MEDIA TECHNOLOGY & INNOVATION

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tech-i

The challenges of Next Generation Audio

Plus

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- **INSIGHTS FROM A VR PIONEER**
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Issue 30 • December 2016

Cover Story: Audio technology is in focus for two articles in this issue of tech-i. On page 8 Roger Miles explains why audio renderers are important and on page 16 David Wood asks how likely it is that audiences will embrace Next Generation Audio.

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What's that you say?

Simon Fell, Director, EBU Technology & Innovation

I have noticed a worrying trend recently: I have started talking to my devices. Is this the first sign of madness, or because of the emergence of the VUI – Voice User Interface? A VUI is defined by Wikipedia as making *"human interaction with computers possible through a voice/speech platform in order to initiate an automated service or process."*

For me, it started innocently enough with talking to my smartphone, whether via a Google app or Siri. The condition then spread to my tablet and, I hate to admit it, but also to my watch. I had already disabled voice recognition on my Smart TV because I did not know where the voice commands were going to. Nevertheless, in the past month the condition has worsened – I have been trying out the Amazon Echo. So far, so good. I can now find out the next train at my local station, play radio channels (as streams), tap into my music collection and play a track, add to my shopping list and, if I had enough commitment to the Internet of Things, it would even control the lighting. Today,, however, the tension rose when the device began trying to sell me music that was not available on my existing account. For a small sum I could upgrade to access millions of tracks – and if I speak to the device nicely it will give me a free 30-day trial.

Now, when your devices start talking back to you, it is time to remind yourself just how many online services you subscribe to. That said, it is surprising how quickly you get used to speaking to the Echo, and stop walking over to manually change the channel.

Staying on the voice theme, Adobe recently previewed a technology called Project VoCo. They describe it as the "Photoshop of speech"; essentially it allows the user to type words and have the software mix them into a pre-existing audio track as if spoken by the original voice. This may set alarm bells ringing for lawyers, in that verifying what a person actually said could become more difficult in future, particularly if there are no controls to avoid misuse.

IN THIS ISSUE

I hope you enjoy this issue of tech-*i*. You'll find reports on our recent Developer Conference and on a visit to BBC News Labs that marked the transition from our Integrated Media Production Strategies project to the new (FCP) Flexible Content Production project.

At IBC 2016 we saw just how hot a topic Live IP production was. The demo on the EBU stand showed the potential flexibility, using dynamic content to personalize the news experience for viewers. It also showed how IP production and distribution can work together to create an integrated media experience. On page 7 we hear from France Télévisions about their approach to exploring live IP-based production.

Finally, cyber security remains a critical issue for broadcasters. We covered this topic during a session at IBC and, as you'll read on page 5, we're following up with a two-day seminar next February.

So, until then stay secure – and mind what you say to your devices!

Until next time… Simon

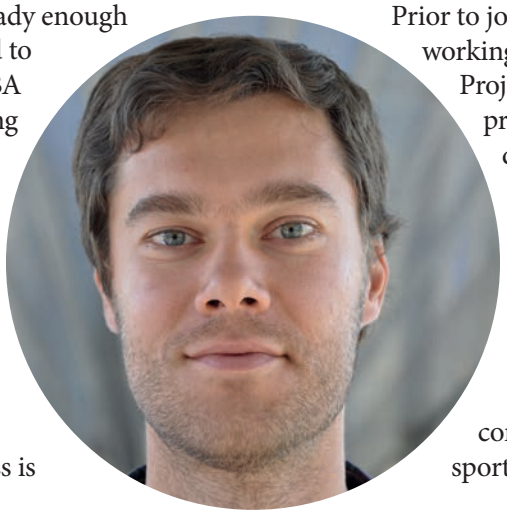
Goodbye and hello

IN OCTOBER 2016, THE EBU TECHNOLOGY & INNOVATOIN TEAM SAID FAREWELL TO ONE STAFF MEMBER AND WELCOMED ANOTHER.

Shannon Frame (right) joined the EBU in April 2014 as Technical Editions Manager (and editor of this magazine). As of October 2016 she has taken up a new role as Market Analyst & Communications Manager for Eurovision Services & Sports Rights.

In her two and a half years at Technology & Innovation, she transformed the department's web, news and social media offerings. She has also played a big part in delivering our popular technical seminars and publications not to mention our annual presence at IBC. And if that wasn't already enough to have on her plate, Shannon managed to successfully complete a demanding MBA programme at the same time, graduating last June. Apart from her talent for communicating complex topics in a comprehensible way, T&I will miss Shannon for her good nature, her capacity to bring people of diverse backgrounds together and her inherent need to improve processes. As Simon Fell said, in announcing her departure to the T&I department, "Shannon, we will miss you, but our loss is Eurovision's gain. We wish you all the best and much success in your new role!"

(The recruitment of Shannon's replacement is under way at the time of writing.)



NEW ARRIVAL

October was also the month when Yury Brukau (bottom left) joined the T&I team. Yury, a software engineer, comes from Belarus and studied at the Belarusian State University, Minsk. He specializes in the development of web applications.

Prior to joining us at the EBU, Yury was working at CERN and at the Human Brain Project, in both cases involved in various projects that aimed to help scientists do their daily work. At the EBU he will be involved with software projects such as RecSys, a group that is working to help Members to exchange anonymized data and retrieve information from third-party recommendation providers.

When he needs to get away from computers and code, Yury turns to sports, and volleyball in particular.

The Summit and much more

ALL EYES – OR SHOULD THAT BE EARS?! – WILL BE ON GENEVA IN FEBRUARY FOR **DIGITAL RADIO WEEK** (6-9 FEBRUARY 2017).

Mid-February is an important fixture in the calendar for radio enthusiasts, as they gather in Geneva for the annual Digital Radio Summit. The EBU's premier radio technology event comes in a week of events called the Digital Radio Week, comprising meetings of standards groups like RadioDNS and WorldDAB. Additionally, the RadioHack workshops will take place on the two days prior to the Summit.

Digital Radio services are starting to take over from FM in many countries, with Norway and Switzerland moving to switch off FM services altogether, a move that we might not have imagined even five years ago. However, most countries include under the term "digital radio" both radio delivered over digital broadcast networks and radio consumed over the internet.

For listeners accustomed to FM radio, moving to a new way of receiving radio requires a certain amount of effort, even where, as with Digital Radio, the benefits are manifold. One of the challenges of today's radio broadcaster is making sure that the listeners will take the time to look for, and easily find their services.

The EBU's position is that the future of radio lies with Digital Radio, and Hybrid Radio (linked partly to RadioDNS) is a key enabler in this migration.

The Digital Radio Summit will cover these topics, the challenges of extending digital radio to local and regional stations, as well as the commercial case for digital commercial radio.

Left: A collaborative workshop on the first day of DevCon 2016 generated multiple discussions around diverse topics such as metadata extraction, storage challenges and the publication of large archives. Right: Viktor Farcic led a lively workshop on using Docker Swarm Clusters.

Room to develop

REPORT ON DEVCON 2016

The EBU's annual event for software developers took place for the fourth time on 1-2 November. Among the forty participants at DevCon 2016 were representatives of fourteen EBU Members, along with others working on a range of media-related projects. In addition to those in the room in Geneva, the event was also available on an exclusive live stream.

Beyond the actual presentations and workshops – which were of a very high standard – the real value of an event like this is found in the new connections and alliances that form between developers. The software-driven projects that today touch virtually all parts of the broadcast production and distribution chain rely heavily on collaborative approaches.

In his keynote on DevOps, 'Docker Captain' Viktor Farcic talked about an approach that relies on "a cross-disciplinary community of practice dedicated to the study of building, evolving and operating rapidly-changing resilient systems at scale". For EBU Members, the potential benefits – perhaps even the necessity – of pooling resources and experience make events like DevCon and the wider developer community hugely valuable.

The programme this year covered a broad range of topics, as usual, but there was a particular focus on the challenges associated with the large scale systems that broadcasters need to run, such as web streaming sites. Hot technologies in this domain include Docker and Kubernetes, platforms that use what's known as a container-centric approach to delivering applications. (EBU Members can access the video recordings of this event, including the workshops on Docker and Kubernetes, at: tech.ebu.ch/devcon16)

INNERSOURCING

The opening keynote came from Robert Hansel of Bosch, who talked about that company's adoption of the "InnerSourcing" approach: adopting the culture and tools used by the open source movement for in-house software development projects. BIOS is the Bosch Internal Open Source project, and it has delivered benefits both for the development of new products and acquiring new business with existing products.

There is growing interest in InnerSourcing, not least among broadcasters, who are realizing the benefits of maintaining in-house development teams. In fact, the EBU will host next year's InnerSource Commons Summit, on 18-20 April 2017. (See: tech.ebu.ch/innersource2017)

An excellent set of lightning talks rounded off DevCon 2016. Highlights included a talk on Storyboard, a tool that allows broadcasters to quickly share audio files as videos on social media, and an update from the volunteer-run Frikanalen TV channel, which is based entirely on open source solutions.

Conference participant Matteo Naccari, who works on video compression algorithms for BBC R&D, summed the event up well: "I really liked the idea of bringing together developers from the broadcasting world to talk about the work they've been doing. It's impressive how much software development is associated with broadcasting systems."

> EBU Members can access the proceedings of DevCon 2016 at: tech.ebu.ch/devcon16

Preparing for the inevitable

THE EBU'S **ADI KOUADIO** LOOKS AHEAD TO FEBRUARY'S MEDIA CYBER SECURITY SEMINAR.

There is already plenty of evidence that media and broadcast organizations are viewed as prime targets for malicious cyber-attacks. One need only think of the infamous Sony Pictures case in 2014, where confidential and sensitive information was released to the public, or the attack that took twelve of TV5Monde's services off air for 18 hours in 2015. We also see DDoS (Distributed Denial of Service) attacks against public service broadcasters becoming increasingly common. Cyber security is a topic that EBU Members cannot afford to ignore.

In 2015 we established the Media Cyber Security programme, bringing heads of information security from EBU Members together in a trusted environment to share their experiences. The group has issued a series of recommendations (available from the EBU T&I website (tech.ebu.ch/groups/mcs); and on 21-22 February, it will hold a special two-day seminar on the topic.

BEST PROCESS

On the first day there will be a chance to gain some valuable hands-on experience. It's not just about best practice; it's also about becoming familiar with the best *processes* to tackle these challenges. A series of tutorials will be on offer, covering topics such as securing cloud services, mitigating DDoS attacks and web app security.

The second day will look more towards organizational and strategic topics, with a series of presentations from security industry experts and EBU Members that have taken a lead on addressing particular risks or challenges.

For information and registration visit: tech.ebu.ch/cyber-security2017

From Linear to Agile

PREVIEWING THE EBU PRODUCTION TECHNOLOGY SEMINAR, 24-26 JANUARY 2017.

The EBU's Production Technology Seminar is the organization's biggest annual technology-focused conference. There are few, if any, other events that offer the same breadth and depth of coverage of recent and future developments in media production technology away from the hype of commercial conferences and trade shows.

PTS 2017 will, as always, feature two and a half days of presentations and tutorials, demos and discussions, with plenty of opportunities for the peer-to-peer conversations that make such events so valuable. Whether you are interested in a specific area – immersive content, IP production, new workflows, sound and audio technologies – or are seeking a broad overview of the production technology field and want to hear about successfully implemented projects at broadcasters, your time in Geneva will be time well spent.

The strapline for the event – From Linear to Agile – can be seen as reflecting not just the changing nature of how media is produced and consumed, but also the way broadcast organizations themselves are changing, moving from traditional strategic models to more adaptive ones. There is a need to introduce feedback loops, whether in response to market changes or to the specific viewer's preferences.

The programme for PTS 2017 is still being finalized at the time of writing, but some of the highlights will include use cases such as BBC's Planet Earth 2 in UHD/HDR, a glimpse into Virtual Reality, IMF in television applications, and of course an update on the roadmaps to IP, virtualization and cloud-based production. There will also be a special session dedicated to new ways of successfully managing new technology investment projects in an agile way.

Last year's event brought 142 participants to Geneva, 73 of them from EBU Members. Among the comments received after the event, were the following:

"There are few events of this quality, I'm very glad I attended!" (Technology vendor)

"The event was really interesting and well organized. I hope to attend PTS again next year." (EBU Member)

"Very well organized. Intimate conference when compared to IBC. Good for networking." (Commercial broadcaster)

Operation Innovation

SINCE 2012, THE EBU'S PROJECT ON INTEGRAGED MEDIA PRODUCTION STRATEGIES – IMPS – HAS BROUGHT MEMBERS TOGETHER TO EXPLORE HOW NEWS PRODUCTION IS CHANGING. ITS SUCCESSOR – FLEXIBLE CONTENT PRODUCTION – SEES THE FOCUS SHIFTING TO INNOVATION. PROGRAMME CHAIR **ROBERT AMLUNG** OF ZDF, INTRODUCES FCP.

The visit, during October 2016, of 26 professionals from 20 EBU Members to the BBC News Labs in London marked the end of one important activity and the beginning of another. In focusing both on specific BBC initiatives around the way news is produced and on the innovation process itself, it served as the perfect point to pivot from IMPS to FCP.

The IMPS project, jointly run by the EBU's Technology & Innovation department and the Eurovision Academy, has delivered valuable insights into how media production is changing. With a specific focus on news, project participants have learned about successful strategies – and potential pitfalls – for integrating digital and mobile effectively into production processes. But the story, of course, is about much more than just news.

In the digital environment, EBU Members are producing content for a variety of audiences on a multiplicity of outlets. This involves producing radio and TV content for linear or non-linear distribution. It also increasingly means producing content primarily for online distribution, including on social media platforms. All content must be easy to find and should remain accessible over time. Public service media organizations are required to do this efficiently in a climate of shrinking resources.

INTRODUCING FCP

FCP – Flexible Content Production – is a new initiative that will build on the successes of the IMPS project. Once again jointly coordinated by the Eurovision Academy and EBU T&I, it will follow the same template of themed visits that participants will be invited to join a few times per year. The aim will be to explore how EBU Members – and others – successfully manage to take good ideas from proof-of-concept to prototype, beta version and, hopefully, 'business-as-usual' operation. Or, if not, to ensure that they fail quickly and early so as to minimize wasted resources.

One key difference that FCP will have, in contrast with IMPS, is that the themed visits will not be limited to broadcast organizations. The chosen locations will be rich with other innovative actors – start-ups, large technology companies, etc. – providing a stimulating environment in which to explore innovation.

SAFE SPACE

BBC has made innovation central by creating its News Labs, a safe space in which ideas can be explored. Aside from the embracing of the tools and approaches that are used in the world of software development, there are two other key points worth noting.

Firstly, the organizational structure is deliberately kept 'fuzzy' to ensure that those working on projects have the freedom to move beyond the approaches typical to their own 'tribe'. This starts at the top: BBC News Labs is jointly managed by a journalist – Robert McKenzie – and a software engineer – Miles Bernie. It sits at the interface of BBC News, the Products & Systems division, and Research & Development, requiring these departments to closely work together and to know and appreciate each other's work.

The visit to BBC News Labs included a panel discussion with Andy Conroy (Controller of BBC R&D), James Montgomery (Digital Development Director, BBC News) and Alan Whiston (Controller of Systems & Service Delivery, BBC News).

Secondly, resources are made available to ensure that the teams that form around projects can be fully (or sufficiently) dedicated to those projects for as long as it takes. If, for example, a news editor goes on attachment to a News Labs project, someone will be hired to temporarily fill their place. As BBC R&D head Andy Conroy pointed out, while public service broadcasters often struggle with financial constraints, public funding can make innovation easier in that it often offers relative certainty over a fixed period of time. Short-term return on investment is not required and a decision can be taken to prioritize innovation.

Over the coming years, FCP will take a deep dive into innovation, creating an orchestrated clash of the cultures of broadcast journalists and IT and internet professionals. The themed visits will continue and a set of use cases to demonstrate successful innovation pipelines will be developed. The project kicks off with a Network & Learn event at ZDF in Mainz on 27-28 March. During this event, participants will get a quintessential overview over the findings of the IMPS visits, thereby setting up the base for the work of the new group.

Get on board at www.ebu.ch/fcp

Live & IP: another approach

IN DECEMBER 2015, FRANCE TÉLÉVISIONS PUT TOGETHER A PROOF-OF-CONCEPT OF A LIVE AND IP VIDEO PRODUCTION SYSTEM; THEIR APPROACH CONTRASTED WITH THAT OF THE VRT/EBU LIVEIP STUDIO PROJECT. PROJECT MANAGER **EDMOND DEBAR** TELLS THE STORY.

Prior to last December, there hadn't yet been any Live and IP trials in France, although the topic was ubiquitous at NAB and IBC. We decided to join forces with 42 MediaTVCom, a consultancy that was also working on the topic.

We looked closely at the VRT LiveIP Studio project, but we didn't simply want to replicate what they were doing. We had four main goals:

1. Create a temporary platform ourselves on our own premises;
2. Use COTS (commercial off-the-shelf) components;
3. Involve as many vendors as possible;
4. Obtain a clear picture of the technologies and standards as they stood at the end of 2015.

Why did we focus on these goals? Well, by doing it ourselves we could have a very clear picture of how it was implemented and of the real issues that would emerge. Having a temporary platform created constraints for the vendors: with a very tight schedule there was no time for upgrades or long discussions. We would not have a showcase demo, but a real installation.

SOFTWARE-DEFINED

Having a system that actually worked was not a goal; this was a temporary platform and we fully expected it to fail from time to time. We wanted to see how a software-defined network (SDN), that had already been successfully used for the VRT trial, would interact with standard commodity switches.

We think that standard IP switches are mandatory to have a real open infrastructure. Because we wanted to have a picture of the relevant standards and their implementation, we asked a lot of vendors to send us equipment so that we could test – and hopefully help them to improve – their interoperability.

Setting it all up took two days of intensive work – lots of brain power per square metre! The platform was open for three days, during which about 100 people came to visit us, including broadcasters and vendors.

A busy office: around 100 people came to visit and work with the platform across three days.

The results were pretty clear: in 2015 it already worked. That was the main lesson.

But we can go deeper. Last year, all vendors indicated their intention to implement PTP (Precision Time Protocol), which meant none of them actually had done so. The two separate networks remained separate, creating two different worlds: the SDN one and the classical one. It was impossible to exchange video and audio streams, which was clearly where the platform failed. We were provided with many prototype implementations – we were not allowed to shut anything down.

The key standard for live IP production was SMPTE 2022, and we found that interoperability was almost perfect. We noted that it's important to pay attention to the IGMP (Internet Group Management Protocol) version, V2 vs V3.

COST BENEFITS?

One of the main takeaways was that there was no monitoring like in SDI. This appeared to be a sticking point for using such an IP setup in the real broadcast world. We also have questions around security and costs. Money makes the world go around, as they say, so the cost question was not a surprise. Broadcasters will certainly go down this route if it's in their interest. Technology itself is not a goal; production efficiency, security, reliability and money certainly are.

To conclude, we were truly proud to be involved in what was a successful project, along with 42 MediaTVCom, Cisco, Embrionix, EVS, Grass Valley, Imagine, Nevion and Tektronix. By the end of the proof-of-concept we were convinced to go further in 2016, with a more ambitious test of the next generation standards with even more vendors. And that's what we've been doing just as I'm writing this article! A topic for a future issue of tech-*i*…

Surrendering the rendering?

IN THE LAST ISSUE OF TECH-*i*, **ROGER MILES** (EBU) INTRODUCED THE CONCEPT OF OBJECT-BASED AUDIO, WHERE SOUNDS ARE ACCOMPANIED BY METADATA THAT DESCRIBE WHERE AND HOW THEY SHOULD BE PLAYED BACK. HERE HE MAKES A CASE FOR STANDARDIZED AUDIO RENDERERS.

Making sense of object-based audio at the reproduction end is something of a two-part process. The replay system needs to know what its resources consist of; a pair of headphones, a single loudspeaker, a stereo set of loudspeakers or lots of loudspeakers distributed in the listening room (and at what distances, heights and angles from the viewing/listening position they are situated). Knowing what its replay capabilities actually consist of, the reproduction system must then render or reassemble the incoming bits to distribute the audio objects appropriately in order to reconstruct the audio scene as it was authored.

While it is impossible for the author of the sound scene to know what and how many loudspeakers – and their physical disposition around the listening position – are being used by all members of the listening audience, he should ideally know that there is a good chance that the listeners are hearing what was intended, and not some random or spurious reproduction with little integrity to the original. For this to be the case, the renderer that is used in the reproduction process should ideally be a working copy of the renderer that was used to construct and monitor the sound scene in the creation process.

VERTICALLY INTEGRATED

If you are Dolby (or DTS or MPEG; in fact any vendor of such an audio environment) you will most certainly make sure that your end-to-end object-based audio system has this necessary integrity, because you will have designed it yourself, from end-to-end. This is the "vertically integrated platform" model, where nothing is left to chance.

> "With some vendor-specific renderers, it is not possible to control what the receiver does with the control metadata"

Back in the real world populated by the relatively impoverished independent content producers and public service broadcasters (PSBs), things are not so seamless, despite what their customers might wish. PSBs need to use non-proprietary, open standards for broadcast, not having the freedom to operate a "vertically integrated platform" of their own choosing. It is therefore essential that all parts of the system are known. The renderer at the end of an object-based audio system is what reassembles the jigsaw puzzle of delivered bits. More than that, it also does the "painting-by-numbers", following the metadata instructions to colour-in and animate the scene. A broadcaster needs to know that this will be done properly.

Non-standardized (vendor-specific) renderers can be available, but for the broadcaster to be sure of what audio experience the listener will have, a standardized renderer must be available; one matching that used during programme production. This is demanding nothing more than what a vendor would ensure for its own vertically integrated system – the only difference being that the broadcaster must use standardized parts as opposed to bespoke parts.

VERSATILE OBJECTS

Another difference between the "Hollywood" and "broadcast" uses of object-based audio ecosystems should be noted. Audio objects can indeed be scraps of sound disseminated around the 3D space inhabited by the audience – and this provides the immersive experience sought by the blockbuster movie or theme-park. Audio objects can also be different parts of a complete programme; for instance, English commentary, German commentary, Manchester United commentary, Bayern Munich commentary, commentary for the hard of hearing, music soundtrack only – the list is potentially endless.

Bearing in mind that while all these objects are under control of the authored control metadata, they can also be individually selected and manipulated by the end user (where permitted by the control metadata) so that the concept of personalization of reproduction is introduced. Also, as it is the replay environment that makes sense of the authored metadata in the knowledge of its replay resources, the concept of multi-platform repurposing is introduced. With no additional authoring overhead at the time of creation, the original sound scene may be rendered in a way that is appropriate for headphone listening and all the way up to multi-loudspeaker environments. This is an exceptionally important advantage of object-based audio systems for broadcasters that are obliged to operate a multi-platform broadcast environment.

While both Hollywood and broadcasters can make good use of multilingual capabilities of object-

ARCHIDEAPHOTO

based audio systems, broadcasters are more likely to exploit the personalization and access services that are facilitated than the immersive aspects.

TAKING CONTROL

A broadcaster's programme will certainly end up in receivers with Dolby, DTS, MPEG and other licensed technologies taking part in the reproduction chain. Each vendor will have its own way of doing things – including the rendering. Each vendor will be vying with the others for unique differentiation, with its own particular features and processing to ensure its success.

It is known that with some of the personalization features of these vendor-specific renderers, it is not possible to control what the receiver does with the control metadata, even if limits were signalled on the range of adaptation that should be done using that data. As such, there would be no control over the range of commentary level balance, for example. This is, no doubt, a direct consequence of not mandating the behaviour of the renderer in the system. It also means that hard-won things such as EBU R128 loudness control could be broken.

The broadcaster must have the option of being able to request that the receiver use a renderer with known behaviour so that the experience of the audience can be guaranteed. Other renderers could be available, but, in the event of any audience complaints, it must be possible to say, "Is it still bad if you switch to 'standard rendering'?"

IS IT WORTH IT?

At this stage you might well wonder if the complexity of producing object-based audio is worth it, whether it will in fact be used in the UHDTV 'broadcast' space, but a better question might be what will happen if broadcasters do not use object-based audio techniques? How will their broadcasts be evaluated alongside packaged media served up by Hollywood and the burgeoning OTT streaming businesses?

And don't forget virtual reality (VR) gaming (and news coverage too, it appears) that will most certainly need an immersive audio environment to go alongside the 360° video environment; probably rendered to head-tracked binaural stereo. But that is yet another story to render.

- David Wood shares some thoughts on Next Generation Audio on page 16.
- Part 1 of the above article by Roger Miles can be found in issue 29 of tech-*i* (tech.ebu.ch/tech-i)

DATES FOR YOUR DIARY

An EBU workshop on Object-Based Audio will take place in Geneva of 16-18 May 2017. See tech.ebu.ch/events

VR: Immersion, Presence, Empathy

CULTURE-FOCUSED FRANCO-GERMAN TV NETWORK ARTE HAS BEEN A PIONEER IN DEVELOPING A STRATEGY AROUND VIRTUAL REALITY BROADCASTING. **KAY MESEBERG**, HEAD OF THE ARTE360 PROJECT, OUTLINES SOME OF THEIR EARLY EXPERIENCES.

Since the first performances in Greek theatres, with every new medium storytellers have thought deeply about how to make the audience feel like they were part of, or in, the story themselves. Broadcasters too have always looked for ways to give audiences an escape from reality, to immerse them more in the content. The promise of Virtual Reality (VR) is to take the viewer right into an experience.

Experiments to show panoramic images and films go right back to the earliest days of cinema and television. In 1900, cinema pioneers the Lumière brothers created the Photorama, showing images in a sphere, while Russian filmmaker Sergei Eisenstein explored the projection of film onto the walls of a room so that the audience was placed in the centre of the story. And Walt Disney experimented with panoramic movie theatres when developing Disneyland.

Today VR is used to create artificial worlds for video game enthusiasts, often driven more by technological developments than by the needs of the story. At ARTE our mantra for VR today is Immersion – Presence – Empathy. Immersion is the root in history. Presence refers to the feeling of being present in a story. Empathy is what we aim for when we bring the two together.

UNKNOWN MEDIUM

In 2014, ARTE launched the first ever VR documentary within its project *Polar Sea 360°*. The idea behind Polar Sea 360° was to look at how climate change was affecting people living in the Arctic. Rather than bombarding viewers with facts and figures, we chose to use 360° video to give the audience a real feel for the daily lives of people in the Arctic. It gave them a video they could navigate in and, therefore, feel as if they were there.

Parallel to the development of the TV series, while we were working on a *Polar Sea 360°* web app, we found out about the Kickstarter campaign for the first generation VR headset called Oculus Rift, built around a smartphone screen. We decided to try bringing our 360° content to the Oculus – and it worked. We received such positive feedback that we were encouraged to look deeper into 360° video and VR. Thus the ARTE360 VR project was born.

WHY 360° VIDEO?

For broadcasters, video is a familiar format. So the step to a 360° video sphere is not that far off in terms of experience. With 360° video the viewer can experience more than with classical video formats. To date, 360° video has already been used on many different distribution vectors. For example, you can find 360° video on YouTube and Facebook and many smaller players like MilkVR, Eyes Kolor and others.

The core idea of our strategy was to publish content on different distribution vectors. Today these include the ARTE websites, with the ARTE360 player, the ARTE360 VR App, our social media channels, and VR headsets. This multiplatform strategy is helpful as we step into the unknown, giving us access to audience feedback on their experiences with the different devices. This information is very helpful to us to plan the next steps into "VR-Neuland".

We talk about VR-Neuland because VR is new territory for everyone. Everybody who watches or produces content for VR must first figure out how it feels and how stories can be told using it. Perception of screens is a well-studied area, whereas perception with devices that take the audience right into the story is as new and mysterious a domain to us as were the flickering images on the screen to the earliest film trailblazers.

It remains unclear how big the market for VR headsets will be and so it's difficult for broadcasters to gauge what kind of audience reach might be possible. Nevertheless, we believe it's very important to undertake detailed experiments at this early stage. We're working with a production company called DEEP Inc. They create analyses using a heat map tool that shows which content

The world famous La Scala opera house in Milan is one of the most impressive places where ARTE360 content has been filmed.

DEEP INC. / ARTE G.E.I.E.

360° cinematographer Nicolas Jolliet knows how to get the best out of 360° cameras, inventing new approaches like this 360° camera on a wire.

is seen and how. Do people really use the 360° sphere or do they watch the content like a classical video? It is information like this that will help us make a decision about how well the experience is working.

PRODUCTION CONSIDERATIONS

For the capture of VR content, GoPro cameras and rigs are the most widely known and common system at present. They are relatively light and easy to handle. They're also inexpensive, so if they malfunction it won't impact too much on the budget. To raise the picture quality one can look at more professional solutions such as Ozo by Nokia, Black Magic, or RED, especially when a more cinematographic effect is intended.

The big difference with classical video production is that presence at a specific place is a key factor. This means that editing does not work in the same way as for classical video: in classical video, the editor can introduce a place with different angles, whereas in a 360°/VR experience, the user can choose to do this on his own.

The producer of an immersive experience must choose between two major options in the beginning of a production, depending on the subject and the goal of the experience. The first is to create game-like experiences using game engines like Unity to build an artificial world based on graphics and animation. The second, on which ARTE has focused, is based on the capture of spherical video in 360°. The real pictures can of course be enhanced with graphics and animation, but the images are captured with several cameras in a rig that allows them to point in all directions. (Note: Don't forget to find a place where the film crew can hide!)

For an even more immersive feeling, it is highly recommended to also capture spherical sound. After capturing the content, the 360° assets are stitched together. This means that the directional videos are put together to create a sphere. Usually a rough stitch is done first, before editing the different sequences together to get the story you want. After this comes colour correction and fine stitching with the goal of creating high quality content.

This is, of course, a very basic description of the procedure. To raise the quality level many things are possible, such as putting the cameras on moving objects (being careful to avoid inducing motion sickness) or adding interactive elements like hotspots.

AN EXTRA STEP

We realize now that the move to VR requires an additional step in the production process, namely authoring. How can we embed the red line of a story, as we know it in classical video, when we're capturing a sphere? To achieve this, several techniques are being examined. Gaze control is one, to have titles always in front, or there is forced perspective, pointing the viewer to a part in the sphere that is important to understand the story. Analysis of the heat map to discover how the content is seen provides options to adjust and polish the experience.

We're still right at the beginning of our exploration of this new medium. The ultimate aim is for the viewer to enjoy the story in a more natural way and make them forget about the technology behind it. With 360° video and VR we get one step closer to the idea of complete immersion.

5G: The Holy Grail of Telecommunications

MOBILE COMMUNICATION TECHNOLOGY WAS INTRODUCED MORE THAN 30 YEARS AGO. SINCE THEN WE HAVE SEEN FOUR GENERATIONS OF MOBILE NETWORKS TAKING US FROM MAKING VOICE CALLS TO INTERNET ACCESS. SWR'S **ROLAND BEUTLER** PONDERS THE NEXT GENERATION.

5G is in focus for various stakeholders around the globe and is fanning the wildest dreams of politicians, manufacturers and researchers. For policymakers and regulators in Europe, this developing technology seems to represent a means to regain global leadership in mobile technology.

5G is expected to offer a new level of functionality and performance: not only higher data rates but also significantly lower end-to-end latencies to embrace real-time applications as much as possible. Concurrently serving more devices than ever and being able to offer basically unlimited network capacity are complementary requirements. And at the same time energy consumption and costs per bit shall be reduced by orders of magnitude.

As the European Commission expects 5G to impact all economic areas, it began engaging with various market sectors such as energy, transport, infrastructure and entertainment and media. These so-called 'verticals' have been invited to collaborate in the definition of the basic features of 5G technology and become part of the technological development process. Broadcasting is, without any doubt, one of these important vertical markets.

COMMUNICATION REVOLUTION?

As there is wide support from industry, regulators and politicians, 5G may very well be successful in revolutionizing all our communications, if not society as a whole. Therefore, it may give rise to a new way of broadcast content distribution and the opportunity to offer a greater variety of content, hopefully at lower distribution costs. 5G can be an opportunity for broadcasters if their requirements are met.

Hence, broadcasters are actively engaging at a policy level*, e.g. in the context of the 5G for Europe Action Plan**, as well as in specification, standardization and technical development in 3GPP, ITU-R Working Party 5D (WP5D) and 5G-PPP.

The primary objective of public service broadcasters' engagement is to inject their requirements into this process, to make sure that future distribution technology will let them participate under the conditions and constraints to which they must adhere. These are, in the first place, free-to-air access to content, ubiquitous coverage at a guaranteed quality of service – independent of the size of the concurrent audience – and the possibility to design coverage areas in accordance with the relevant regulatory obligations.

For the time being the 5G development process is dominated by manufacturers. For them any new mobile generation represents the potential for good business. In contrast, mobile network operators are less enthusiastic about embracing 5G. They are concerned that setting a course for new networks may conflict with their 2G, 3G and 4G commitments.

THE ROLE OF FIBRE

In organizations such as 3GPP or the WP5D of ITU-R, the implicit assumption is that 5G is about wireless communication in the first place. This will go hand in hand with a plethora of new services and applications spreading out into every corner of the globe. As a consequence, data traffic volumes to be carried over 5G networks will increase dramatically compared to the existing mobile networks (3G and 4G). But this means that the wired part of the infrastructure of future communication networks (e.g. backhaul and the core network) has to be adapted correspondingly to be able to cope with this traffic.

As a consequence, the major investment and innovation induced by 5G will quite likely take place in wired infrastructure. Fibre networks have to become ubiquitous, reaching out to every household, factory, office and public place. The wireless 5G sector may then just play the role of providing access to the omnipresent fibre network infrastructure for portable and mobile devices.

The question is who should bear the necessary investments? It seems doubtful that such fibre penetration can be achieved by relying only on market forces. Fibre rollout may be economically viable in urban settings but probably not in rural areas.

If, however, broadband connectivity is indeed so important for the future development of society, as unanimously presented in all the 5G debates and discussions, then its availability is as important as that of water and electricity. If this is right, then it is hard to avoid the question that provision of broadband

Autonomous driving is one application that is likely to benefit from device-to-device communication via 5G networks.

connectivity is a common goal of communities or countries as a whole. This would suggest accomplishing universal fibre rollout by public funding. However, in times when most development is left to the market this proposal is likely to elicit no response.

NON-TRADITIONAL USE CASES

In addition to the fibre issue there is another aspect of 5G which may stir up the current mobile communication ecosystem. Some of the developments in 5G, such as autonomous driving, will certainly build on device-to-device communication. Information will be sent directly from one device to another in real-time without routing through a base station. Without a doubt there is still a need for traditional base station type communication, for example for those services that have to be made available for all vehicles, such as detailed traffic information or road conditions. But it remains to be seen how far future communications will deviate from the classical approach still used today.

It is evident that both the dominance of wired communication and non-traditional use cases will have a dramatic impact on the role that mobile network operators will play in the future. Their current business models may no longer be sustainable in such an environment.

Against this background it is natural that the incumbent stakeholders in the mobile broadband business are desperately trying to unlock new markets that could benefit from 5G technologies. Finding new customers in new markets is always good. However, doing business with new customers requires offering a product or service that suits their needs. This is the crux of the matter, at least regarding the mobile network operators, and for the time being it seems they have not understood the signs of the times. In 3GPP they say they want to get hold of new customers but still believe their current business models will also work in the future. It is quite likely they will be confronted with a different reality.

* https://www.ebu.ch/publications/how-5g-can-enhance-public-service-medias-contribution-to-the-digital-society
** https://ec.europa.eu/digital-single-market/en/5g-europe-action-plan

Introducing .radio

A FLOOD OF BRAND NEW TOP-LEVEL DOMAINS WILL CHANGE HOW PEOPLE RELATE TO THE INTERNET. THE EBU HAS BEEN ENTRUSTED WITH RUNNING .RADIO AS A COMMUNITY TLD. **ALAIN ARTERO** IS MANAGING THE PROJECT.

Top-level domains (TLDs) represent the top level within the hierarchical structure of internet domain names. Originally, there were 21 generic TLDs, including .com, .org and .net, as well as country code domains such as .de, .co.uk, etc. However, the world authority that maintains and regulates web addresses, the Internet Corporation for Assigned Names & Numbers (ICANN), invited applications for new, more creative TLDs with a deadline of April 2012.

Around 1,900 applications for new TLDs were submitted, covering areas as disparate as .club, .bmw, .hotel, .sport, .gay, .google, .africa, etc. The EBU applied for the string .radio.

More than 600 applications were withdrawn or refused, mainly because of duplicate projects for the same strings. Among the remaining projects, a majority are now up and running or will be launched in the coming months.

The new TLDs can be grouped in four main categories with contrasting profiles and purposes.

- Standard generic TLDs (e.g. .com, .club, .cloud), with no particular TLD-specific policy
- Brand TLDs (e.g. .ibm, .eurovision), for exclusive use by the respective registry operator
- Geographic and cultural/language TLDs (e.g. .paris, .swiss, .cat), for the respective local community, culture or language
- Community-based TLDs (e.g. .bank, .radio, .pharmacy) for the respective community

AN INCLUSIVE APPLICATION

In submitting an application for a community-based TLD for .radio, the EBU requested the support of all the key radio organizations across the world.

By implementing a community TLD for .radio we can prevent cybersquatting by limiting who can obtain a domain (using policy, pre- and post-controls). This avoids schemes that are seen with, for example, the .tv domain, where speculators buy domains simply for commercial purposes, aiming to resell them to brand owners who are willing to pay for defensive reasons.

Few community TLD propositions passed the very difficult ICANN Community Priority Evaluation (CPE) process and many projects were rejected. Being recognized as a Community TLD is thus a significant endorsement. (In the alternative scenario, auctions are organized and names can be assigned on a purely commercial basis.)

Passing the CPE gate marked the start of challenges by the three other applicants for .radio. Their goal was to use .radio for purely commercial purposes, which contrasted with the EBU's willingness to make .radio a high-quality internet space reserved for the world radio community. Other Community TLD projects are still dealing with challenges due to the resistance on the part of those involved in the domain name industry to accept the community TLD concept.

PREPARING FOR LAUNCH

The .radio TLD was delegated in mid-October 2016, and the first host has been set up (nic.radio, with naming based on ICANN rules).The domain is in a transient state until January 2017. We will launch a pioneers' programme in February 2017 followed by the launch in Q2 2017.

This latter period will be key for all radio organization and stations across the world. We will not operate a first-come, first-served approach as we want to optimize this TLD for the whole radio community. Instead, we will work hard to solve issues of contention and propose different options when several entities seek to acquire the same domain name.

To apply for a .radio domain, organizations should wait for the TLD launch, which will take place over several months, during which radio stations (and other bodies related to radio) will be invited to announce their desire to acquire a given domain name.

We are in the process of devising clear rules. For instance, domain requests will need to be similar to the usual name of the radio station in question, and not anyname.radio. Concerning prioritization, on-air radio entities will be given priority over web radio services or radio professionals. This policy has already been described publicly in our .radio application.

After the launch, the General Availability period will establish and test the rules and controls to ensure the TLD is focused on radio content, but the prioritization that characterized the initial period will have come to an end.

WHAT'S IN IT FOR YOU?

Developing content on .radio will help to avoid the constraints of overcrowded name spaces in generic and country TLDs. The community will have the final say over the rules in this common space, which will provide memorable names with a clear message. End-users can trust the domains and there will be opportunities for innovation and new usage models.

Watching the watchers

THE LATEST REPORT ON AUDIENCE TRENDS FROM THE EBU'S MEDIA INTELLIGENCE SERVICE (MIS) INDICATES THAT, DESPITE THE GROWTH OF INTERNET USAGE, TV AND RADIO ARE HOLDING THEIR OWN, WRITES **ALEXANDRA BRENKMAN**, SENIOR MEDIA ANALYST, EBU.

We've drawn on a wide variety of sources to put together our latest annual report on Media Consumption Trends, which was published in September 2016 and is available exclusively to EBU Members. It contains a wealth of data and is generally encouraging for broadcasters, with an overall growth in the amount of time spent on media and with live TV and radio remaining dominant.

Of the total amount of time that people spend watching audiovisual content (**Figure A**), live TV is by far the main type of viewing. Although the definition of "total viewing" might differ slightly from country to country, research shows that in many countries live TV represents roughly 9 out of 10 minutes watched. In Northern European countries the proportion of live TV tends to be smaller, and in general, young people across Europe spend less time watching audiovisual content than other age groups.

The shift to online TV and video is happening slowly. In 2010, live TV represented 82% of total viewing in the UK according to Ofcom's Digital Day research. By 2014 it had declined to 69% of total viewing, but viewing of all content had increased from 3h32m per day to 4h18m, meaning that the amount of time dedicated to live TV was stable. In the latest Digital Day survey, carried out early 2016, total viewing time was nearly stable (4h14m per day) while the proportion of live TV slightly dropped to 63% of total viewing. Looking more closely at the other types of content being viewed (**Figure B**), we can see that free on-demand (mainly broadcaster catch-up) and paid on-demand (including services such as Netflix) now both account for 6% of viewing time in the UK, whereas 3% of viewing time is dedicated to online clips.

Online viewing is growing, particularly among young people.

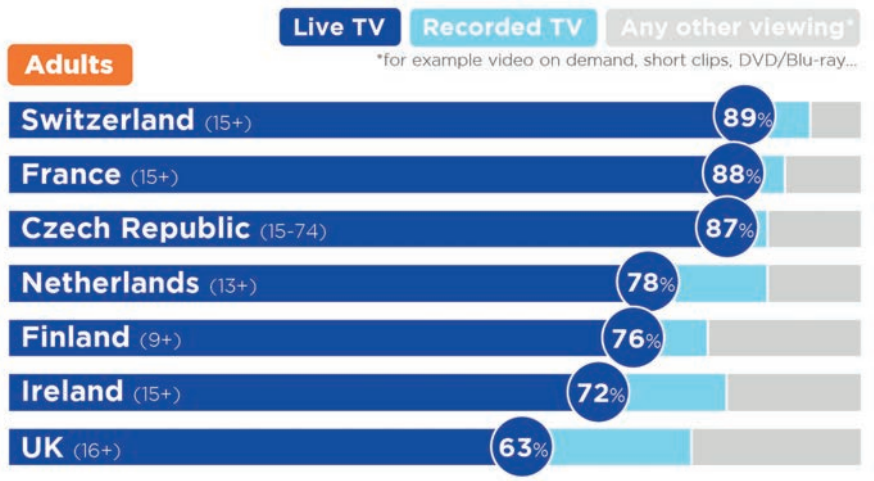


Figure A: Proportion of live TV out of total viewing

Interestingly, however, most online videos are still watched at home, which has an impact on what kind of network connection is used (**Figure C**). Google's Consumer Barometer reveals that only 12% of online videos are watched via a mobile network. Across Europe, most online videos are watched via WiFi. In Finland, where unlimited mobile data packages are commonplace, one out of four online videos are watched via a mobile network. Conversely, viewers in countries such as Hungary, Latvia and Romania still rely heavily on fixed-line internet to watch online video.

EBU Members can download the complete 48-page report from: www.ebu.ch/mis

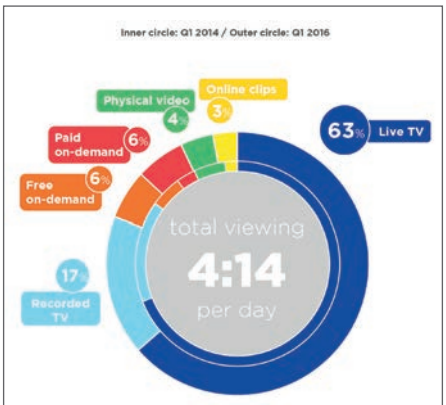


Figure B: Total viewing time by type of content (adults aged 16+, United Kingdom, type in % of total viewing)

Sources: Figure A: Mediapulse Time Use Study, 2015 (Switzerland), Médiamétrie, 2015 (France), ATO / Nielsen Admosphere Cross-medial study, 2015 (Czech Republic), Media:Tijd, 2015 (Netherlands), Finnpanel / Yle, Autumn 2015 (Finland), Ipsos MRBI Total Viewing Study, 2016 (Ireland), Ofcom Digital Day, 2016 (UK); **Figure B:** Ofcom Digital Day; **Figure C:** The Consumer Barometer 2014/2015, 31 European countries, TNS Infratest on behalf of Google

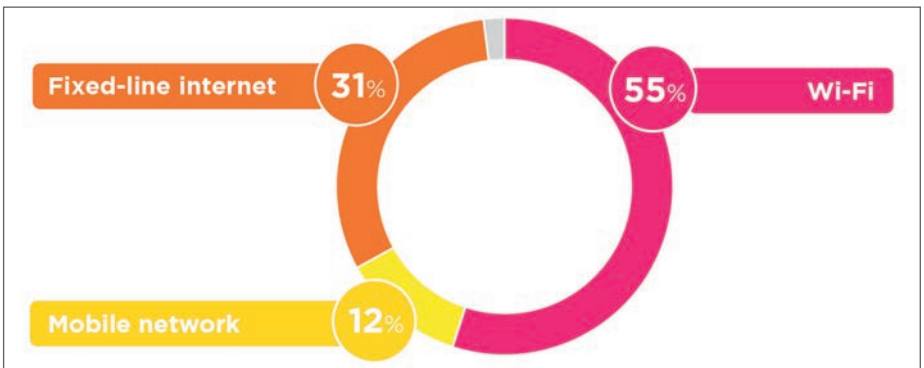


Figure C: Connection used to watch online video (in % of online video users 16+, based on last video watched)

Taking A Sounding About UHDTV

THE NEW NEXT GENERATION AUDIO IS GREAT TECHNOLOGY, BUT, WONDERS **DAVID WOOD**, DO WE NEED TO ASK WHETHER MR AND MRS JOE PUBLIC WILL DO IT JUSTICE?

Question: What is the favourite breakfast of stereophonic sound enthusiasts? Answer: Two bowls of cereal spaced exactly three metres apart! It's an old, but telling, joke. Much of the public never took the correct placing of stereo loudspeakers in the lounge seriously, especially when used for TV sound. If the speakers came in the walls of the TV cabinet, well and good. If they didn't, the layout of the lounge furniture took precedence over the correct placing of the loudspeakers.

Where lounges and people are concerned, simpler can be better.

In the age of HDTV, 5.1 surround sound offered the prospect of being used independently, without or with a TV set. This called for five, ear-height, loudspeakers strategically located in the lounge, in an arrangement centred on the TV set. A critical speaker was centre-front, best behind or above the TV screen, because it anchored the person speaking to the screen, wherever you were in the room. A sixth loudspeaker – the sub-woofer – should be located on the floor near the TV set.

SIMPLY STEREO?

Though surround sound can be found on HD Blu-ray Discs, HD broadcasters did not take it up with enthusiasm. Many said its use led to unpredictability. The programme producer likes to know how his or her great work will be experienced by the viewer. Out there in viewer-land, there are any number of haphazard 5.1 loudspeaker arrangements, so the sound images of the producer's "work of art" could end up being equally haphazard. It is safer, they would say, to broadcast in stereo, because you are more certain about how it will be experienced by the viewer. Where lounges and people are concerned, simpler can be better.

Enter the age of Next Generation Audio (aka NGA) – the stage beyond surround sound. The case for NGA is that the UHDTV television experience – the sense of reality – will be significantly better if an advanced sound system is used alongside the improved image quality. It allows, among other pluses, the position of the sound to be anywhere in a vertical or horizontal plane. If a bird flies up the large TV screen, the sound of the chirping can follow it up. NGA is thus sometimes called 3D sound.

Technically, it uses a new way of broadcasting sound. Instead of sending a number of audio signals that are directly used by the loudspeakers in the home, a double-figure series of 'sound objects' are sent. Each object is a sound itself, and coupled with it are instructions to the receiver of what to do. The receiver brings them all together and translates the result into signals for each room loudspeaker. This is a process called rendering. Elsewhere in this issue, Roger Miles explains why broadcasters need a reference renderer, so they have an idea how the viewer/listener will experience the sound – all other things being equal. (See page 8).

2-7-2

Specialists estimate that the home arrangement of correctly positioned loudspeakers ideally would be something like three layers: one at ground level, say with two speakers, one at ear level, say with seven speakers, and a third level higher up in the room, say with two speakers. This would be called a 2-7-2 arrangement.

Without going into technical detail, NGA brings the prospect of an amazing "theatre of sound" in the viewing room. Take it from me, if the system is correctly set up, the result of NGA and UHDTV images is astounding. It is more than an addition to the image experience – it is a multiplier of the experience.

Having said that, at the back of our mind has to be the question of how Mr and Mrs Joe Public will set up the multiple NGA loudspeakers in their lounge in practice. History suggests that what is simple for an engineer may not be so simple for the layperson. For all its technical elegance and great potential, should we ask how things will look – and sound – in practice in the UHDTV home?

Let's hope that future generations will not tell jokes about audiophiles, breakfast and eleven bowls of cereal.

DVB Update

FOLLOWING HIS RECENT APPOINTMENT AS CHAIR OF THE DVB PROJECT, THE EBU'S **PETER MACAVOCK** SHARES SOME EARLY IMPRESSIONS.

I am hardly a new face to those who have followed the development of the DVB Project over the years, but there's a good reason why I am back in DVB's picture. It's all about securing broadcasting's future. How is DVB going to achieve this heady aim? Only with the active support from broadcasters! And EBU Members are absolutely key.

Many are struggling with how to deal with the rise of OTT. Some are even suggesting that OTT is only a fad, that the sums don't add up: you need Netflix's scale to be in any way profitable, but even this profitability is precarious because the margins aren't there. Distribution is expensive, and how long before Hollywood will demand the returns they need to continue to run their business? And why is YouTube making all that money from your content?

DVB'S ROADMAP

What is DVB going to do in OTT? As chairman, you have surprisingly little influence on the direction an organization like DVB takes. You're reduced to establishing the ground rules and relying on input from the Membership – and that's you!

I often get asked will there be a DVB-T3? I don't yet know the answer, but there are many exciting developments. One of the pioneers of DVB-T, Erik Stare (Teracom) recently won an award for an IBC paper that has the whole world thinking about the next stage for DVB's terrestrial system. I don't know whether there will be a T3, but I am excited about the prospect of an industry considering its next stage.

Arguably the technology direction of broadcasting and broadcasters will be largely decided in DVB. It's therefore critically important that the broadcaster community contributes actively.

The first event to showcase new directions in DVB will be DVB World (Vienna, 13-15 March 2017). It promises to be quite a show, with high profile keynote presentations as well as insights that will shape the future of our industry.

ABU Update

TECHNICAL DIRECTOR OF THE ASIA-PACIFIC BROADCASTING UNION, **DR AMAL PUNCHIHEWA**, PROVIDES AN OVERVIEW OF RECENT ACTIVITIES IN THE REGION.

The two dominant themes for the ABU in recent months have been the effort to accelerate the analogue to digital transition in terrestrial broadcast, and preparations for future IP-based production environments. These are key issues for our Members and for broadcasters in general.

To address the slow progress in DTT rollout, we partnered with the ITU and the Asia-Pacific Institute for Broadcasting Development (AIBD) on a workshop in Incheon, South Korea, to provide a clear picture of evolving digital broadcasting services. Participants reviewed and discussed the experiences of digitization in Asian countries, especially at the sub-regional level. A similar event, focusing on the Pacific region, took place in Port Moresby, Papua New Guinea, again in partnership with the ITU.

The ABU once again contributed to June's BroadcastAsia Exhibition and Conference in Singapore, conducting a full day session on digital broadcasting in partnership with the DVB Project. The session addressed high dynamic range, IP, virtual reality, immersive audio, UHD-1 and video coding.

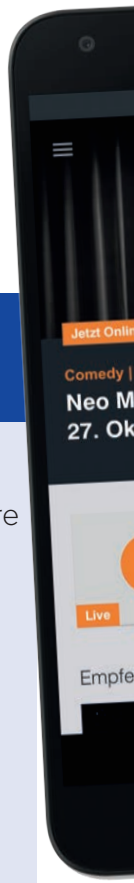
Just ahead of BroadcastAsia we partnered with Asia-Pacific Broadcasting, a publisher, for the APB ConneXxion Forum, looking at the benefits, limitations and challenges associated with IP production environments. The event, titled "Embrace IP today for tomorrow", focused in particular on industry standards and interoperability. Broadcasters require an assurance that all-IP studios for live productions will be as reliable as traditional systems. With this in mind, SMPTE standards (2022-1/2/6/7) were identified as dominant for compressed and uncompressed video, while AES-67 was recognized as a digital audio standard.

A specific challenge identified was the relative lack of IP skills among broadcasting staff. There will be a necessity for IP specialists in the broadcast domain and so current staff will require training to "up-skill" them on the essentials of IP for broadcast operations.

Finally, another topic of critical interest to our Members, particularly in the context of the move to the IP domain, is security. As the assets and infrastructure are not confined to a physical building or area, cybersecurity is required to protect operations against intentional attacks. These issues were discussed at a recent three-day Integrated Broadcast-Broadband and OTT workshop (photo below) in Kuala Lumpur, with over twenty speakers and more than sixty participants.

ZDF preparing for the future

GERMANY'S ZDF RECENTLY OVERHAULED AND RELAUNCHED ITS ONLINE OFFERING, WITH ENTIRELY AN NEW FRONTEND AND BACKEND BASED ON MICROSERVICES. **UWE HOFER**, PARTNER AT THE PROJECT'S GENERAL CONTRACTOR EXOZET, PROVIDES THIS OVERVIEW.



On 28 October 2016, German public broadcaster ZDF relaunched its online offering: the merging of ZDF.de and the Mediathek (its catch-up TV service) into one.. The online core of one of Europe's largest public service broadcasters underwent a complete overhaul.

The launch has been a great success. To quote Andreas Grün, System Engineer and Project Manager at ZDF:

"With the relaunch, we have taken a decisive step in developing our technical basis and can adapt more quickly to future technological progress. With the relaunch, the ZDF Mediathek is optimized to run on all relevant devices and third-party platforms, can be personalized, is more accessible and, thanks to its powerful search function, content is quicker and easier to find."

We were delighted, at Exozet, to work with ZDF on this project. A crucial element of our pitch was the proposal to take an integrated approach to the overhaul. Over a period of five months, both parties together developed a lead idea for a public service media library that is fit for purpose in the digital world. This idea became the foundation of the new Mediathek that went live at the end of October: the presentation of content and the way it interlinks, as well as usability and design. Naturally, the new Mediathek is responsive and compatible with most platforms. Flash has become obsolete.

We also redesigned the backend, which is based on a microservices system architecture and integrates a new content editor (the content management system "Sophora" from Subshell). This integrated solution paves the way for flexibility that has been lacking in providing ZDF content across all platforms. The core is no longer a central content library but loosely interlinked microservices that communicate via an API management platform with the outside world.

The new Mediathek uses a whole range of channels. There are apps for smartphones, tablets, Android TV,

ZDF MEDIATHEK: ENABLING TECHNOLOGIES

From a technology point-of-view, the highlights of the new ZDF website are:

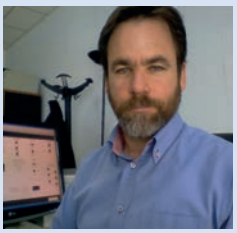
- **Microservices**
  Both the new backend and the new frontend were implemented based on various microservices.
- **Content API**
  All microservices are aggregated in a centralized API, which can be used by all platforms while also serving as a single data source for responsive distribution in browsers.
- **Feed approach**
  Synchronization of all elements works via a feed approach and therefore does not result in ESB (Enterprise Service Bus) or message queues.
- **Search/recommendations**
  Various semantic recommendation processes have been implemented based on Elasticsearch, indexing and tagging services.
- **Personalization**
  Personal settings are stored and synchronized across devices for logged-in users. For users with a usage history, recommendations are personalized.
- **Smart clients**
  In addition to a CDN, the caching architecture also uses a Varnish farm and several NGINX servers plus ESI and SSI for the integration of third-party content. Some logic is therefore transferred to the clients to improve content caching and to speed up delivery.
- **Continuous delivery/ integration**
  Each microservice is automatically established using Jenkins, automatically tested using BDD (Behaviour-Driven Development) tests on a Docker basis, versioned using SemVer, and deployed on the TEST system using Puppet. Updating the production environment is just a question of the required microservice versions.

Components used:
Nginx, Varnish, Java 1.8, Spring Boot, Spring Data, Elasticsearch, MariaDB, Nodejs, Jsb, Handlebars.java, Grunt, Webpack, Lua, Behat, Mink, Gherkin, JUnit, Sophora CMS, Puppet, Git, Jenkins, Docker

IMAGES: ZDF/ZDF NEUE MEDIEN

and even Amazon Fire TV. There are separate apps for the Apple platforms tvOS and iOS 9/10. A universal app covers Windows 10, as well as Windows 10 mobile. The old Windows 8 app has become a wrapper for the web portal. Because it is based on the HbbTV standard, the new Mediathek is also accessible from smart TVs by pressing the red button. All apps use the content API in the new backend to access and display the content.

Exozet was commissioned by ZDF as the general contractor for the technical implementation. Our subcontractors were Condat AG and m.a.x. Informationstechnologie AG. Together, they implemented the new backend and the responsive frontend design and merged the content from the old to the new Mediathek.



In the spotlight
Mike Nugent
DIRECTOR OF TECHNICAL DEVELOPMENT & PLANNING, ERT, GREECE

WHAT ARE YOUR CURRENT RESPONSIBILITIES (AT ERT)?
Since the closure of the Hellenic Broadcasting Corporation (ERT) through a legislative act in June 2013 and the formal re-opening 2 years later, an effort is ongoing to reestablish the operations of its five TV channels, 27 radio stations, website, digital archive and two orchestras. My responsibilities are to propose and supervise the investment plan, in order to restore the functionality of the existing infrastructure, and to explore and implement new technologies and more efficient workflows.

WHAT DO YOU CONSIDER AS YOUR FINEST ACHIEVEMENT SO FAR IN YOUR CAREER?
Working in research and planning can be very stimulating – a number of different projects are initiated across a variety of areas, taking into consideration technological progress and innovation. Taking on my current role has given me the opportunity to coordinate these activities within ERT and engage in international technical bodies such as the EBU Technical Committee.

WHAT ARE YOUR PREDICTIONS FOR BROADCASTING TECHNOLOGY IN THE FUTURE?
Many predictions made in the past have proved to be dramatically mistaken. Accordingly, I do not foresee major disruptive innovations in the immediate future, although emerging technologies and business models will eventually prevail, as long as they prove to be sustainable.

Having said that, more and better quality pixels and next generation audio are under way, television experience is evolving from linear to an "anytime, anywhere and any device" era, and the broadcast ecosystem is gradually becoming a software-driven IP environment. Therefore, and based on deliberations between members of the Technical Committee, we expect to see three main trends in technological change today: image and sound technical enhancements leading to an improved user experience, the personalization of media content for users of broadcast and broadband services, and the transition to a greater use of information technology.

WHAT, FOR YOU, ARE THE MOST IMPORTANT CHALLENGES FACING EBU MEMBERS TODAY?
All broadcasters need to take a glimpse into the future and assess the impact of emerging technologies on their content production and delivery models, for the benefit of their strategic decision making. They need to become aware of innovations that eventually will bring along new business models and have the flexibility to adjust to the new environment. That said, EBU Members should not deviate from their core values, always maintaining high standards of professional programming and content production. Innovation is an important element of their mission and being part of the new landscape should be a priority in their strategic programming.

TELL US ABOUT SOME OF YOUR INTERESTS AWAY FROM THE WORKPLACE.
I am an avid long distance runner and enjoy its many merits. Every year I look forward to the Athens Classic marathon event which has a great historical significance as it runs along the original route taken 2,500 years ago.

Four great reasons
to book your next trip to Geneva!

PRODUCTION TECHNOLOGY SEMINAR 2017
24-26 January

There are few events that offer the same breadth and depth of coverage and analysis of recent and future trends in media production technology. PTS is consistently our most popular annual event. Join us to find out why!

tech.ebu.ch/pts2017

MEDIA CYBER SECURITY SEMINAR
21-22 February

The first of its kind in Europe, an event to help media and broadcast organizations tackle the growing threat of cyber-attacks. Day 1 will provide hands-on tutorials, with Day 2 offering expert insights.

tech.ebu.ch/cyber-security2017

DIGITAL RADIO WEEK 2017
6-9 February

Focused around the Digital Radio Summit (8 February), the week also provides the usual chance to get hands-on at the RadioHack (6-8 February) along with the RadioDNS General Assembly and a meeting of the WorldDAB Technical Committee.

tech.ebu.ch/radio2017

BROADTHINKING 2017
11-12 April

At the crossroads of broadband technologies and broadcasting, this is the EBU's essential annual event for catching up with the latest trends in OTT, CDNs, IP delivery, HbbTV, second screen and more.

tech.ebu.ch/broadthinking2017

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