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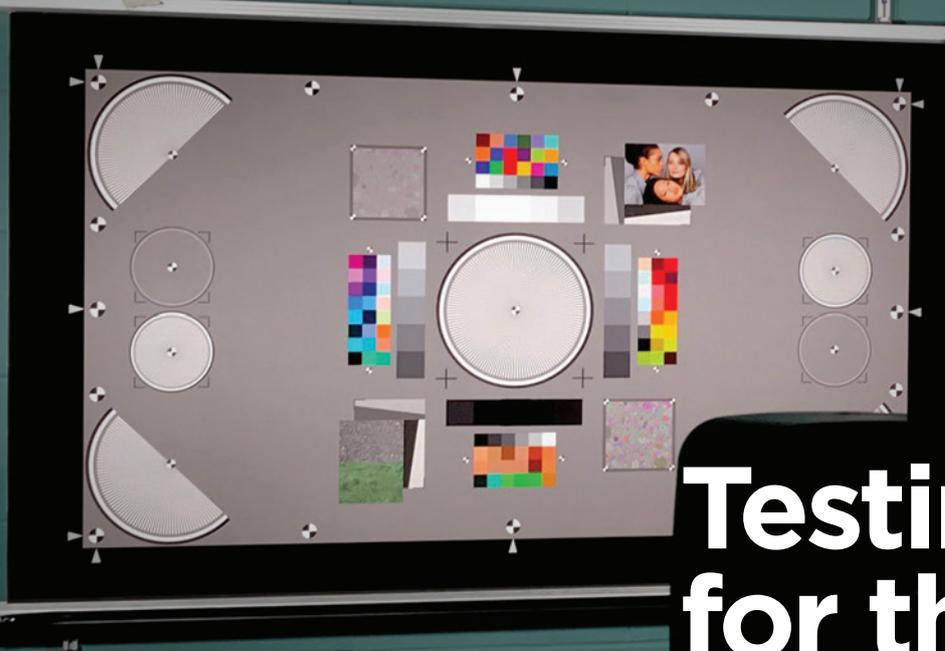
Testing times for the UHD transition

Plus
- **Launching 5G-MAG**
- **UHD1 truck wins 2019 T&I Award**
- **High Frame Rate: is it worth it?**
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Issue 41 • September 2019

Cover story: In this issue of tech-*i* we put UHD technology under the microscope to assess the state of the overall ecosystem. UHD lenses are in focus on pages 10-11; there's new EBU guidance on optimal features and formats for PSM on page 12; and the results of subjective tests on high frame rate on page 13. Elsewhere, David Wood looks further ahead to whether 8K will ever make sense (page 16). Cover photo: Pierre Hugues Routhier (see page 10)

Introducing 5G-MAG

Antonio Arcidiacono
Director of Technology & Innovation, EBU

I wrote last March in these pages about our vision for a new kind of media delivery system, where the key concept is a cooperative network coupled with intelligent receivers. To build this, I wrote, we would need to bring together organizations from across the media delivery chain – broadcasters, public and private, universities, telcos and network providers, both terrestrial and satellite.

I said then that we at the EBU were ready to embrace this vision that "could raise European industry to the forefront of media technology in the world". We have now reached the point where that vision starts to become a reality, with the launch of the 5G Media Action Group (5G-MAG).

CHICKEN & EGG
Much has been said about the potential for 5G networks to play a central role in media delivery in future. One of the big challenges, however, is to ensure that new 5G features such as broadcast capabilities are supported by chipsets, network infrastructure and user devices. The vendors require certainty regarding market adoption, which will be driven by the existence of new services that rely on these new 5G features.

If that's the chicken, then the egg is that the service providers will only invest in such new services if they are sure they can reach the end users. 5G-MAG hopes to foster the simultaneous emergence of both the chicken and the egg.

Although liaison with the relevant standards developing organizations is foreseen, 5G-MAG will retain a primarily commercial focus. Specific objectives will include encouraging the development and commercialization of 5G chipsets and user terminals that support media use cases; or facilitating agreements between content/service providers and terminal suppliers and service distributors. In content production, too, there 5G-MAG will aim to foster the necessary developments.

CONVERGENT NETWORKS
It looks certain that services based on 5G will initially see the light of day in urban areas, where the biggest commercial opportunities lie for incumbent telecoms operators. However, the media-related applications that are of most interest to broadcasters require reliable wide area network coverage, i.e. close to 100% of the population and 100% of the territory.

And it's not just media providers that require this level of coverage. Similar requirements come also from the transport sector and PPDR (public protection and disaster relief). 5G-MAG will thus also foster innovative approaches to 5G coverage and promote the use of the convergent, collaborative networks that will be required. An orchestration specification among the different network components will be a key element.

You will hear and read a lot more about 5G-MAG in the coming months, not least at its public launch during IBC2019. The EBU is proud to be driving the creation of this new association, which will have its own legal identity, funding and governance.

Conference videos on demand
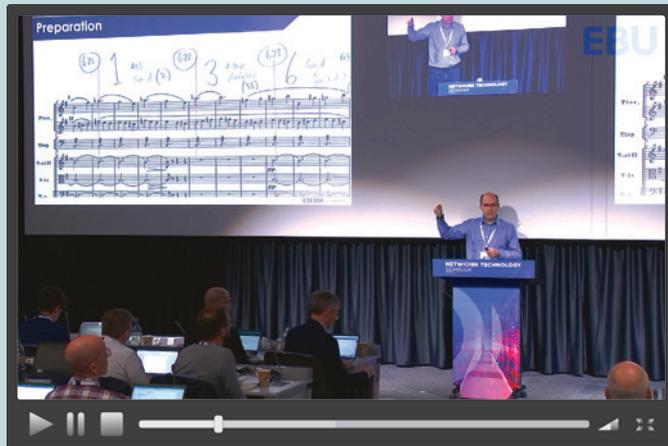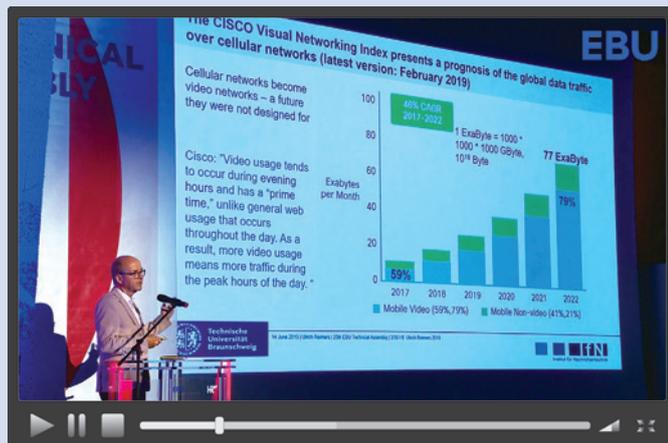
Robotics, automation and orchestras •
David Chalmers (BBC)

Sustainable remote production • **Larissa Görner
(Grass Valley)**

Broadcasting in a world of cellular networks •
**Ulrich Reimers (Technical University
Braunschweig)**
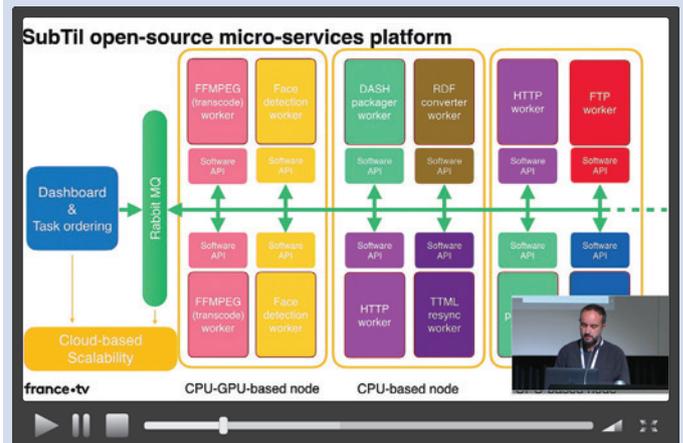
SubTil Project: an open platform to run
microservices with AI • **Matthieu Parmentier
(France Télévisions)**

EBU Technical Committee meets with Arab Members

Just before the 25th EBU Technical Assembly in Croatia last June, representatives of several EBU Members in Arab countries met with the EBU Technical Committee. Eight CTOs and technology managers from Algeria, Egypt, Lebanon and Morocco were present. (The participation of colleagues from Tunisia, Jordan and Oman was also foreseen, but was not possible for administrative reasons.) Also present were staff members of the EBU Technology & Innovation Department, including Director Antonio Arcidiacono, and EBU Director of Member Relations and Communications Vanessa O'Connor.

While the Arab States

Broadcasting Union (ASBU), with which the EBU collaborates, brings together 27 broadcasters in the MENA region, 11 of them are also EBU Members. The June meeting was a valuable opportunity for the Technical Committee to gain insights into the status of the digital transition in both production and distribution for broadcasters in the region.

Several areas for future cooperation were identified. Most of the the participants remained in Cavtat to attend the Technical Assembly, which included a presentation on the digital transition in the Arab States. (See: **tech.ebu.ch/ta2019**)

Pioneering OB truck wins EBU Technology & Innovation Award 2019

The EBU Technology & Innovation Award recognizes technology contributions that "make a difference and create value" in broadcasting. The winning project this year was UHD1, a pioneering outside broadcast vehicle developed by tpc, a subsidiary of the Swiss public service media organization SRG SSR. The truck has allowed

Detlef Sold with the EBU Technology & Innovation Award

tpc and its clients – including the Swiss public broadcasters – to put IP-based production to the test. (Read more about the project on page 6.)

Now in its fourth year, the award was presented to Detlef Sold, the then outgoing CEO of tpc, at the Technical Assembly in Croatia on 13 June. Accepting the award on behalf of tpc and its many technology partners, Mr Sold said: "We have built an IP lab to help us answer the many questions that come with moving to an all-IP environment, but going on air with a full-IP truck has been much more useful. What we have learned from the engineering and architecture design of UHD1 is being transferred to the design of our new technology centre in Zurich."

The OB truck from tpc was one of four shortlisted projects selected from the 13 entries received for this year's T&I Award. The other shortlisted projects were ORF's IP-based multimedia newsgathering vehicles (see page 7); ITV's cloud-based live-to-VOD platform (see page 14); and the Greenfield Playout project from TV2 in Norway, revolutionizing the way content is handled both in terms of technology and organizationally. (The TV2 project will be covered in more detail in the next issue of tech-*i*.)

For past winners and information on how to apply: tech.ebu.ch/award

Our workplan for the next two years

A NEW TWO-YEAR WORKPLAN FOR THE EBU TECHNICAL COMMITTEE WAS ENDORSED AT JUNE'S TECHNICAL ASSEMBLY IN CROATIA. COMMITTEE CHAIR **JUDY PARNALL** (BBC) EXPLAINS THE THINKING BEHIND IT.

There is an established rhythm to how the Technical Committee (TC) operates with regard to planning its work: elections for the TC take place at the Technical Assembly every second year, while a new workplan is developed and presented in the intervening years. This schedule meant the Workplan 2019-21, with a streamlined structure and approach, was presented at the Technical Assembly in Croatia.

So, what problems were we trying to solve with this new approach?

We have sought more flexibility. The speed of change is increasing at an almost unbelievable rate. Take smart speakers, for example: did any of us foresee even two years ago how popular and almost ubiquitous they would become? We wanted to make sure that the workplan, even though it covers two years, could adapt quickly to such changes.

We were aware that we needed better communication, both between the TC and its Strategic Programmes (SPs), but also with the wider community of EBU Members. Furthermore, we wanted to simplify the workplan, knowing that there are people who want to contribute to our work, but have been unable to easily identify how best to engage with us.

The new workplan was based on several inputs, including the overarching EBU Together strategy, a survey of Members, requests from other EBU committees, and the experience of the TC itself and the existing working groups.

FEWER PROGRAMMES

The number of SPs has been reduced to five, which will continue to oversee Project Groups that carry out defined tasks. We have also made provision for Communities of Practice – to facilitate learning and sharing among Members – and Collaborative Developments towards a specific product or service.

In the interests of transparency, the workplans of each SP will be accessible to all EBU Members, with common tools used to manage their respective backlogs (of work items). The use of remote tools and online meetings will continue to grow, recognizing the pressure on travel budgets throughout the membership.

I encourage all Members to get involved with our work so that we can bring this workplan to life and really deliver value for public service media.

Judy Parnall at the 2019 EBU Technical Assembly

Structure of the EBU Technical Committee Workplan 2019-21 – see tech.ebu.ch/workplan

IP-based truck moves UHD/HDR into the fast lane

ANDREAS LATTMANN, CTO OF SWISS PRODUCTION COMPANY TPC, WRITES ABOUT THE NEW UHD1 TRUCK, WHICH RECENTLY WON THE 2019 EBU TECHNOLOGY & INNOVATION AWARD.

UHD1 has been on the road since October 2018.

The main production gallery.

When we set about replacing an existing, very large HD truck, we knew we wanted to have all the capacity, operational familiarity and production functionality in our new truck – but we wanted it full-IP uncompromised UHD HDR (high dynamic range) too.

Traditional technology was not going to allow us to support 24 full 4K UHD cameras, with cross-conversion between UHD and HD, SDR and HDR, in the space available. The only way we could fit it into the truck was by using a software-defined architecture, with connectivity conforming to the SMPTE ST 2110 family of standards.

IP CONNECTIVITY

One of the ways we saved space was by putting all the video processing, including cross-conversion between the various standards, into a device called the Selenio Network Processor (SNP), from Imagine Communications. Each one of these, in a 1RU chassis, includes four separate processor blocks, so in a single rack in the truck we could get effectively 176 reconfigurable video processing units.

The SNPs also provide a bridge between IP connectivity inside the truck and edge devices that still need to use SDI. These include some of the key hardware, like EVS servers and Sony cameras. So everything has to work with minimal latency.

On the IP side we used switches from Arista Networks, which include the ability to support 100 gigabit ethernet links. In turn, this means we do not have to worry about running out of bandwidth in complex productions, even in 4K UHD.

Having the SNPs and other IP devices connected to the Arista switches allows for sufficient concurrent uncompressed UHD links over ST 2110 to support rich live playout operations. It also means that most of the fixed cabling was lightweight network cables, which makes a big difference when you need to keep the weight down to highway limits.

UHD1 has been on the road since October 2018, and both the crews and the clients love it. Indeed, operationally, it looks and feels like the trucks that our crews have been operating for years.

FROM SKIING TO OPERA

UHD1 works in very challenging environments, and is relied upon to provide world-class coverage. Of the many occasions when the eyes of the world have been on the output of UHD1, perhaps the most dramatic was the Lauberhorn, the most exciting of the FIS Alpine Ski World Cup races, held each year in Wengen in Switzerland. The summary of the operational crew at tpc is that UHD1 "is really as stable as SDI, and far more flexible. Basically, we really like it!"

UHD1 also regularly goes out to cover the ice hockey national league and other sports events. But because it is designed to be flexible, it is used for music and cultural events too: operas like Nabucco from Zurich and Idomeneo from Salzburg; the opening concert of the Lucerne Festival; and the Vienna Philharmonic Orchestra in Salzburg.

We were designing UHD1 at the same time as the SMPTE ST 2110 standards were being defined, so we needed a patient and informed technology partner to guide us through. We chose Imagine Communications because their specialists were so closely involved in the standard-setting process that they were constantly informed about what we should do. IP connectivity and software appliances solved an otherwise impossible technical challenge in UHD1 – to get flexible, agile, uncompromised, uncompressed facilities into a truck we could still take on the road. It also gave us invaluable experience in software-defined architectures, which we will carry over into our new headquarters building and studio centre, which we are currently developing in Leutschenbach.

Reinventing mobile newsgathering

A NEW FLEET OF IP-BASED MULTIMEDIA NEWSGATHERING VEHICLES TOOK TO THE ROAD IN AUSTRIA IN 2018. ORF'S **KARL PETERMICHL** EXPLAINS HOW THE PROJECT TOOK SHAPE.

In 2015, Austria's public service media organization ORF started to evaluate replacements for its fleet of ten mobile units for radio newsgathering. After consulting all relevant stakeholders – journalists, editors, production teams, and the finance and technology departments – it was clear that the design must be based on IP transport and extend to video and online journalism.
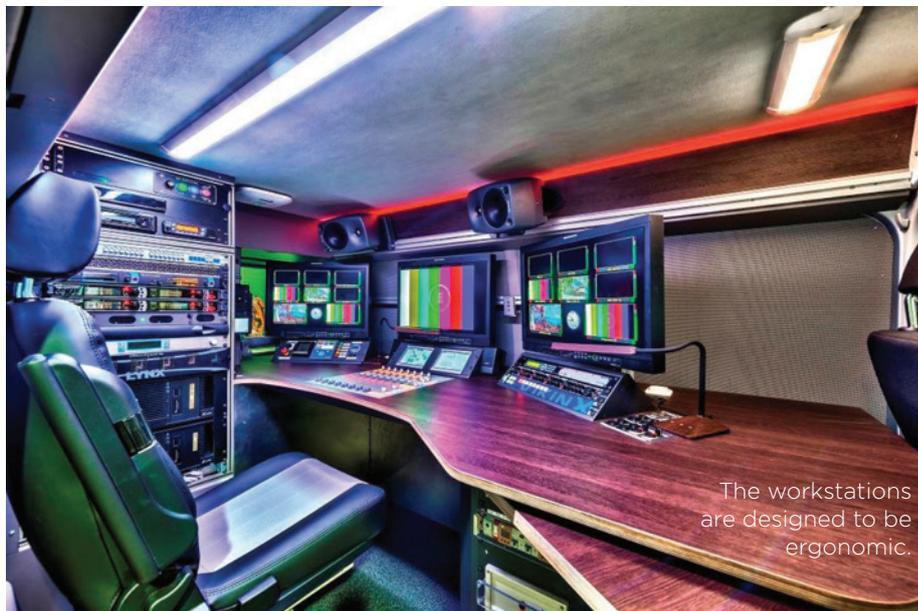
CHALLENGING REQUIREMENTS
The project to create a new IP Multimedia Newsgathering Vehicle (IPMNG) thus began in 2016, with a focus on allowing for highly flexible radio, television and online news reporting in all possible circumstances. There was a requirement to keep costs down: minimal investment, low operational and contribution costs, and a lean approach to technical staffing for the vehicles too.

Further requirements were to have a maximum weight of 3.5 tons, 4-wheel drive and excellent heating and climate control. (Austria's geography can lead to some extreme weather conditions!) The units should also have a fully self-contained battery operation for over four hours.

The new vehicles needed to offer three working positions, and it was specified that operation for editing of audio and video and transmission could be handled by just one driver/technician.

The media contribution and data transport layer was specified to be fully IP-based. Based on a new IP routing concept by SATCOM, it now offers full access to the private network of ORF, with the possibility of using a Ka-Band IP-SAT dish, LTE, xDSL and WLAN in a transparent way to the user via Viprinet and VPN.

A mobile IP camera backpack with technology from Mobile Viewpoint was integrated; a special antenna configuration had to be invented for stationary and mobile use. To cover the needs of video journalism, clean switching between up to three sources is guaranteed. Video recording, editing and playback is done with an Adobe Premiere Pro workstation, while a second workstation with a DIGAS software stack is available for radio journalists. Great effort was put into ensuring

the workstations would be ergonomic and that the vans would be safe on the road, while stable in broadcast mode.

One requested feature was the design of a "Stage Box" to extend the audio and video inputs over 150 metres. As there was no such product on the market, ORF together with the company SATCOM invented a new product for the vehicles.

The last of the ten new units was delivered at the end of 2018, and they have been a huge success. ORF can even avoid renewing at least three dedicated video SNG vehicles, as the Mobile Viewpoint pack combined with Viprinet offers a CNG/Ka-Band solution comparable to a traditional large scale Ku-Band dish. Each IPMNG vehicle cost EUR 300,000 and the overall savings compared to a traditional renewal were significant.

In the course of the project, considerable know-how was gained by ORF's project manager Christian Knoll and this will prove valuable when applied to future projects.

The ORF IPMNG project was shortlisted for the 2019 EBU Technology & Innovation Award.

The workstations are designed to be ergonomic.

The complete fleet was delivered by the end of 2018; right, the innovative Stage Box.

Riding the innovation waves in content production

BROADCASTERS ARE SOMETIMES COMPARED – UNFAVOURABLY – TO NEW MEDIA PROVIDERS WHEN IT COMES TO INNOVATION. BUT, SAYS **HANS HOFFMANN** (EBU), THERE IS PLENTY OF EVIDENCE THAT PSM ARE THE NEW INNOVATORS.

It's an easy cliché to fall back on: public service broadcasters are like "supertankers", slow to react and cumbersome to turn around. And perhaps there was some truth in it in the past – the innovation cycles of the traditional broadcast industry were closely coupled to the rhythms of the broadcast engineering vendors, where change did not come quickly. We're playing to a new rhythm now.

In recent years, the wider ICT industry, and in particular the FAANG companies, have discovered "media" as a business. As they've started to compete, both for audiences and with the equipment vendors, the traditional rhythms of innovation and reinvestment cycles for broadcast companies have broken.

AUDIENCE-CENTRED

Europe's public service media (PSM) organizations have, for the most part, embraced these changes, putting digital at the heart of their corporate strategies and moving towards a new portfolio of services and programming where the audience is the primary focus for all actions.

Through communities like New Builders and Implementing Open Innovation, the EBU is helping to capture and share the new best practises that are crystalizing along with these new rhythms. Today's PSM operate with multidisciplinary teams, bringing technologists and creatives together, with a clear focus on the needs of the end user, whether internal or the audience itself (for new content and services). Digital skillsets have become crucial, where EBU Members are now competing directly with the big technology companies to hire experts in IP, data science, AI, etc.

Multiple strands are coming together to weave a new kind of PSM organization, far removed from the supertankers of the past.

They also, of course, collaborate with "big tech" where it makes sense to do so.

The innovation that today characterizes PSM has been triggered by several new technologies that are at different stages of readiness for adoption and integration into workflows. Since these technologies often have strong interdependencies, broadcasters find themselves dealing with several transitions in parallel.

The migration to live IP and microservices-based infrastructures; the evolution towards UHD and enhanced audiovisual quality; the automation of processes, often using AI and machine learning, making new tools available to journalists, and all usually relying heavily on (meta)data: in engaging with these shifts, broadcasters are riding the technology waves. And there are related EBU initiatives in place to maximize the benefits of collaboration and sharing.

5G IN CONTENT PRODUCTION

Much hope has been placed in 5G as a possible revolutionizing force in media distribution in future, but it is possible that EBU Members will see positive impacts more quickly in B2B applications related to content production. From newsgathering and PSME to wireless studio applications and media campus environments, 5G could be an enabling technology that brings great benefit to makers. Here, too, the EBU has a group working to find the optimal solutions.

These are only the broad strokes, with each area involving multiple strands that all come together to weave a new kind of PSM organization, far removed from the supertankers of the past. EBU Members have always been strongly focused on creating stories and getting content to their audiences. The new technologies that are available today are core innovation-enablers for programme production. Under the EBU umbrella, EBU Members and their R&D centres come together more effectively as a powerful customer base, influencing industry, driving innovation and mastering technology transitions.

Find the EBU groups and communities that can help you to get the most from media technology innovation. See: tech.ebu.ch/ourwork

Broadcasters respond to the rise of Netflix et al

WHILE THE BUSINESS OF BROADCASTING HAS BECOME MORE CHALLENGING, SOLUTIONS FROM HBBTV AND DVB CAN FORM THE BASIS OF A FIGHTBACK, SAYS THE EBU'S **PETER MACAVOCK**.

The rise of global subscription video-on-demand (SVOD) players has changed the media landscape almost beyond recognition. Households have multiple cheap subscriptions and linear television viewing competes with high quality, well-funded, personalized content available on any device, anywhere. So that's it. Game over? Not quite.

Public service media in Europe and beyond are universally suffering from reduced budgets. Linear television is how their product has reached audiences for decades, using technology and a regulatory regime ideally suited to their model. Commercial and pay-TV operators have built very successful businesses around the simple proposition of linear television.

The pay-TV operators in particular, faced with competition from OTT, have had to quickly adapt their models to encompass a personalized, multi-device approach, bundled with broadband access in some cases. These propositions are based on a combination of high-speed broadband, linear broadcast and the use of local storage to give an impression of instant access to media services. This hybrid approach means that the virtual media pipe into a pay-TV home is equivalent to a constant 100Mbit/s or higher, even if the broadband connection alone isn't yet capable of sustaining these speeds.

HOLD BACK THE TIDE?

Commercial television faces a more difficult problem. With online advertising generating a fraction of the revenue that linear television advertising generated, there is a strong incentive to maximize the linear proposition despite the dwindling advertising pie. Nevertheless, any broadcaster must have a strong hybrid/OTT proposition to survive in the future. As one commercial broadcaster told me, "the business is changing, becoming harder with tighter margins, but you can't hold back the tide".

In the EBU, we recognize the digital shift that places a greater emphasis on IP distribution of personalized media content to multiple devices. That shift sees a world that was linear moving to hybrid distribution of IP-based services. Broadcasters are preparing for the shift by strengthening their online presence, blending their linear proposition into a hybrid one on TV sets, and working with the regulatory community to adapt the rules to take account of these changes.

To prepare technically, the EBU is active in the DVB Project and HbbTV in particular, to

Spain's LOVEStv: an example of the coordinated national approaches that prove the value of HbbTV.

help address EBU Member challenges. Linear distribution is simple: use DVB. Online distribution, on the other hand, is a costly and highly complex nightmare.

HbbTV is a key enabling technology deployed in most of the TV sets sold in Europe. There are still some territories where users are not able to switch the features on in their devices, but the hope is that compelling broadcaster applications will encourage enabling these features by default. We have seen that coordinated national approaches are helping to convince the whole industry of the value of HbbTV and reducing the divergence between different national implementations.

THE PROMISE OF DVB-I

Perhaps the biggest change has been in the DVB Project. DVB-I is the talk of the industry, seeking to bring a linear television experience to internet-connected devices, including TV sets. The traditional digital television service concept based around an MPEG Transport Stream, with DVB's Service Information helping TV sets autotune and display programme guides, is being extended into the hybrid and OTT space. The specifications will start to appear towards the end of the year, with a first big demonstration of the concept at IBC2019 (Stand 1.B71).

Tomorrow's OTT world will be different to today's. The global SVOD players won't have it all their own way, and a richer media experience will result for the benefit of all consumers.

Can we do UHD with HD lenses?

ONGOING TESTS AT EBU ASSOCIATE MEMBER CBC/RADIO-CANADA SHOW THAT DECIDING WHICH LENSES TO USE FOR UHD PRODUCTION IS FAR FROM STRAIGHTFORWARD, WRITES MEDIA PRODUCTION ARCHITECT **PIERRE HUGUES ROUTHIER**.

In anticipation of the migration to higher spatial resolutions and high dynamic range (HDR), the CBC has undergone a programme of rigorous training and testing, in a collaborative effort between its *Architecture and Strategic Development* group and the supervising technicians of its *Production* group.

One of the challenges we were asked to solve was whether the vast pool of HD zoom lenses that the corporation owns could be reused in UHD. In an ideal scenario, the CBC could transition progressively towards UHD through a gradual replacement of lenses when they reach the end of their service life, instead of disposing of an inventory that is still in working order.

In order to settle the question, we have assembled a pool of our most common box and ENG zoom lenses for testing and procured a 4K/UHD lens as a benchmark. The lenses were tested on two different models of UHD cameras using the same sensor (3-CMOS, 2/3" imagers). One camera was configured for studio use and one was optimized for sports and exterior applications.

What makes a good UHD zoom lens? Answering that question could take an entire book, or at least lead to very heated debates. In the context of broadcast, we focused on three technical attributes we think a lens should possess:
a) The capability of maintaining UHD resolution, from the centre to the edges of the frame (resolution)
b) The capability of maintaining the primary colours (red, green and blue) aligned within one pixel (chromatic aberration)
c) The capability of maintaining

a) and b) above through the entire focal range of the lens.

TESTING THE UHD LENS
Our first step was to characterize the UHD lens, in order to have a benchmark against which we could compare our HD inventory. For this purpose, we procured a "general purpose" ENG zoom lens, ranging from 8 to 75 mm. For objective testing, we used *Image Engineering*'s IQ analyzer and charts, namely the 42_16x9_V2 (fig. 1) and the TE-251 (fig. 2), which automatically measure resolution and chromatic aberration on each camera.

The resolution of the UHD lens varied significantly in the centre of the image depending on the camera model. The studio camera offered a lower resolution, averaging approximately 1640 pixels of vertical resolution, which is far below the 2160 lines of the UHD format. The sports camera fared better with the same lens, averaging 1940 lines in its centre. However, resolution fell off in a similar fashion to the other camera at the edges, to around 1500 pixels of vertical resolution.

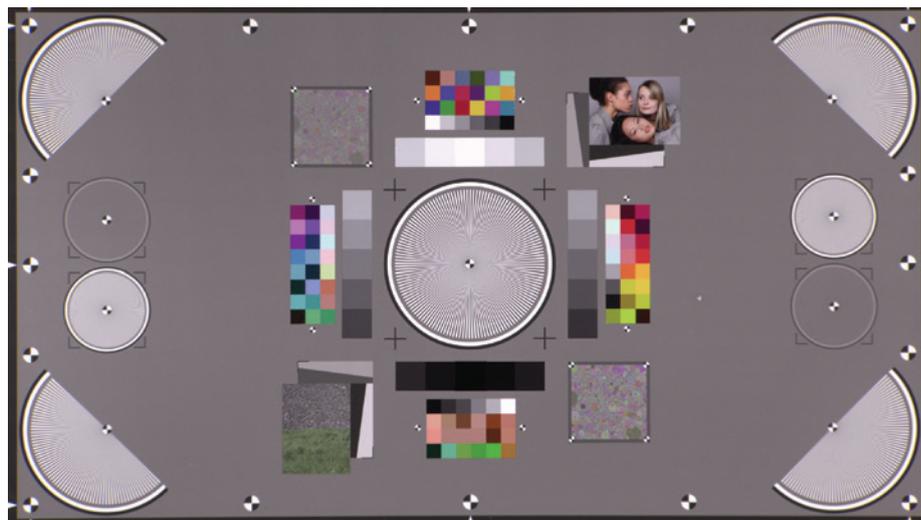In order to capture native resolution, we turned off the

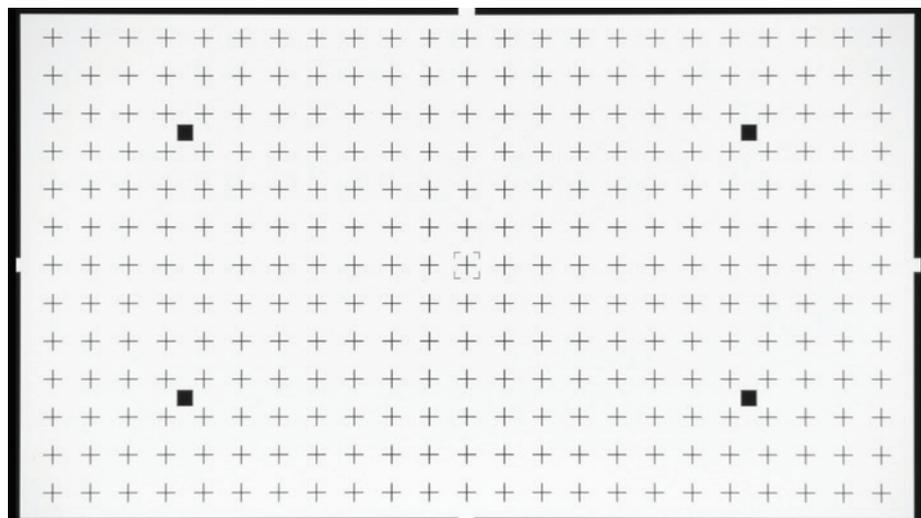Figure 1. Chart 42 16X9 Version 2 used for resolution tests

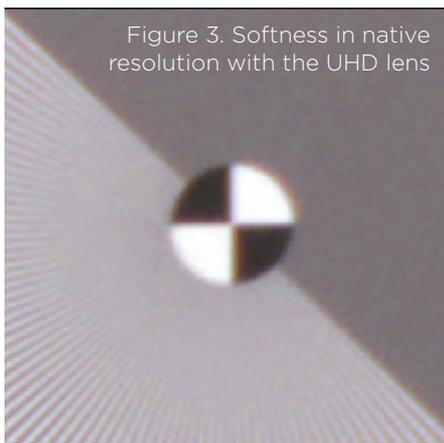Figure 2. TE-251 Chart used for chromatic aberration tests

Figure 3. Softness in native resolution with the UHD lens

image detail enhancement circuit of the sports camera. Once we turned it on and set it to the manufacturer's preset, the perceived resolution increased beyond the actual capacity of the 2160p sensor, delivering more than 2200 pixels of vertical resolution. Our analysis showed that this is because the manufacturer's preset triggers signal processing aimed at improving edge sharpness, which gives the illusion of resolution; it does not translate to an actual increase in resolution, and potentially leads to unsightly artifacts like aliasing.

So, to our surprise, *the 4K lens we evaluated did not offer enough resolution to provide full UHD* and we ended up with a somewhat soft image (fig. 3).

From a chromatic aberration point of view, the lens is equipped with an automatic compensation system, which enables compatible cameras (both of our models were) to correct chromatic aberration up to a certain point. Our tests indicated that on average, the chromatic aberration (shift between GREEN and RED, and shift between GREEN and BLUE) is below one pixel for both models of cameras, through the entire focal range, an acceptable level of quality for UHD.

AND THE HD LENSES?
Since the 4K lens did not offer a full UHD level of resolution, maybe our HD lenses could offer a comparable performance in UHD. We sampled a number of our HD lenses to determine whether this is the case or not,

as well as requested a number of other UHD/4K lenses to determine if this "softness" is systematic or not (which will be part of a second round of tests in the near future).

We tested six different HD zoom lenses, ranging from ultra-wide ENG to 60X Box lens, for resolution and colour aberration. Starting with resolution, we found sharper images with our HD 25X and 60X box lenses; this is not so surprising when we consider the size and cost of such optics.

It is also not surprising, at the other end of the spectrum, to find that the lowest resolution out of centre was measured on our widest lenses, making them too soft for UHD production. The more recent HD ENG lenses offered performances that were close to the 4K lens, especially in the wider focal length range, decreasing in resolution sharply at 40mm and beyond.

For chromatic aberration, the more recent lenses equipped with aberration compensation fared much better than the older models which are not, even the high quality box lenses. Once again, we found our HD wide lens to be the worst in this category (fig. 4).
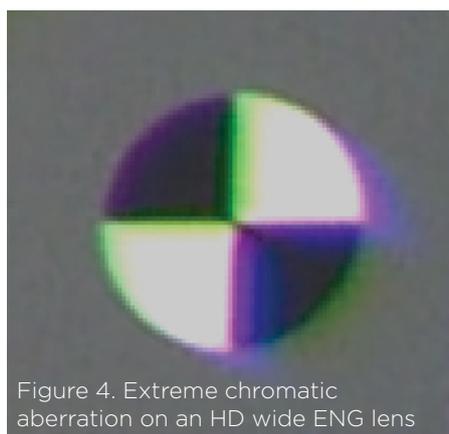

Figure 4. Extreme chromatic aberration on an HD wide ENG lens

PRODUCING UHD
The 4K zoom lens we tested was not able to achieve full UHD resolution, which is a major issue. Even if we upgrade our cameras to UHD, we will not achieve it fully – we would deliver a resolution that is between Full HD and UHD. If we do not accept this level of quality, then

Supervising technicians Eric Laflamme (left) and Benoit Fortin (right) setting up a UHD camera.

we should look for more precise lenses, which will probably be significantly more expensive.

If this level of quality is the best that can be achieved for the moment, then we certainly should reuse some of our HD lenses and limit our purchase of UHD lenses until such time as better optics reach the market.

Looking at resolution and chromatic aberration, many of our HD lenses offer performances that are comparable and sometimes superior to the benchmark 4K/UHD lens. None of the lenses offer flawless images in UHD, but then neither did the "true" UHD one.

By carefully selecting from our inventory of HD lenses depending on the criticality of certain aspects in different productions (composition, light levels, colours, etc…), we should be able to start producing a limited amount of UHD content. It will require technical expertise (to characterize lenses and put them in the most favorable conditions) at first, but as new and better UHD lenses reach the market, we should be able to gradually integrate the next generation of lenses to our workflow and make high quality UHD production more accessible, not unlike the approach used during the transition from SD to HD.

Preparing the way for 2020+ UHD services

THE EBU HAS PUBLISHED NEW GUIDANCE ON WHICH UHD FEATURES THE NEXT GENERATION OF TV DISPLAYS ARE LIKELY TO SUPPORT. **FRANS DE JONG** PROVIDES THIS OVERVIEW.

With the growing support for new image and audio formats in consumer electronics (CE) devices and the steadily growing interest of media organizations to provide services with higher technical quality (often as part of the planned replacement cycle of production equipment), a key question is which service parameters actually work in practice.

The freshly published EBU Tech 3372 *UHD/HDR Service Parameters* answers this question. It provides a basic list of the formats/options that broadcasters can expect CE devices sold from 2020+ will support. The publication is the result of a substantial series of conversations between EBU Members and CE equipment manufacturers.

HDR & WCG; NO HFR
EBU Tech 3372 focuses on new UHD services that feature at least 1080p resolution, High Dynamic Range (HDR) and Wide Colour Gamut (WCG). On the HDR side, both HLG10 and PQ-10/HDR10 are listed as suitable choices. Tech 3372 does not assume a precise quality for the CE display's resolution and displayable colour volume. This is because market players are competing on these aspects, using different technologies. This makes it very difficult to capture qualitative differences in a simple value.

The frame rates listed are 25 and 50 fps. These are the most commonly used in Europe. The case for High Frame Rate (HFR) was discussed, but it is clear that new CE devices typically will not support more than 50/60 frames per second and that broadcasters are not keen to provide HFR services in the short term. In any case, the jury is still out on the

TECH 3372

UHD / HDR SERVICE PARAMETERS

Version 1.0

Geneva
August 2019

optimal HFR approach (see page 13).

NGA INCLUDED
Audio is regarded as an essential part of new UHD services, but it has also been the hardest part on which to reach consensus. DVB has standardized three different NGA systems. The EBU has expressed the desire to see support for multiple NGA systems (see EBU R 151), while CE manufacturers prefer to reduce the options to save on (licensing) costs, especially as the roadmaps for NGA adoption are still maturing. This is the reason why the text of EBU Tech 3372 leaves open the choice of which NGA codec to use. The ultimate choice for which NGA system to use is

often made at a national level. Support for stereo, 5.1 and at least one NGA system is the minimum that broadcasters will be able to rely on.

OTT SERVICES
For OTT delivery the keywords in the new document are MPEG-DASH and HbbTV. For the latter, version 1.5.1 is the minimum recommended version to use, as that guarantees HDR support. For adaptive streaming a word of caution is included to make sure the dynamic range system and colour gamuts are not changed between different resolutions, to maintain graceful degradation in case of bandwidth limitations.

With the publication of EBU Tech 3372, the EBU has provided basic guidance for Members wishing to deploy new services. For an individual media organization, the choice of distribution channel and timetable for starting will, of course, depend a lot on the market share of UHD/HDR/NGA supporting CE devices in the country concerned. The latter can be expected to grow substantially from 2020 onwards, but it may still be some years before UHD/HDR services become plentiful, given an average television replacement cycle of eight years and the need for new production equipment.

For more details, see: tech.ebu.ch/publications/ tech3372

"With the publication of EBU Tech 3372, the EBU has provided basic guidance for Members wishing to deploy new services."

High Frame Rate: is it worth it?

RECENT SUBJECTIVE TESTS CARRIED OUT BY THE EBU AND IRT INDICATE THAT THE PATH TO HIGH FRAME RATES IS NOT YET CLEAR, AS **DAGMAR DRIESNACK** (IRT) REPORTS.

Sending 100 (progressive) frames per second instead of 50 can improve the quality experienced by viewers up to 1.5 points on the 5-point ITU-R BT.500 quality scale. This was the main result from the subjective evaluations the EBU and IRT organized at the beginning of the year during PTS 2019. Taking into account that many broadcasters today still use interlaced rather than progressive scanning and distribute only 25 frames per second, the actual quality increase of moving to 100p delivery can be expected to be even larger. But that's not the whole story.

EBU Members can access a video of a presentation on this topic by Dagmar Driesnack (IRT) at: https://tech.ebu.ch/ta2019

FAKE FRAMES

The first tests – deliberately – did not consider display-side processing. Higher-end televisions often come with some form of motion-compensated frame interpolation (MCFI), which means that the device basically "invents" additional frames to smooth motion portrayal. So, 50p broadcasts could be upconverted on the receiving end to "fake 100p". A second series of EBU tests held in spring showed that this indeed can have a large influence on the resulting quality. During the EBU BroadThinking 2019 conference, 20 participants were asked to score the same test sequences that were used for the first round of evaluations, but this time the display was allowed to try to improve the image (i.e. MCFI was turned on). As Figure 1 illustrates, this boosted the perceived quality of the content. Good MCFI thus partly weakens the case for transmitting at higher frame rates. In other words: why broadcast more frames if the display can create them already?

One answer is that far from all displays in the market are higher-end models. So, "mileage will vary".

HFR SWEET SPOT

Another consideration is that the test results are valid for (almost non-available) 100 Hz consumer market displays, while High Frame Rate (HFR) distribution may only really become attractive once models capable of 200 Hz become available. 100p broadcasts (with 50% shutter) could then be upconverted in the display (using MCFI) to really good 200 Hz images. That may be the most efficient use of both bandwidth and intelligence on the receiver side.

In any case it is too early for HFR production: there are virtually no displays from consumer electronics manufacturers, nor on the production side; the cost penalty for originating in (especially live) HFR is high; and the content for which it can be expected to be relevant is relatively niche. Before all of this changes we will first witness a step in quality improvement by moving from legacy 25i to 50p. Actually, some people call 50p HFR…

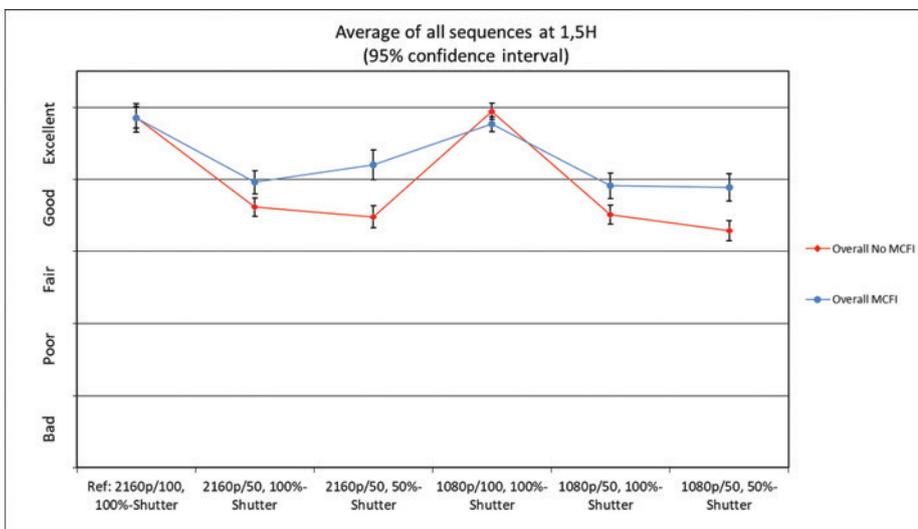**For more details, see: tech.ebu.ch/publications/tr050**

Figure 1. The positive influence of MCFI is reflected in the higher values of the blue points compared to the red ones. The improvement that can be obtained seems to be larger for material with a 50% shutter, which makes sense as these shuttered images can be expected to be sharper (with less motion blur), and thus better suited to calculate new frames from.

Accelerating live content publication to on-demand platforms at ITV

ANDREW PEARSON, ITV SENIOR SOLUTIONS ARCHITECT, EXPLAINS HOW A PARTNERSHIP WITH A CLOUD-BASED PLATFORM HAS ACCELERATED DELIVERY OF LIVE CONTENT TO ITS OTT CATCH-UP SERVICE AND TO VOD DISTRIBUTION PARTNERS.

Live content makes up a big part of ITV's content offering in the UK. As an integrated producer-broadcaster, the challenge has always been to deliver live and near-to-live content to our catch-up services as quickly as possible after transmission on our broadcast channels.

So last year we set about accelerating the delivery of hit shows like *The Voice*, *Britain's Got Talent* and *Love Island* to our catch-up services. In the UK we deliver catch-up content through our ad-funded OTT service, the ITV Hub, which is available on multiple platforms, through pay providers Sky and Virgin Media and through direct content deals with the likes of Samsung, Amazon Fire TV and Google Chromecast. We also have ITV Hub+, where subscribers have access to ad-free catch-up content and can download it too.

We wanted to modernize our existing in-house process that converts live programmes into multiple catch-up assets. We wanted to improve the time it takes to publish those assets, simplifying the legacy multi-step workflow and automating capture and transcode.

SPEED

Speed and quality of delivery are priorities for us and we partnered with M2A Media, a cloud transcode and delivery platform, to achieve our aim of delivering live catch-up assets no later than 10 minutes after the transmission of the live programmes on our broadcast channels.

To achieve this we worked with M2A Media to develop a highly complex solution where live content is captured in the cloud, then segmented, transcoded and joined into multiple output formats, while maintaining frame

Sections of live content with non-compliant material can be marked for removal in the cloud.

accuracy, lip sync and frame rate.

The cloud solution has been integrated into ITV's existing content distribution workflows to make the end-to-end process seamless and error-free. As part of the workflow a call is made to a new ITV microservice for each and every job, which is synchronized with our rights catalogue.

QUALITY

Quality is assured through capture at a high bit rate of 100 Mbps, with dual, diverse live streams to ensure resilience. This enables transcoding into multiple file formats, with metadata added to indicate where automatic ad-insertion can take place.

On occasions, live programmes need minor edits for compliance reasons, which can cause significant delays to the delivery of live catch-up assets. We addressed this challenge with compliance editing in the cloud. This allows sections of live content with non-compliant material, to be marked for removal in the cloud, avoiding the time-consuming process of downloading the content locally to enable an edit to take place.

For ITV's content distribution team, a browser-based cloud edit console gives access from any connected location, which brings operational flexibility

to our teams across the UK and globally. Comprehensive workflow messaging gives them new insights too, into the flow of content through the catch-up process.

As you'd expect of an innovative solution of this complexity, the implementation was not straightforward. To design and operate the service required the coordinated effort of a number of ITV teams across multiple locations and M2A Media. ITV provided project management, architecture, content processing, networks and content operations expertise, while M2A brought their cloud architecture skills and video expertise to the project.

The results have been very positive: we can now get our live and near-to-live content onto the ITV Hub and to our distribution partners far faster than we've ever done before. This means fans of our hit live shows can now catch up on their favourite programmes on the platform they want, at the time they want to watch.

ITV innovation continues and we are planning to speak at several major conferences including IBC2019. Come and meet us to learn more.

The ITV cloud-based VOD content delivery project was shortlisted for the 2019 EBU Technology & Innovation Award.

Television viewing stable, except among young people

THE LATEST REPORTS FROM THE EBU'S MEDIA INTELLIGENCE SERVICE CAPTURE KEY AUDIENCE TRENDS FOR TELEVISION AND RADIO MARKETS ACROSS EUROPE. **FRANCESCA CIMINO** SHARES SOME TELEVISION TRENDS.

Television and radio remain central to European citizens' lives and represent the bulk of their media consumption. They also have well-established measurement systems, which help researchers analyse trends in audience behaviour. In this article, we'll look at the latest figures regarding television viewing.

Television continues to play an important role for European citizens. On average they spent 3 hours 35 minutes watching television per day in 2018, with 85% tuning in every week. Over the past five years, there have been minor declines in time spent (down 2 minutes) and weekly reach (down 2.7 percentage points) across the 44 markets with available data.

COMPETITION FOR YOUTH

Given the increased competition for the audience's attention from new content and platform providers, the likes of Netflix and Amazon Prime, which are not currently measured by the official Television Audience Measurement (TAM) systems, it is not surprising that the trend among youth is very different.

European youth spent on average 1 hour 40 minutes watching television each day in 2018, a notable decrease of 26 minutes over the past five years. The average weekly reach for youth audiences is also down significantly, from 75% five

years ago to 66% in 2018, indicating that fewer young people are watching traditional broadcast television, which is captured by the official TAM systems. For now, it remains a challenge for the audience measurement industry to fully capture and integrate the viewing of on-demand platforms, be it broadcaster content or global players.

That said, when young people *do* choose to watch traditional television, the majority is still live viewing, at 89% in 2018. This is comparable to the all-citizen consumption pattern of 91% live viewing. Non-live viewing in the national TAM systems encompasses time-shifted viewing of broadcast content up to seven days after the live broadcast.
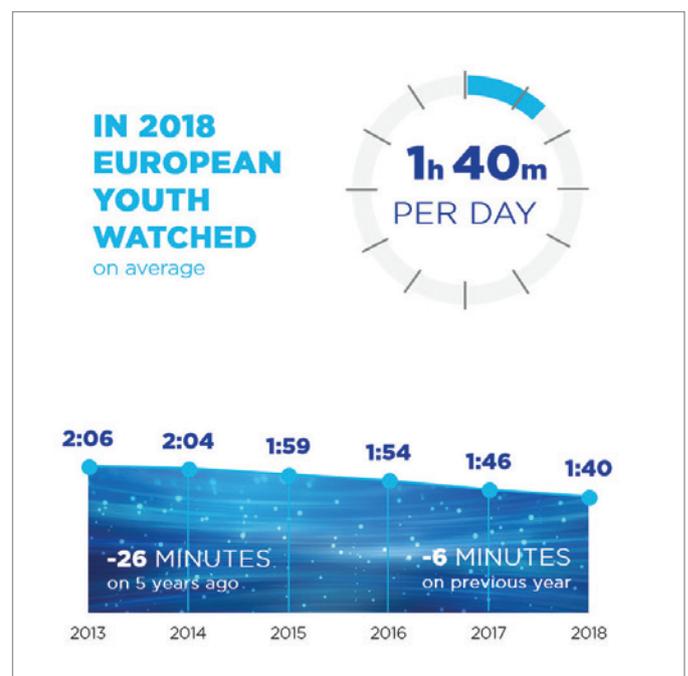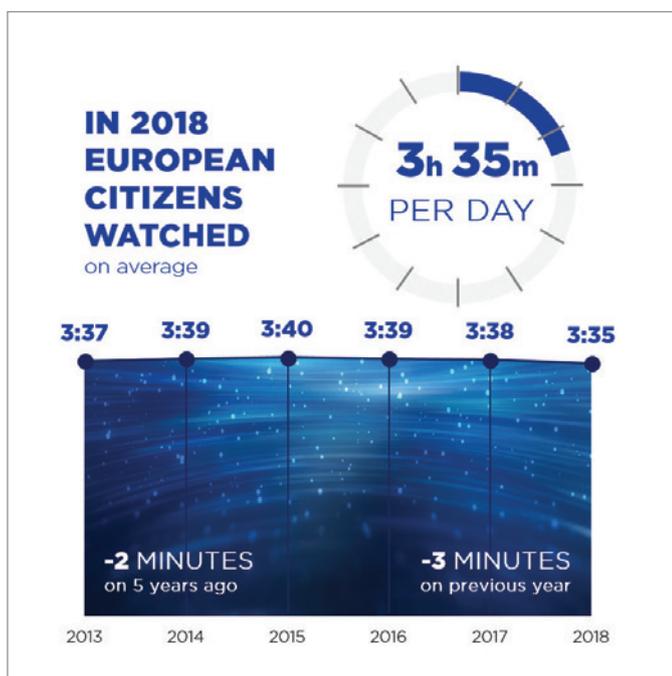
Television viewing time ((Source: EBU, based on Eurodata TV worldwide and data from Members and relevant partners)

8K – where does the balance of the arguments lie?

8K IS NOT EVEN CLOSE TO THE AGENDA FOR MOST BROADCASTERS TODAY. NEVERTHELESS, SAYS **DAVID WOOD**, IT'S WORTH TRYING TO SHED SOME LIGHT ON THE TOPIC.

"Should you spend your precious, finite, funds on raising image quality, and on much higher transmission bandwidths, when much of the audience may hardly notice it?"

8K can be a complex issue for broadcasters and broadband content providers. Sometimes it could seem like we are all looking for a light switch in a darkened room, with boxes on the floor that you could trip over

On the one hand, surely no one can stop the tide from coming in? The technical quality of television has steadily risen over time for the last 80 years. Does it make sense to think the trend would stop now? Coupled with that, TV set makers claim they can make 8K TV sets for the same price as the 4K TV sets. The public seems always willing to buy something better than they have now. 8K content, though rare, can be found. Our Japanese colleagues argue that 8K will be the Next Big Thing, and in the past they were right with their predictions of the success of HDTV and the failure of broadcast 3DTV.

COSTLY UPGRADE
But, on the other hand, for a broadcaster or content provider, the economics have to balance. Should you spend your precious, finite, funds on raising image quality, and on much higher transmission bandwidths, when much of the audience may hardly notice? Why would broadcasters spend a fortune upgrading their infrastructure, using equipment very little of which is available today, and not perfect 8K at that? Broadcasters often have to live with a ten-year replacement cycle for production equipment. To cap it all, we have only just started thinking about and implementing 4K. Are we and the public supposed to throw all that investment away?

Can we find any management tools to help find the light switch? Armchair managers say that if you can find the right two-by-two matrix, you understand the problem. The simplest tool is a matrix of "degree of disruption" against "degree of benefit". If there is a low degree of disruption and high degree of benefit you know you are on to a winner. This is possibly why app-based approaches do so well. If you have a high degree of disruption and a low degree of benefit your chances of success are slimmer. So what about 8K?

One of the complexities of 8K is that it is not obvious exactly where it would lie on the matrix. Users will need a new TV, and programme makers will need new production equipment if they are to offer native 8K content, so it has to be somewhere in the high disruption row. But where it will lie on the degree of benefit axis? What this could mean in terms of slow or fast take-up is more difficult to say.

CLEANER WINDOWS
One thing we can be sure is that 8K TV sets *will* become available *and* be affordable in the coming years. They will be used for upscaling the content that is available at lower resolutions. Having an 8K display is rather like cleaning the window. If what appears behind the window is an image that is free of artefacts/impairments (other than lower resolution), the 8K display pictures will look better than they would with a display at their lower native resolution. But if the source pictures do have artifacts/impairments, the viewer may be able to notice them more than he or she would with a native display. The window has been cleaned. Either way, broadcasters and broadband content providers' viewers will be affected by the use of 8K displays.

It is said that management is the art of making decisions without having all the information you need, so we must try to find the light switch before we trip over the boxes.

BNE: a common voice for broadcast network operators

IN THE PARTNER PROFILES SERIES, WE INVITE ORGANIZATIONS WITH WHICH THE EBU COLLABORATES ON TECHNOLOGY-RELATED MATTERS TO INTRODUCE THEIR MISSION AND PRIORITIES. **LARS BACKLUND** PROVIDES THIS PROFILE OF BNE.

Lars Backlund, Secretary General of Broadcast Networks Europe

Broadcast Networks Europe (BNE) was created in 2010 with the purpose of securing long-term business opportunities for its members and developing a common voice and lobbying platform for terrestrial broadcast network operators in Europe. It currently has 16 members with operations in 19 European countries. It is based in Brussels.

BNE works closely with key relevant European and global institutions, including the EU and the ITU, and with important stakeholders such as the EBU. We participate in international technical organizations – including CEPT, DVB, ETSI and 3GPP – where common rules, standards, policies and new technologies are defined and developed.

BNE is recognized as a strong voice internationally, defending business opportunities and safeguarding the availability of suitable and sufficient frequency spectrum for terrestrial broadcasting services – mainly for digital terrestrial television (DTT) but also for radio. In this context, BNE contributed to the EU decision granting access to the sub-700 MHz band for terrestrial broadcasting until at least 2030.

Looking ahead, there will be further opportunities and continuing challenges where revised legislation and international agreements may affect the audiovisual sector. Of particular interest for BNE members is securing longer-term availability of spectrum for terrestrial broadcasting beyond 2030. To this end, BNE is actively engaged in discussions, preparations and studies ahead of the forthcoming ITU World Radiocommunication Conference.

Other areas of equal importance include new EU telecoms and audiovisual legislation. New technologies could offer new business opportunities using existing terrestrial broadcast network infrastructure. This includes the growth of digital radio broadcasting, internet of things, and the capability of BNE members to offer broadcast customers a broad range of media services. This could include additional 5G-based services to reach mobile devices and cars.

BNE does not act alone but as part of a larger dynamic ecosystem, in close cooperation with a substantial network of other associations and organizations. We host the Wider Spectrum Group (WSG), with wide participation from stakeholders in the European cultural and creative sectors. The WSG has played a central role in raising awareness of how public service media support European content production and culture.

Over time, DTT networks have continually embraced technology improvements and migrated to more efficient modulation and compression techniques. This has allowed DTT to remain the leading distribution platform in Europe, offering more channels, improved image quality, new audio formats and increased interactivity. At the same time, new and improved services are delivered in 30% less spectrum following the clearances of the 800 MHz and 700 MHz bands.

Based on DVB standards, DTT is a spectacular European success. DTT is firmly established in practically all European countries serving primary or secondary TV sets in almost 50% of European households. DTT secures European values and underpins the content production and audiovisual industry. Terrestrial broadcasting of television and radio will remain as one of the most important distribution platforms for years to come.

Innovative ideas for PSM on voice interfaces

AN INTERACTIVE ASSISTANT TO KEEP FAMILIES ENTERTAINED ON LONG JOURNEYS WAS THE WINNING PITCH AT A RECENT VOX GROUP HACKATHON, WRITES THE EBU'S **BEN POOR**.

VOX hackathon at VRT, June 2019

ALINA CRISTEA

Smart speakers, voice control and digital assistants were at the heart of a hands-on innovation workshop hosted by VRT in Brussels last June. The position of public service media in such a rapidly evolving area is important, with EBU Members having an influential role in shaping and influencing how audiences will consume content on new platforms.

The second VOX Group hackathon (following last year's edition at NRK in Oslo) brought together more than 30 people from ten EBU Members in an environment designed to facilitate innovation and collaboration.

Participants were encouraged to bring along their own ideas around voice interfaces, specifically relating to themes such as automotive applications, improving content accessibility and the enhancement of storytelling and drama content. One other key theme was smart speakers and video, i.e. those that have displays or are used for interacting with connected TVs.

At the start of the hackathon, participants were encouraged to form teams with those from other EBU Members. Their ideas were then shared and shaped with the help of facilitators from VRT Innovation (see opposite). Using techniques such as the six-step storyboard, empathy maps, personas, innovation battlefields, future scans and the business model canvas, ideas were tested, improved and made more user-focused.

PITCH & PIZZA
Once refined, each team presented their idea as a pitch to the others before they started their "hacking". Each team then continued working into the evening, assisted by pizza and drinks, resuming early the next day.

The second day of the event ended with each team giving a demonstration of their idea to a panel of three judges. The judges assessed the demonstrations on three criteria:
• Innovation – how imaginative was the idea? Was it a new solution to an existing problem?
• Implementation – how much of the demonstration was tangible?
• Presentation – How engaging was the final presentation?

The judges were impressed with the strength of all of the projects and with the general standard of work.

The overall winner was a team drawn from BBC, VRT and Yle. The proposal, called The Passenger, was an interactive assistant that would help to inform, educate and entertain audiences in cars on long journeys. Their presentation gave the example of a family car journey to Scotland, accompanied by the historical figure Mary, Queen of Scots. She would pose questions, give facts and be an additional passenger in the car. The judges remarked that it was something that could be deployed now and that it showed strong potential for showcasing public service content and opportunities for partnerships with other organizations.

VRT Innovation, MARCONI and HRADIO

The Flemish public broadcaster is committed to open innovation and exploring new technologies and applications in a media context. With a team of more than 25 people – researchers, developers, data scientists and user experts – the VRT Innovation department tests new prototypes on the production floor itself, together with VRT's brands. Innovative media solutions for content, experience and workflows are scaled and shared for broader implementation.

VRT Innovation is project coordinator of MARCONI (www.projectmarconi.eu) and partner of HRADIO (www.hradio.eu), two European radio projects that will be showcased in the Future Zone at IBC2019.

MARCONI offers fully interactive and personalized radio solutions by integrating broadcast radio with digital and social media. With the development of different microservices, MARCONI enables radio stations to easily manage listener interaction automation, for incoming text, audio, image or video content. As part of the open piloting phase, radio stations are now able to integrate MARCONI's service components and explore the radio solution that best fits their needs and expectations.

The HRADIO project aims to leverage the full potential of hybrid technology for radio, which enables cost-effective and user-engaging live broadcasting to be integrated with experience-enriching online features. This allows broadcasters to deliver time and location independent linear radio services seamlessly linked to personalized on-demand content.

Both projects received funding from the European Union's Horizon2020 research and innovation programme. **Find MARCONI and HRADIO in the IBC Future Zone (Hall 8) at Stand F.30.**

Marco Tinnirello CEO OF EUROVISION SERVICES

WHAT ARE YOUR CURRENT RESPONSIBILITIES AT EUROVISION SERVICES?

As CEO of Eurovision Services, my goal is to ensure that we continue to maximize content value for our clients, including EBU Members and partners. We do this by providing end-to-end solutions to efficiently and seamlessly deliver content and services to media organizations, sport federations and event organizers around the world.

WHAT DO YOU CONSIDER AS YOUR FINEST ACHIEVEMENT SO FAR IN YOUR CAREER?

The ongoing evolution of Eurovision Services to include more digital services and the opening of our new technology hub in Madrid (Eurovision Labs) are recent examples. I'm also proud of the deal that I negotiated with Modern Times Group (MTG) in my previous role, to take an insourced operational model to an outsourced service delivery model. This project required exceptional team spirit and hard work and the positive outcome was very satisfying for all.

WHAT ARE YOUR PREDICTIONS FOR MEDIA TECHNOLOGY IN THE FUTURE?

Media technology continues to develop at a rapid pace. I think it's important that we consider the opportunities that machine learning can bring us in the future. For example, we are already exploring ways to automatically generate metadata that pinpoints specific types of content that can be used to personalize the viewing experience for different audiences. This will be especially interesting for media organizations and sport federations that want to provide different options to their viewers.

WHAT, FOR YOU, ARE THE BIGGEST CHALLENGES FOR EBU MEMBERS TODAY?

Keeping up with the digital landscape while trying to deliver more, for less and fulfilling their public service media remit are probably the biggest challenges for many EBU Members today. Our aim in Eurovision Services is to come up with innovative products and solutions to help minimize these challenges and make it easier for EBU Members to focus on what really matters to them – creating truly amazing content for their audiences.

TELL US ABOUT SOME OF YOUR INTERESTS AWAY FROM THE WORKPLACE.

Spending time with my wife and two children (aged 9 and 11) is the most rewarding experience for me. I try to do this as much as possible when I'm not at work. I also love being outdoors and Geneva is a cycling paradise!