy or difficult to find services, for example using EPGs, apps, menus, or hand controls. Is it going to be easy to find and control the services? Will everyone know that? What can be done to make sure that they do?

Above that is the *quality of content production* of the accessibility services. Like any kind of content, this can be well done or less well done. Will the expertise and talent be available to make the best use of the technology? Will economics or lack of training constrain what can be provided?

The top layer is the presentation of the services – the so-called *contact moment*. Are the presentation, the placing of the accessibility elements, the style, colour, audio, and other appearance factors optimum for users? Are the on-screen elements 'agreeable' to users? How can they be made so? This can also be influenced by the capabilities of the base layer.

TECHNOLOGIES & TOOLS
The finest individual technologies can be of less value if any element of the tower is weak. Providers of today's services, and proposers for new services, should review the strength of all the elements in their own tower.

The development of individual tools is important. There are many ongoing studies. Today, for example, there are projects to develop realistic computer-generated sign language interpretation. Having sign language provided by an avatar would mean much more content could be signed. Yet, at the same time, the hard of hearing community has declared that the avatars so far seen would be a second-class service compared to human signers. The options must be studied.

As a second example, there could be several ways to make superposition of an avatar or human signer optional – using an HbbTV channel, a second conventional channel, or the new VVC video codec. Here too, the options must be studied.

We must not forget that users always need the means to communicate their experiences of service range/availability/findability, etc. to the content provider. What is more, content can be delivered by different platforms in an ecosystem of partners and competitors. Steering this toward better accessibility is challenging and calls for different actors to accept and act on their responsibilities.

Figure 1: The accessibility tower of elements affecting the user journey for accessibility services
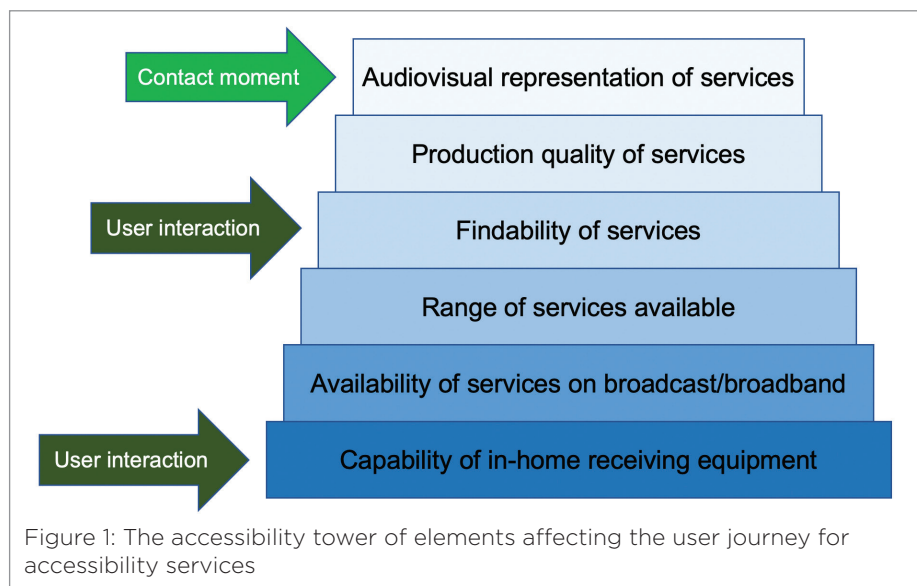
HbbTV – a major tool for accessibility

A rich and flexible feature set coupled with widespread deployment means HbbTV offers great possibilities for broadcasters to deliver accessibility services, writes **Klaus Merkel** (rbb).

The HbbTV application renders a video combining the original programme with the sign language interpreter

HbbTV is certainly not the only technology for delivering accessibility services, but it provides an extraordinarily rich toolbox for broadcasters to implement a wide range of services, including those addressing accessibility requirements. It's worth noting that in many European countries HbbTV has the highest market reach among all smart TV platforms.

A recent EBU report (tech.ebu.ch/publications/tr065) examines how HbbTV can be used to provide accessibility services for those with sensory differences. It focuses on four important features, namely **subtitling** for the deaf and hard of hearing, **sign language interpretation**, **audio description**, and **accessible audio experiences**.

SUBTITLING
The report details several options for implementing subtitles. One of the basic decisions is whether to use native rendering on the TV set (and there are three standardized rendering engines available in many sets: teletext, DVB subtitling and TTML/EBU-TT-D) or to let the HbbTV application do the rendering of the subtitles. Whereas native rendering is easier to implement, as it does not need dedicated rendering libraries to be integrated into the HbbTV offering, the main benefit of the app-based rendering is that individual rendering options can be offered, like adjusting font sizes and colours and the position of the subtitles.

Additional degrees of freedom can be found in delivery and syncing modes for both the video stream and the subtitles. HbbTV allows, for example, to sync IP-delivered subtitles to broadcast-delivered video. This enables the provision of subtitles in multiple languages without consuming any additional broadcast bandwidth. The report provides a matrix with an overview of all options plus decision trees.

SIGN LANGUAGE
Sign language interpretation, in contrast, has only one efficient implementation option. Unless the decision is to have the interpreter burnt into the broadcast video, we must go for a separate IP video. A picture-in-picture rendering option that would place the signer video on top of the broadcast is not available in typical HbbTV devices. Thus, a video containing the combination of the regular TV programme plus the signer must be rendered at the back end and launched on the device as one single video. This IP-streamed video with signing can be announced and launched via an HbbTV application.

AUDIO FEATURES
Audio description and accessible audio experiences, like enhanced dialogue prominence, rely on technical features for the provision of additional audio tracks. In this context too, the HbbTV toolbox offers several approaches that may be smarter and more flexible than just adding more broadcast soundtracks. Syncing mechanisms in HbbTV 2.0 allow audio streams delivered via IP to be synchronized with the broadcast video. This means an unlimited number of additional audio channels can be delivered without consuming extra bandwidth on the broadcast. Also, for catch-up services the preferred audio track can simply be chosen in the player settings.

If the TV is equipped accordingly, Next Generation Audio codecs can be used to offer immersive and/or personalized experiences and mixing capabilities in the receiver. Finally, mobile devices can also be paired with HbbTV 2.0 devices for the individual use of audio variants.

HbbTV thus provides a very broad and versatile base for the accessibility tower (see David Wood's article on page 12), letting people build on the upper layers with confidence!

EBU Members are encouraged to join our working group on "HbbTV & DVB-I Interoperability".
Visit: tech.ebu.ch/platforms

The future of R&D&I at Germany's ARD

The closure of the IRT left a sizable gap in the research and development and innovation (R&D&I) capabilities for public media in Germany. ARD's new competence centres are designed to address that gap, writes **Michael Eberhard** (SWR).

Public service media in Germany is provided by the nine self-governing regional members of the ARD, along with the national ZDF and Deutschlandradio. Together they deliver a wide range of programmes for radio and television as well as online services. There is a high degree of collaboration across the ARD members, with five transversal groupings that sit below the general directors and cover video programming, audio programming, finance, legal matters, and production and technology (the commission for which is known as the PTKO).

For more than 60 years, most of the R&D&I activities of the ARD (and ZDF, Deutschland-radio, ORF and SRG SSR) were carried out by the IRT – Institut für Rundfunktechnik – an internationally renowned research centre for broadcast and media technology. Around 100 employees worked in Munich, in close collaboration with the broadcaster affiliates and industry and research partners. Over the years, the IRT developed new formats, production technologies, metadata solutions, hybrid radio and television technologies, expertise around cloud production and IP distribution, and so on.

The closure of the IRT in 2020 raised questions as to how technology research at ARD should be handled going forward. The answer comes in the form of a new networked approach based on a series of competence centres.

FIVE NEW COMPETENCE CENTRES

Previously the PTKO had many different working groups that each had its own contract with the IRT, often working in parallel on the same themes. To secure the future of shared technology

The new structure of the ARD Production and Technology Commission
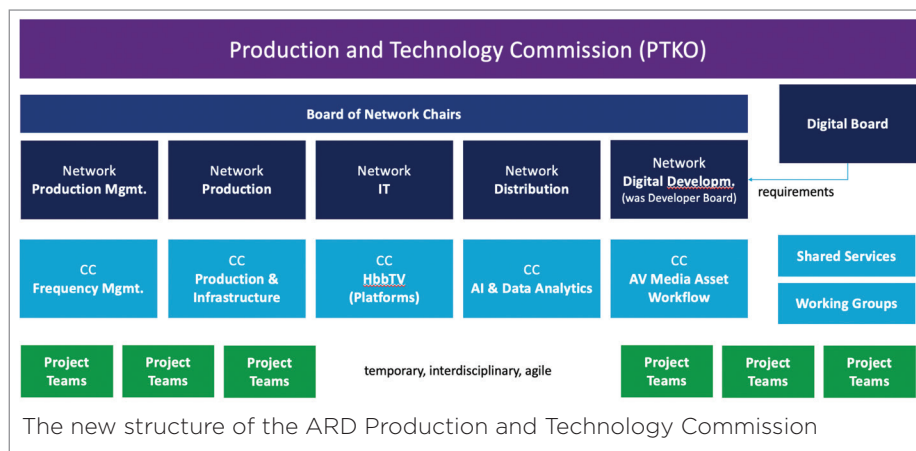
services across the ARD, these working groups are now part of an overarching portfolio within five networks that sit under the PTKO. The five networks deal with production management, production, IT, distribution, and digital development.

A central board brings together the chairs of the different networks. It functions as a kind of clearing house for questions and requirements, and for sending experts to groups such as the EBU. As of recently, the networks are responsible for a set of competence centres and a series of agile, interdisciplinary project teams.

One of the first competence centres to be put in place was the CC on Frequency Management. Based at BR in Munich since mid-2021, it provides centralized know-how on frequency management and related regulatory, standardization and interference issues – currently working with a focus on WRC-23.

Another CC is focused on HbbTV and platforms. Hosted by rbb and WDR, it looks at end-user devices, accessibility, the user experience, and collaboration on the further development of the HbbTV standard.

A CC on AV Media Asset Workflow, hosted by WDR and SWR, looks at the overall process of audio and video playout over the public internet, from encoding, transcoding and streaming to the player or end device.

Kicking off in early 2022, the Production and Infrastructure CC is based at SWR and HR. It will look at the development of technical infrastructure as it relates to audio and video technology, data in media, production workflows, green production, etc.

Also formed early this year, the CC on AI and Data Analytics, hosted by WDR, will be focused on the creation and provision of standardized, use-case-oriented AI solutions. Its work will include systematic assessment of available technologies and service providers and development of best practices.

With this new structure and approach, the PTKO will be an innovator and driving force behind the digital transformation. It is vital for us to work together, editorial colleagues with digital and technical colleagues. We must leave behind the age of developing things in parallel. We need a new kind of thinking; we want to be more digital, more agile. We're still working on the future; we are working together.

Digital sobriety for a greener web

The website at the heart of a new sustainability-focused initiative for young people is built according to the principles of digital sobriety. **Léa Nogier** (France Télévisions) explains what that means.

Digital technology is responsible for a growing share of energy consumption. In France, the digital sector accounts for 2.5% of greenhouse gas emissions and consumes around 10% of the country's electricity. For this reason, when France Télévisions and the German broadcaster WDR launched a new sustainability-focused initiative targeting 15- to 25-year-olds, the mobile-first web platform was designed to minimize the energy it consumed, and therefore its environmental footprint.

Two-thirds of young Europeans rank the climate emergency as the top priority to be addressed by the EU. Aiming to further raise awareness of environmental issues among young people and to help them take action, NOWU is the new platform created by the two broadcasters. Launched in September 2021, it has been built according to the principles of 'digital sobriety'. A concept originally developed by a French think tank called The Shift Project, digital sobriety promotes using the internet and technology in a more mindful and responsible way as opposed to cutting it out entirely.

TWO MAIN PRINCIPLES
In building the NOWU website (nowuproject.eu), the team followed two main principles: have no superfluous features and make the remaining elements as light as possible. This meant limiting the use of external scripts, compressing the code, and using light technologies and what's known as lazy loading (only initializing a web object when it is needed, rather than loading it as soon as the site is opened).

On NOWU you won't find video, infinite scrolling or embedded third-party elements such as tweets, YouTube videos, Instagram posts,
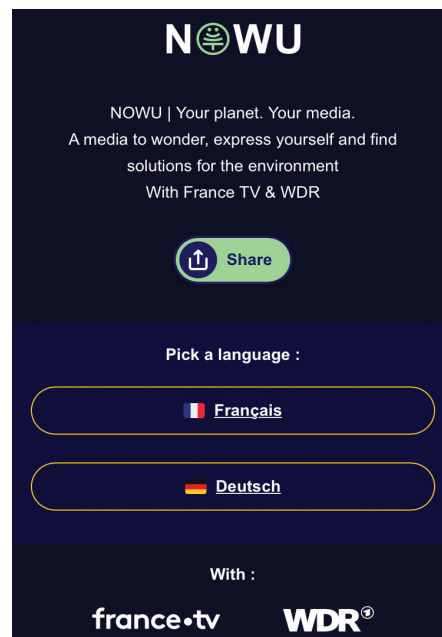
etc. Furthermore, all images published on the site are compressed so as not to exceed a 50 kb limit. This is about 60 times lighter than a photo taken with a smartphone.

To measure the carbon impact of the digital platform, NOWU uses a solution called GreenFrame, which provides end-to-end data on the energy impact for each functional modification on the website. It models the impacts from the client workstation (browser) to the product's architectural back end (database, web servers, network).

On the NOWU project, the digital sobriety approach also includes an ethical dimension:
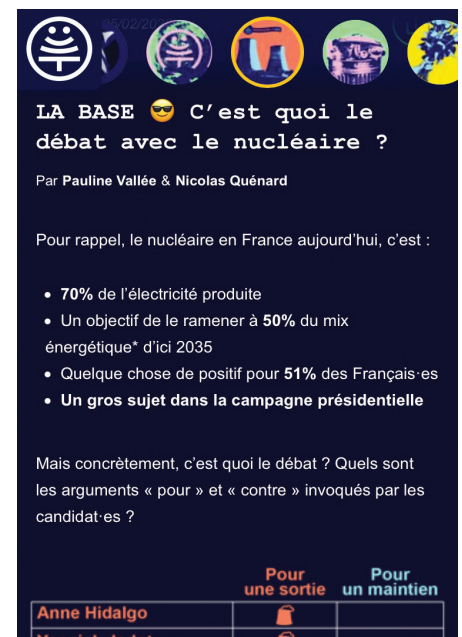
nowuproject.eu does not collect any data on its users. This avoids the need for a heavy, energy-intensive analytics tool that would run permanently on the site.

With NOWU, France Télévisions and WDR took up the challenge to launch a new digital destination and offer young Europeans the experience of a more sober and eco-designed digital platform that combines raising awareness of the issues they care about with reducing resource consumption and their own carbon impact.

Find more data on NOWU's digital sobriety approach in this blog post: https://tinyurl.com/ftv-digital-sobriety

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The French and German teams behind NOWU, a European project, are seeking additional public service media organizations to join it in 2022. With an optimistic and guilt-free tone, NOWU's content is divided into three main areas: content to ACT, content to BE INFORMED, and content to GET INSPIRED.

Every day, NOWU publishes an interactive and useful article, always proposing solutions. How to check the eco-responsibility of clothes thanks to the label? Are electric cars really a solution? What is the debate on nuclear power? How to convince your friends to avoid flying this summer? To learn more and discuss joining the the project, contact:
• Gautier Curtil, NOWU Director – gautier.curtil@francetv.fr
• Léa Nogier, NOWU Project Manager – lea.nogier.ext@francetv.fr

Digital-first content is radio's key to success for younger audiences

A careful examination of recent trends in audio consumption suggests that radio's best opportunity to engage younger audiences lies in producing digital-first content, writes **James Cridland** (Podnews.net).

Radiocentre Ltd.

Radio is, as we know, a medium with remarkable longevity. Often written off as no longer relevant, the data tell a different story.

The UK's commercial radio association, Radiocentre, recently celebrated that UK radio had the highest number of listeners ever, at 49.5m. Commercial Radio Australia also claims more (commercial radio) listeners in metropolitan Australia than ever before, at 11.2m. Growing populations are good for radio, it seems!

YOUTHQUAKE?

Yet listening to radio, expressed in terms of total hours, is decreasing; and it's falling quickly for younger audiences. In the UK, figures from RAJAR show that listening to radio by 15–24-year-olds has decreased by 40% in the last five years. Some industry commentators are calling it a "youthquake"; but, in fact, everyone under 55 is listening to less radio than they used to.

That's not bad news for audio in total. The amount of all types of audio that we listen to has increased in recent years. Music streaming services like Spotify and Deezer now take a significant share of audio listening.

But, since 2014, consumption of spoken word content – what radio excels in – is increasing. In the US, younger audiences aged 13–34 are listening to much more spoken word audio than they were eight years ago: an increase of 114%, according to NPR and Edison Research. They just don't listen on the radio.

Research shows younger audiences prefer listening to audio on mobile phones or laptops: devices where users expect on-demand audio. Live radio is a poor experience on a mobile phone, however good the

app is. Even in the UK, where I launched the world's first live streaming radio app in 2005, only 4% of live radio is delivered on a phone.

Radio stations have attempted to compete by offering "listen-again": a recording of a live show; but with outdated news bulletins and time checks, it's hardly using the medium to its best effect.

Other radio stations have taken to recording and then editing parts of live radio shows for online use. Sometimes that works but, more often than not, live radio isn't as polished as other post-produced material available online.

James Cridland, a radio futurologist who edits the daily Podnews.net newsletter, was the keynote speaker for the Digital Radio Summit 2022. EBU Members can access his presentation via: **tech.ebu.ch/drs2022**

For these new listeners, the primacy of live is no longer important. And if it's badly hacked out of a longer programme, listeners notice. They want a well-produced piece of on-demand content – with clear metadata to help it be discovered.

DIGITAL-FIRST CONTENT

Thankfully, digital-first content like this works well on the radio too. A well-produced, de-ummed and de-erred interview sounds much better on-air. And a well-produced piece can also be used in different parts of the day to get the most out of the great content we make.

It could even help promote live radio, too. In the UK, Ofcom reported in 2019 that 37% of people said they listened to a radio show for the first time after listening to a podcast.

To make our content digital-first – to atomise it, produce it, and then to put it on air – is a significant change to how we make and think of radio; but it could be the future of the medium for younger audiences.

MPEG's new generation of media standards

With a new fresh organization launched in the second half of 2020, MPEG released advanced standards that are attractive for the media and broadcasting industries. **Igor Curcio** describes them and anticipates what's coming next.

For more than 30 years, the MPEG (Moving Picture Experts Group) committee* has been releasing successful standards for audio, video, graphics and genomic data, as well as transmission protocols and file formats for different applications. Examples cover the well-known MP3 and AAC formats for audio and music, the MPEG-2, AVC and HEVC video codecs for digital television, the MP4 file format, and the DASH protocol for internet media streaming.

In the last few years, MPEG has been working on a set of standards that enable novel use cases in the area of extended reality (XR) in order to deploy more immersive experiences.

NEW ORGANIZATION

To provide more efficiency in its operations, a new MPEG organization was launched in the second half of 2020. Despite the challenges of the COVID-19 pandemic, the committee has achieved excellent results in delivering new standards to the media industry. The new structure clearly defines technical areas of responsibility and is organized into working groups (WGs) and advisory groups (AGs) as follows:

- WG2: MPEG Technical Requirements
- WG3: MPEG Systems
- WG4: MPEG Video Coding
- WG5: MPEG Joint Video Coding Team with ITU-T SG 16
- WG6: MPEG Audio Coding
- WG7: MPEG Coding of 3G Graphics
- WG8: MPEG Genomic Coding
- AG2: MPEG Technical Coordination
- AG3: MPEG Liaison and Communication
- AG4: JPEG and MPEG Collaboration
- AG5: MPEG Visual Quality Assessment

MPEG WGs and AGs meet four times per year during the same week. This guarantees efficiency in communication and working practices. A new website has also been created and is available via: www.mpeg.org.

Since the establishment of the new organization, a new set of standards has been released. The most notable one is Versatile Video Coding (VVC), which halves the amount of bits needed for transmission at a given video quality, compared to its predecessor HEVC. In addition, it enables new use cases for immersive media and XR.

Other major standards released are Essential Video Coding (EVC), Low Complexity Enhancement Video Coding (LCEVC), a new suite of immersive media standards that include the Omnidirectional MediA Format (OMAF) for streaming of 360-degree video; Video-based Point Cloud Compression (V-PCC) and Geometry-based Point Cloud Compression

Igor Curcio is Director of International Standards with Nokia Technologies and Convenor of the MPEG Technical Requirements Working Group

(G-PCC) for capturing volumetric visual data from the real world; MPEG Immersive Video for enabling 6 Degrees of Freedom (6DoF) experiences; and Neural Network Compression for multimedia applications.

MPEG is also working on the next generation of media technologies and standards, and its roadmap is rich with new items that are going to be delivered within the next 1–3 years. The list includes a new immersive audio codec for 6DoF; a dynamic mesh compression scheme for capturing volumetric visual data; a new codec for haptics signals; a new codec for improved compression of genomic data; and a new video codec oriented to machine processing.

CELEBRATING AWARDS

Under the wings of the new organization, MPEG standards have been recognized with three prestigious Technology and Engineering Emmy® Awards: in 2021 for the ISO Base Media File Format, and in 2022 for font technology for custom downloadable fonts and typography for web and TV devices, and for HTTP encapsulated protocols (in particular for DASH). The latter technology has greatly changed the streaming industry and has been widely adopted by 3GPP, ATSC, DVB, and HbbTV, and across different sectors.

These recent Emmys follow a long list of previous Emmy Awards received since 1996, for MPEG-1, MPEG-2, AVC, MPEG-2 Transport Stream and HEVC technologies and standards.

MPEG operates under a joint technical committee of ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission).

Changing perspectives on social media platforms among PSM

A recent EBU report explores how public service media are using social media. **Léa Besson** highlights some of the key takeaways.

Social media are crucial for public service media (PSM): 66% state that those platforms are very important to them, and none say that they are not important. (See Figure 1.)

It comes as no surprise that the most popular social media platforms are also the most important ones for PSM. Yet things are starting to change. Facebook leads the way by far, with 100% of surveyed PSM being present on the platform and three quarters considering it as strategic. Nonetheless, it has lost some of its shine, especially among younger audiences. TikTok and Twitch are the platforms with the greatest potential for adoption by PSM – many think about joining those newer platforms.

When looking at where PSM plan to increase their efforts, Instagram comes as the top priority, with 66% of those surveyed planning to increase their efforts on the platform. TikTok comes second (Figure 2). Even if fewer PSM are on this platform, the ones that are clearly see the importance of having an active presence there. It is also evident that PSM are completely disengaging with Snapchat, and Twitter and Facebook are not in a good spot either.

Not all social platforms are strategic for PSM and they use them for different purposes. PSM use YouTube and TikTok to reach specific audiences, especially younger ones, while Facebook and Twitter are used more often for promotion and to drive traffic to PSM-owned websites. The purpose of Instagram is a little bit less defined among PSM – it goes from increasing reach to building and engaging with communities.
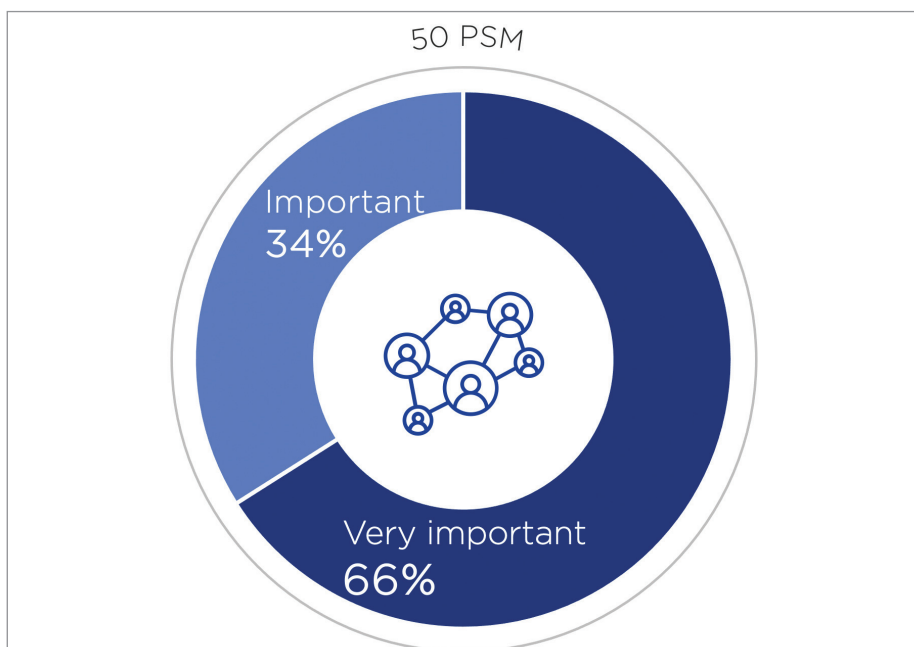

Figure 1. Importance of social media for the organization's strategy; as % of PSM organizations (Source: EBU based on 2021 Members' data, including 50 Members)
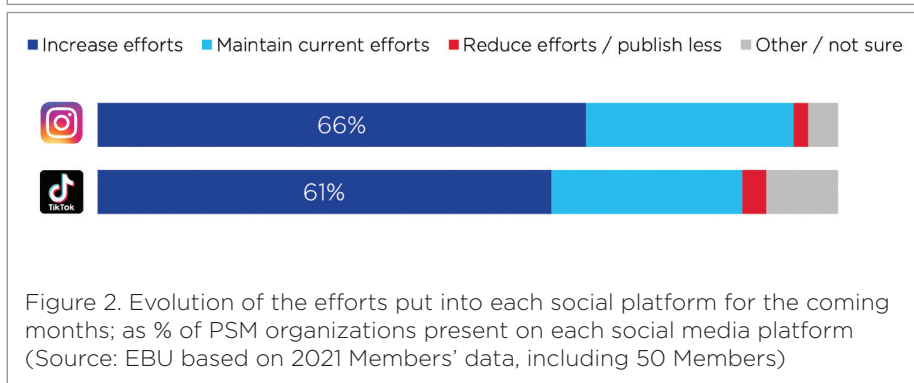

Figure 2. Evolution of the efforts put into each social platform for the coming months; as % of PSM organizations present on each social media platform (Source: EBU based on 2021 Members' data, including 50 Members)

The above insights are drawn from the recently published EBU Media Intelligence Service and Media department report "How Public Service Media Use Social Media". Visit: ebu.ch/publications/ *and select research.*

TECHNOLOGY & INNOVATION
AWARDS 2022

EBU Technology & Innovation Awards – call for nominations

Do you know of an innovative technology solution created in your organization that could have a lasting impact on public service media? Do you know recent graduates in your organization or students in universities and institutions who have been working on novel technology solutions relevant to public service media?

The EBU recognizes and supports Members' outstanding technical solutions and the teams that developed them with its **Technology & Innovation Award**. The **Young Technology Talent of the Year Award** focuses on the technology talent pipeline of students and recent graduates, those who will build the solutions for tomorrow.

The deadline for nominations is **Friday 29 April**. *For information on who can submit nominations and how to do so, please visit:* tech.ebu.ch/awards

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IN THE SPOTLIGHT **Jörgen Bang** PRODUCT OWNER, SVERIGES RADIO

WHAT ARE YOUR CURRENT RESPONSIBILITIES?
I work as an agile Product Owner in a cross-functional team that works with audience-facing offerings. We strive to be truly cross-functional; that is, not only work with all layers in our tech stack, but also do data-driven product development. All this while not growing the team too big, and hopefully having fun along the way.

WHAT DO YOU CONSIDER AS YOUR FINEST ACHIEVEMENT SO FAR IN YOUR CAREER?
What I seem to enjoy the most at work is being part of a truly synchronized group of people working together, gaining a shared view of a hard problem that you're trying to grasp. If you can reach a level of safety and trust when you can have opinionated disagreements but still laugh it off together, that's a wonderful state. Then doing this in a group of people from different disciplines and departments; wherever I've been in my career, they have always been the best moments.

Mattias Ahm, Sveriges Radio

Jörgen Bang chairs the EBU's Strategic Programme on Platforms

WHAT ARE YOUR PREDICTIONS FOR MEDIA TECHNOLOGY IN THE FUTURE?
Although I truly love technology – ever since getting my first computer in 1984, when I was 11, to when my career started with building websites in 1995 – I now find myself not looking too deep into the technology crystal ball. I do favour some principles though. Sharing over secrecy. Using and contributing to open source over proprietary software. Building things over buying things.

WHAT, FOR YOU, ARE THE BIGGEST CHALLENGES FOR EBU MEMBERS TODAY?
I am quite obsessed with lead times. Trying to understand what inhibits us from moving faster. Is it technical debt? Are we too risk averse? Are we inhibiting those who want to experiment because there is a risk of failing? Are we too proud, or big to pivot?

TELL US ABOUT SOME OF YOUR INTERESTS AWAY FROM THE WORKPLACE.
I used to drive around Europe in a van with my friends. We were a rock band and we played for between 0 and 1,000 people. We never made it big obviously, but I am forever grateful for having experienced so many places and made friendships all over the continent. And the beauty is that anyone can do it – just go!

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EBU

Join us and the industry's leading experts for technology updates, strategic insights and real-world use cases, plus demonstrations and networking.
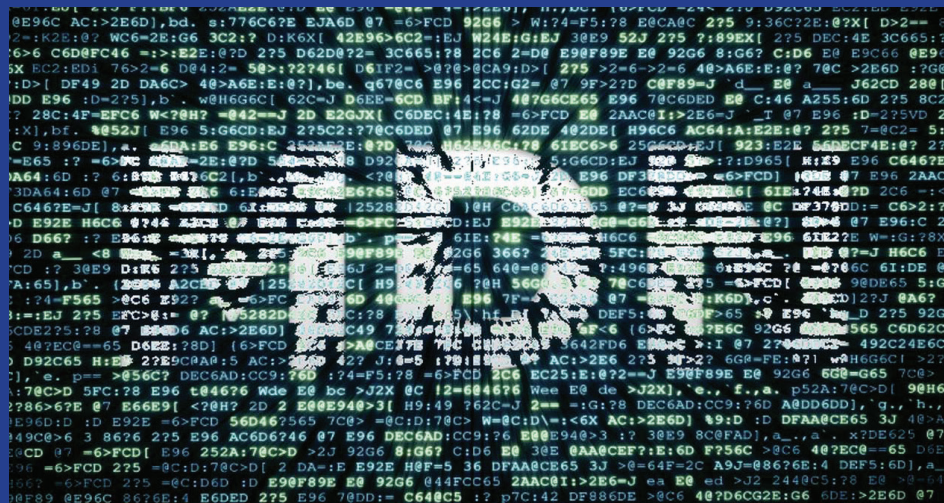

SUSTAINABILITY SUMMIT

PSM GOES GREEN

tech.ebu.ch/events/sustainability2022

Greener futures
for media
**21 April 2022
online**

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Everything
metadata
**30 May 2022
Geneva and online**

NETW(O)RK TECHNOLOGY SEMINAR

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Media and
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**14–15 June2022
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