



# tech



## New buildings, new networks, new challenges!

*Plus*

- RADIO ON SMART SPEAKERS
- TESTING HDR MONITORS
- DVB-T2 & HEVC IN OMAN

*and more...*

## Onward and upward



### Egon Verharen (NPO)

Chair, EBU Technical Committee

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Cover Story: RTL City is a landmark building in Luxembourg, but also for the wider media community, being one of the world's first all-IP production facilities. The EBU's New Buildings Initiative is introduced on page 9, followed by a report on how Broadcasting Center Europe has embraced the world of IP (page 10).

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At the time of writing Simon Fell's successor as Director of Technology & Innovation is not known. Therefore I, as chair of the Technical Committee (TC), have the pleasure and honour of introducing this issue of tech-i.

First of all I wish to again thank Simon, on behalf of the TC and the Members, for his tenure as director. He guided EBU T&I through exciting times, in which digital transformation got into full swing and new technologies emerged, such as UHD, SVOD and OTT services. We saw the continued fight over spectrum, and Simon's personal enthusiasm for media cyber-security and the Make it Digital initiative.

Meanwhile the work does not stop, of course. On the contrary, the technical activities and our strategic programme groups continue to deliver new insights and recommendations for the membership. For example, on an operational level we've seen the latest set of monitor tests, while on a more strategic level we've introduced the New Buildings Initiative. You'll find articles on both in these pages. When it comes to new buildings, we are not only talking about new IP infrastructure specifications but also on what it means for a media organization in terms of designing new architectures and workflows and even the buildings themselves. Learning from the efforts of a pioneering organization like BCE is important for other Members.

Central in all of our work is that we are stronger together. We not only collaborate with other PSM organizations in Europe, but also with our sister unions and other relevant bodies in the media space. One

common goal is to make sure our requirements are met in new technologies. To do so in a cost-efficient way, the standardization process is key. It is a wonderful but complex process and our own David Wood gives us his take on it. It is important that you know some of those different bodies with which we work – I'm happy that the standards development organization SMPTE is the first to be featured in what will be a new series of profiles.

Every issue of tech-i highlights some of the work our Members do: in this issue we take a look at the DVB-T2 rollout of our Associate Member in Oman. Alongside terrestrial distribution many Members are rolling out or scaling up their OTT capabilities, and over the past year several Members have joined the collaborative EBU Flow pilot multi-CDN service for this. New ways of distribution, tuned to new platforms and devices are important for the future of public media. One such new platform where our services should be available is the smart speaker, and you can learn how 'old' services like radio can be adapted to find a new audience there.

Finally, in addition to a new director, we will also welcome a newly elected Technical Committee at June's Technical Assembly in Salford. I will step down as chair of the TC and look forward to supporting my successor, whoever he or she may be!

I wish you happy reading and hope that together you find the way onward and upward. And in the words of Simon: I, for one, will continue to watch and listen with interest.

# NTS 2018: the path to IP perfection?

The EBU Network Technology Seminar 2018 (19-20 June) will again feature a wide and varied programme of presentations, tutorials and demos, writes **Willem Vermost**. The event will open with a pair of keynotes that are sure to be illuminating. The talk of Thomas Edwards, vice-president of engineering at Fox, is intriguingly titled “IP: promise, progress, and the path to perfection”. Complementing that will be a presentation from David Law, chair of the IEEE 802.3 committee, which deals with Ethernet. Given that one of the drivers to move to IP is the scale and growth of the technology, he will outline the roadmap of the Ethernet Alliance.

The first day will continue with the JT-NM roadmap and the approved and tested standards and interface specifications. A reality check and showcase of different use cases from

our Members will follow in the afternoon.

Day two will start with six different tutorials, covering all you need to know about the path to dematerialization and a look into the near future. Accompanying the conference programme will be a set of demonstrations, following two different tracks. The first is about network management and monitoring while the second will reflect the current state of dematerialized facilities.



Join us in Geneva or subscribe to the live stream: [tech.ebu.ch/nts2018](http://tech.ebu.ch/nts2018)



The **Media Technology Pulse 2018** is now available, helping decision-makers at EBU Members understand the current state of the technology and where it's likely to go. [tech.ebu.ch/mtp](http://tech.ebu.ch/mtp)

## The question of quality in online delivery



VRT's Jan Devos was the keynote speaker at BroadThinking 2018

“The number one challenge is quality; how do you deliver a good consistent Quality of Experience online?” For Jan Devos, VRT's enterprise architect for online video

and audio – and the keynote speaker at EBU BroadThinking 2018 last March – measuring QoE is the first step in delivering the high standard that viewers increasingly expect

online.

The challenges associated with defining, measuring and achieving QoE were at the forefront in the presentations and discussions at this year's conference. As the EBU's only annual event specifically dedicated to broadband media delivery, BroadThinking touches on several important topics related to both front and backend aspects. Alongside QoE, delegates heard about developments related to codecs, streaming formats, media players and new interfaces, such as smart speakers. It was also an opportunity to share some of the early results from the EBU Flow multi-CDN pilot that had been running for almost a year. (See page 12.)

As with all of EBU Technology & Innovation's annual conferences, Members can access videos of the presentations along with the slide decks by logging in on the website. **See: [tech.ebu.ch/broadthinking2018](http://tech.ebu.ch/broadthinking2018)**

# UHD and 5G demos at the European Championships 2018



The European Championships is a major new sporting event. The inaugural competitions will take place this August in Glasgow and Berlin simultaneously. (See: [european-championships.com](http://european-championships.com)) The EBU is taking this opportunity, in cooperation with several Members, to stage technical innovation trials, write *Darko Ratkaj and Paola Sunna*.

BBC, IRT, France Télévisions, ZDF and RAI are working with several manufacturers and technology providers to arrange a demonstration of UHD/HFR/HDR (HLG 2160p100) plus object-based audio production at the athletics competition in Berlin. With support and assistance from Eurovision Media Services, this cutting-edge experimental trial will enable the production of a compelling set of audio-visual test sequences.

It will also help identify which gaps still need to be filled operationally and any additional standardization work required.

The signal will be contributed from Berlin to a demo area in Glasgow and to RAI in Italy, to be shown at different resolutions and frame rates.

In the context of the EU-funded project 5G-Xcast, IRT and the EBU are planning a showcase in Munich to illustrate how broadcast media services could be provided to large audiences in the 5G environment. Content coming from the European Championships, both linear and on-demand, will be delivered over a mobile network simultaneously to mobile devices and large television sets. It will combine unicast with the broadcast capabilities of a mobile network to enable an HbbTV-like application. As in traditional broadcast distribution linear TV content will be encoded as an MPEG-2 transport stream; however, in this demonstration the TS will be carried over a mobile network.

Independently, RAI is preparing its own demonstration of LTE broadcast capabilities, based on the most recent 3GPP specification. Specifically, RAI will showcase a deployment of a standalone LTE broadcast network on high-power high-tower infrastructure for free-to-air delivery to portable and mobile devices.



## Changes at ABU

After five years as Director of Technology and Innovation at the Asia-Pacific Broadcasting Union, Amal PUNCHIHEWA has returned to New Zealand where he will pursue his career as an independent consultant and trainer. We have appreciated his contributions to *tech-i* over the past few years and wish him every success for the future. His successor at the ABU will be recruited over the coming months.

Peter MacAvock  
at DVB World  
2018



## DVB World is Dublin-bound

The DVB World conference returns next year to Dublin, where it “lived” for many years, writes *Peter MacAvock*. Since 2008 the event has been on the move, visiting a different European city each year. Last March it was Warsaw, for two and a half days of debate and discussion on the future of media delivery.

Hot topics included DVB’s work on a new specification for the standalone delivery of linear TV over the internet, DVB-I, and the activities around targeted advertising. I was there as chair of DVB’s Steering Board, but the EBU was also represented by Frans de Jong, who provided an informative and entertaining review of the state of the art in subtitling specifications. Another familiar face was our former colleague Mathias Coinchon, now CTO at our Swiss Member RTS. He gave a provocative presentation on how standards development organizations like DVB can ensure that their work is of maximum use to the industry in future.

The media world has changed over the 25 years of DVB’s existence. What was a transition from analogue to digital television is becoming a transition to a hybrid broadband OTT future. Perhaps the time has come for us to embrace new approaches like those commonplace in software development. One of the key challenges is the constant struggle to ensure interoperability, and to control costs, in a multi-device world. I have the feeling that by the time we get to Dublin (11-13 March 2019), we’ll have some new tools in our toolbox to help broadcasters embrace the challenges ahead. Arguably these are more complex than that original transition from analogue to digital.

# Radio Week: all about the user experience

Clockwise from top left: Nick Piggott (RadioDNS), Patrick Hannon (WorldDAB), Travis Baxter (Bauer), Sam Metheny (NAB)

The focal point of February's Digital Radio Week at the EBU was the Digital Radio Summit, writes **Ben Poor**. The theme this year was "It's all about the User Experience", reflected particularly in discussions around how radio can adapt to newer automotive and voice-controlled devices. Delegates heard how broadcasters are not just well placed to compete with streaming services but can use their unique content to exceed audience expectations.

Travis Baxter from Bauer Media, Europe's largest commercial radio broadcast company, stated that "if we don't join up to collaborate, then we are one small voice against many – one small voice against Google and Facebook". Sam Matheny, CTO of the National Association of Broadcasters (NAB) in the US, echoed this and also highlighted the importance of broadcast radio in times of crisis. Audiences continued to turn to radio as their primary source of information. It was the proven reliability of broadcast, ahead of mobile networks, that was driving the NAB campaign to enable broadcast receivers in mobile phones, said Matheny.

Earlier in the week the RadioHack



event once again brought together coders, solderers and thinkers to collaborate on projects over two days. Attendees experimented with voice control platforms, open source digital radio broadcasting, and how consumer equipment can be used for low-cost transmission. Swedish Radio showed a portable case for remote audio contribution, following on from their work with Project Iris.

## RADIO ARCHIVES WORKSHOP

Turning challenges into opportunities was the theme of the first Radio Archives Workshop for EBU

Members.

Spanning technical aspects of digitization and handling metadata, as well as different ways in which archives have been brought to life and turned into valuable services for audiences, the conference was the starting point of an exciting new initiative.

Both Graham Dixon, Head of Radio at EBU, and the BBC's Simon Tuff said that the event showed there is a real need for effective archiving and ways to exploit these treasure troves of content among EBU Members.

See: [tech.ebu.ch/radio2018](http://tech.ebu.ch/radio2018)

## RECENT TECHNICAL PUBLICATIONS Available from: [tech.ebu.ch/publications](http://tech.ebu.ch/publications)

### Tech 3388: EBU ADM Renderer for Next Generation Audio

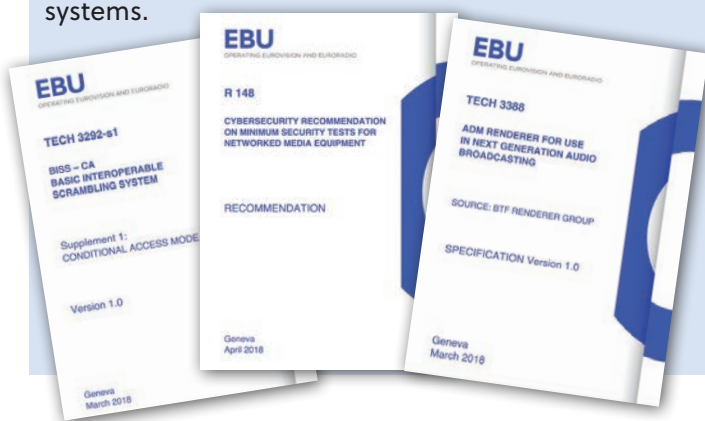
The EBU ADM Renderer is able to natively interpret Audio Definition Model metadata as specified in ITU-R BS.2076. Usage of ADM metadata is recommended to describe audio formats used in programme production for Next Generation Audio systems.

### Tech 3293-s1: BISS (Basic Interoperable Scrambling System) – Conditional Access Mode

The EBU BISS protocol was first issued in 2002, to enable secure and interoperable stream exchange over satellite. It has now been updated with a conditional access extension, BISS-CA, which enables real-time entitlement management for content streams over any network.

### R 148: EBU Recommendation on minimum security tests for networked media equipment

As production workflows and infrastructures rapidly migrate to generic IT technologies, this new EBU Recommendation concerns the need for broadcasters, vendors and system integrators to regularly apply a set of security tests to networked media equipment.



# HDR monitors reveal their true colours

INCREASINGLY BROADCASTERS ARE OPENING THEIR EYES TO HIGH DYNAMIC RANGE. DRIVERS INCLUDE PLANNED UPGRADES FOR EXISTING FACILITIES AND SPECIAL EVENTS THAT WILL BE OFFERED IN UHD HDR. A KEY QUESTION, WRITES THE EBU'S

**FRANS DE JONG**, IS WHICH MONITORS CAN BE USED TO ASSESS HDR CONTENT.

EBU Member RTS (Switzerland) was faced with this question and took the proactive approach of setting up a temporary monitor testing facility in their newly created "Hacker Studio" this spring. Leading professional video monitor manufacturers were invited to bring monitors, which could be measured and subjectively (re)viewed. The idea was to help everybody better understand the strengths and weaknesses of current monitor technology, and especially how to measure HDR reproduction.

## MEMBER COLLABORATION

Measuring monitors correctly requires expertise, which is in short supply. Not every EBU Member has the knowledge for measuring things such as adherence to the BT.2100 colour gamut, but collectively the membership does have sufficient resources to run such activities. For this occasion experts from the BBC, CBC, IRT and RAI had prepared the measurements, while participants from NRK, RTS and ZDF assisted, especially with the subjective evaluation.

The testing followed the requirements expressed in EBU Tech 3320 and included measuring the monitors' luminance ranges, uniformity, black level, colour gamut, contrast ratio, transfer function, grey scale reproduction, delay time, and more. Pixel defects, image sticking, treatment of illegal signals, etc. were verified subjectively. The results showed – as expected – that currently available professional HDR-capable monitors differ significantly in several aspects. This is not necessarily a bad thing. As the differences tend to be accompanied by differences in price, depending on the application, trade-offs may be made. For example, the measured video delay varied between roughly 20 and 60 ms (2160p, HLG, top left quadrant). This may be critical in certain (live, camera-operated) use cases, but irrelevant for simple post-production setups.

## DYNAMIC BURN-IN

It is common knowledge that displays can suffer from localized, persistent image retention. This was especially an issue with the introduction of plasma-based HDTV technology a decade ago, and less so for LCDs. But with the advent of new (e.g. OLED) and very bright HDR-capable screen technology, the topic is on the agenda again. In fact, the EBU is revising its recommendation on avoiding image retention on displays (EBU R 129). In that light it was interesting to see that the tests revealed a new type of effect, which may be called 'dynamic burn-in'. It turned out that some monitors still show parts of (repetitive) moving images long after the signal has been removed. As with static burn-in, cleaning signals may be used to remove the effect, but they may be very screen-specific.

Another lesson from the tests relates to the test signals, some of which will need to be updated. To take one example, display panels age over time and with use; to protect screens from aging prematurely, vendors may choose to limit the light level under certain conditions. These dimming approaches can interfere with some of the test signals that have been used up to now.

## MORE COMING UP

The results of the monitor tests will be summarized in a report this summer. They will also inform the update of related EBU specifications, especially the monitor measurement specification (EBU Tech 3325). The creation of new UHD/HDR compatible test patterns is foreseen as well. The monitor testing work at RTS is one of the projects organized by the EBU Video Systems group. A follow-up exercise around cameras is under consideration. Join the group to be part of that and other UHD/HDR work:

[tech.ebu.ch/vs](http://tech.ebu.ch/vs)

## VIEWING ANGLE DEPENDENCY

One of the most obvious effects visible when putting a series of monitors next to each other is the difference in viewing angle dependency. Ideally, the image should look the same from all viewing angles, but in reality this is of course not possible. Depending on the angle, colours may change (e.g. red becoming more orange) or the correct representation of shapes may suffer. In these cases the severity of the artefact must be seen in context. Is the monitor used by a single person working with content or is it meant to be viewed from different angles by a team, such as in an OB truck? Improved viewing angle independence may come at the expense of other qualities, such as a smaller contrast ratio, for example.



Ideally monitors should all show the same colour when provided with the same signal. In reality this is hard to achieve, especially when monitors are viewed from different angles.



Clockwise from top right:

Four of the monitors under test showing EBU Test Pattern 7.

Preparing content for a subjective evaluation. From left to right: Richard Salmon (BBC), Dagmar Driesnack (IRT) and Blaise Guignard (RTS).

Some of the people who made the tests possible.

Giancarlo De Biase (RAI) preparing a measurement in the specially created dark room.



# On the road to a more innovative media sector



THE EBU-LED MEDIAROAD PROJECT KICKED OFF IN SEPTEMBER 2017. PROJECT MANAGER **AGATA PATECKA** PROVIDES THIS PROGRESS REPORT ON HOW MEDIAROAD SUPPORTS INNOVATION AND CREATIVITY IN THE EUROPEAN AUDIOVISUAL AND RADIO SECTOR.

At the time of writing, the MediaRoad project is one third of the way through its two-year timeline and making good progress within each of its three constituent hubs. The Sandbox Hub is well on the way to creating a European network of media innovation accelerators; the Policy Hub has contributed to key European Commission consultations and initiated its own input gathering process; and the Network Hub is establishing a unique cross-sectoral platform, with two successful events under its belt already.

The overall aim of MediaRoad is to support the transformation of the European media sector by building an ecosystem for innovation. It brings together diverse media associations, public service media organizations, commercial radio broadcasters, media workers' organizations, academic research institutes and innovation centres, independent producers and SMEs.

Coordinated by the EBU, the project is funded by the EU's Horizon 2020 programme. The full list of project partners is available at [www.mediaroad.eu](http://www.mediaroad.eu). What has been achieved so far? And how can you get involved?

## NEW SANDBOXES

MediaRoad's Sandbox Hub has already seen the launch of several new innovation accelerators. France Télévisions, Swedish Radio, Yle and ARD have all launched local sandboxes, and other broadcasters are interested in joining. The idea is to exploit natural synergies between start-ups, SMEs and broadcasters. By connecting sandboxes across Europe, the matchmaking opportunities will be multiplied and the market deployment of ground-breaking



Representatives of MediaRoad's project partners

ideas will be accelerated.

As the project proceeds, tech start-ups that successfully complete a project with a media company will be eligible for a MediaRoad quality label. That, in turn, will qualify them as candidates for awards that will recognize the best projects within the MediaRoad Sandbox Hub.

## FUTURE POLICY VISION

The second of MediaRoad's three hubs, focused on policy, aims to help define a long-term policy vision for the whole European media sector. MediaRoad has already taken part in European Commission consultations on fake news, highlighting the role of quality journalism and trusted content to counteract disinformation. In another consultation process, on EU funding for investment, research and innovation, MediaRoad has put forward recommendations to ensure support for media innovation in Europe. The collected inputs from MediaRoad's own stakeholder survey will serve as the basis for developing a common vision for media innovation in Europe, to be included in the first MediaRoad Vision document on the EU Research and Innovation Agenda.

## NETWORK EVENTS

The overall aim of the Network Hub is to create a broad and diverse network of committed media stakeholders, researchers, creative and cultural industries, technology and policy experts, and entrepreneurs.

They are bound by a common interest in initiating new cooperation with other actors in the creative and media sectors and together creating a media ecosystem for innovation.

Last March, in collaboration with EPFL, a Network Hub event in the framework of the EBU Big Data Week in Geneva focused on media innovation in the age of AI, social media and fake news. Also in March, as part of Radiodays in Vienna, the Association of European Radios took the lead on a session focusing on post-convergence radio and hybrid radio.

*If you would like to join the Network Hub, please get in touch. We're on Twitter @mediaroad\_eu or you can subscribe to our newsletter to stay updated on policy and network news and to receive invitations to our events.*



# Taking the initiative on new PSM buildings

EBU MEMBERS WHO ARE IN THE PROCESS OF PLANNING OR CONSTRUCTING NEW FACILITIES CAN BENEFIT GREATLY FROM A NEW EBU STRATEGIC PROGRAMME.

**HANS HOFFMANN** INTRODUCES THE NEW BUILDINGS INITIATIVE.

The seeds for this new strategic programme were sown at a November 2016 gathering hosted by Bayerischer Rundfunk (BR) in Munich. The meeting brought together seventeen project managers and team members from nine Members, including South Korea's KBS (an Associate Member of the EBU). The aim was to discuss and compare different approaches to developing a new broadcast media facility and to identify the kind of support the EBU could usefully provide. That initial gathering happened in the framework of the wider IOI – Implementing Open Innovation – programme, but it quickly became clear that this topic demanded a dedicated initiative.

Fast forward to November 2017, when the Technical Committee approved the creation of the New Buildings Initiative as a strategic programme, to be run in collaboration with the EBU Academy. In fact, the group had been active in the intervening period, with further sessions at VRT in Brussels, BCE in Luxembourg (see page 10), RTS in Geneva and NRK in Bergen. The formal structure that is now in place provides a Members-only forum in which approved participants can exchange ideas, learning and best practices. The private nature of the initiative is important, as it allows participants to discuss their projects in confidence, even when things might not be going so well or if commercially sensitive information is involved.

## WHY NOW?

At any given point in time, it has always been possible to find an EBU Member who was building a new facility, but for various reasons the number of Members currently



In May 2018 the NBI group visited NRK's new building in Bergen, Norway.

engaged in such projects has increased. There are many drivers for this. For some the move to a new building will help to reduce costs or enable funds to be raised via the sale of existing land or buildings. The move to IP-based production and the digital transformation in general usually also call for at least a major refurbishment, and often entirely new facilities. New workflows, new working patterns and changing market conditions all have an impact on how EBU Members are positioning themselves for the future.

New broadcast facilities represent major long-term investments and are built to specifications that are significantly different from those that shaped the facilities they are replacing. In the planning of these projects, Members need to anticipate the impact of ever more intelligent tools and the increasing 'dematerialization' of facilities. They are laying the

groundwork for adaptable workflows that are capable of delivering suitable content for multiple formats and platforms, while also allowing for working realities that blur the lines of the traditional division of labour.

## TERMS OF REFERENCE

The New Buildings Initiative primarily concerns itself with topics such as IP-based production infrastructures, best practice for spaces that support innovative working environments, and project/change management. The Terms of Reference for the new group list four broad areas of activity:

- Create a community of Members and follow their new building or major infrastructure projects.
- Bring the various disciplines together in workshops (e.g. technical managers, creative staff, company development, change managers, innovation departments).
- Ensure that Members are connected and can share and learn regularly on a trusted platform.
- Liaise proactively with other relevant strategic programmes of the Technical Committee (e.g. Production Infrastructures, Implementing Open Innovation and others) and with the Digital Transformation Initiative and the Digital Committee.

Please join us in building an initiative that will help ensure public service media organizations have facilities that help them to do what they do best!

## PLANNING A BUILDING?

We'd love to hear from any EBU Member planning the construction of a new facility in the coming years. You can join the group via the website. Once your request has been approved you can access resources from past meetings and join future site visits. See: [tech.ebu.ch/groups/nbi](http://tech.ebu.ch/groups/nbi)

# New building, new network, new challenges!



RTL City, home to the new BCE facilities, opened in April 2017.

BCE INAUGURATED ONE OF THE WORLD'S FIRST ALL-IP MEDIA PRODUCTION AND PAYOUT FACILITIES IN APRIL 2017. LAUNCHING BEFORE THE RELEVANT STANDARDS WERE FINALIZED BROUGHT SIGNIFICANT CHALLENGES, AS BCE'S DIRECTOR OF TECHNOLOGY PROJECTS AND SUPPORT **COSTAS COLOMBUS** (PICTURED) EXPLAINS.



Broadcasting Center Europe has a long history of embracing new technology. For example, it was the first European company to move from tape to completely file-based workflows. And now BCE has become one of the pioneers in the shift to IP-based production. We have learned a lot of lessons along the way, and the journey is still far from complete.

Discussions about what technology we would use in our new building at RTL City started in 2013. It's a good thing we didn't make any final decisions then, as the technology has evolved significantly in the intervening years! Following a series of proofs-of-concept and lots of testing, our designs came together in 2015/16 and we worked hard to ensure that we met the hard target of going on air in April 2017.

BCE (owned by EBU Member CTL-UFA s.a., which is in turn a subsidiary of RTL Group) is now broadcasting

35 channels from Luxembourg, for the Netherlands, France, Belgium, Hungary and Singapore. We also provide production facilities for RTL and Télé Lëtzebuerg, and 4K payout over IP for Altice Group. RTL City is a true landmark for Luxembourg.

## WAITING FOR STANDARDS

As we had a hard deadline for launching but were determined to jump straight to a fully IP infrastructure, we had to find the best solution out of the standards and equipment available at the time. We made a decision that all signals, whether they came from external sources or from devices within the facility, would be converted to IP as soon as possible. While we do still have some legacy HD-SDI equipment and some cabling within racks, there are no long-run HD-SDI cables. Everything is in IP on a fibre network.

At launch we used SMPTE ST 2022,

which served as an intermediate solution carrying SDI over IP. We have ensured that our equipment can be software upgraded to SMPTE ST 2110, which will happen as soon as our suppliers' implementations are ready for deployment. While we went on air ahead of the standards for full IP production, we are very happy that the work is being done by the EBU, VSE, AMWA and others – and we hope that the manufacturers will quickly follow with implementations.

In addition to ST 2022 (and soon ST 2110), we are using AES-67 for audio over IP and DANTE for IP-based radio. Our use of ST 2022 and AES67 was guided by the VSE's TR-04 recommendation, giving us a path towards ST 2110 and elementary streams.



## MONOLITHIC APPROACH

We chose to keep our video network entirely separate from the network handling file transfers and office traffic and the KVM network. We did not see any advantage in a converged network. Our chosen setup means we avoid having to deal with a bursty network and have no need to use software-defined networking (SDN).

We have followed a monolithic approach, with two over-provisioned switches running A and B networks, giving full redundancy. The switches are from two different manufacturers. Although this adds some complexity, requiring knowledge of two separate products, it avoids the risk of a software – or even hardware – bug being propagated from one part of the network to the other.

Control is possible using the SAM (now Grass Valley) router controller. The controller then exposes the routing protocol to the outside world, allowing further integration with our workflows via our broadcast controllers, whether MBT or VSM. Overall the network control, while inbound, is working perfectly. The latency is down to less than a frame.

Special testing took place to ensure that inbound control is available even under accidental flooding of the network.

We also have an entirely separate staging set-up, with smaller versions of the two main switches and a representative selection of devices. This allows us to fully test and validate all system upgrades without intervening in the live networks. The integration of new devices is not yet on a plug-and-play basis but requires thought and planning from our engineers. The evolution to NMOS recommendations, envisaged for the medium term, will help to improve that situation.

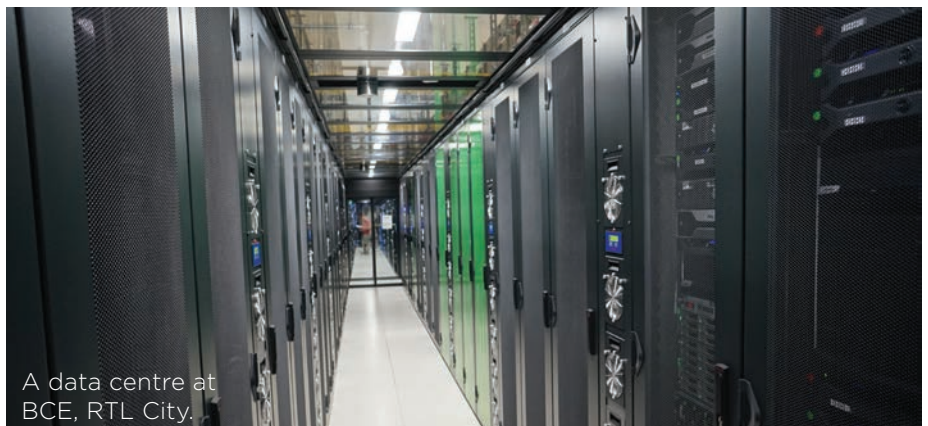
## REQUIREMENTS MET?

We defined at the outset a set of requirements for the project. These included, for example, a desire to be format-agnostic (and therefore as future-proof as possible), to have flexible and scalable installations, high reliability and plenty of redundancy. We also wanted to achieve cost savings and reduce our total cost of ownership, and to be

as innovative as possible. We have managed, to a large extent, to meet those requirements, but there are a few areas in which we have faced challenges.

We had the aim of reducing the overall complexity, but we have not achieved this yet. It's a question that has much to do with the personnel involved: while we had enough people who were trained to work with IP networks, we realized quickly that their skillset did not match exactly the needs of broadcast. Training in video networks was required and we have thus prepared training sessions with specific modules around video networking. And this is a continuous evolution.

Another requirement that we have struggled to meet is that of having multivendor selection. We have not, for the most part, been able to find vendors that provide interoperable IP equipment, perhaps because the standardization ecosystem remains incomplete. This has meant that our aim of using COTS (commercial off-the-shelf) equipment has yet to be realized.



A data centre at BCE, RTL City.

## KEY COMPONENTS AT BCE

- Arista and Juniper: core switches
- Arista: long range QSFP+/SFP transceivers (40 & 10 GB/s)
- SAM (now Grass Valley): IQMIX, IQMADI, multiviewers, audio shuffler, routing controller, vision mixer
- Harmonic: servers, encoders
- Open Broadcast System: encoders, decoders
- Grass Valley: cameras
- Studer: audio mixer
- Tektronix: SPG/PTP generator, test and monitoring
- Meinberg: PTP master clock
- FSMLabs: clock monitoring
- DHD Audio: radio audio mix and routing

# EBU Flow, the story so far...

THE EBU FLOW MULTI-CDN PILOT HAS BEEN UNDER WAY FOR A YEAR NOW. ACCOUNT MANAGER FOR THE PROJECT **HEMINI MEHTA** DESCRIBES HOW THE PILOT HAS EVOLVED AND WHAT HAS BEEN LEARNED.

The EBU Flow pilot arose both from conversations with our Members and from a 2014 study which demonstrated that while 2% of public service media (PSM) viewing time in the UK was via online and mobile delivery, delivering this content consumed 14% of the distribution budgets. What would happen if this online and mobile audience were to grow to 20% in the future? EBU Flow was set up to address this challenge, with two objectives: to improve the quality of online delivery, and to reduce the costs for PSM of online delivery.

The basic idea of EBU Flow is to use a multi-CDN service as a means of achieving the above objectives. Members can improve the quality of online delivery by having the switching platform (provided by Cedexis) select the most performant CDN for any given user at a given location and a given point in time. By performance we mean availability and latency. The

cost-related objective is addressed through the aggregation of Members' content delivery traffic to help push costs down. Collaborating and working together allows the Members to benefit from lower costs and more advanced technology than would be possible working alone. Learning from each other contributes further to reduced costs and saves time.

## PARTICIPANT BENEFITS

Six EBU Members have been participating in the pilot: ERT, HRT, NPO, RTBF, RTÉ and VRT. They achieve a higher quality for their online delivery, but also better value for money. The aggregated traffic allows the EBU to negotiate lower prices on behalf of participants. Some of them would not be able to obtain such rates on their own.

Increased redundancy is another benefit: even if one CDN is down, traffic can be rerouted through the other CDNs. There is no single point

of failure in Flow. Additionally, participants can gain access to new technology. The EBU investigates related new technologies on behalf of Flow participants and builds them into the pilot roadmap. The combination of decreasing costs and access to new technologies contributes to longer term strategic advantages.

Pilot participants have also had access to integrated value-added services. Alongside content delivery, the EBU has negotiated contracts for preparation of content, publication and analytics. Cost reduction also applies to administration and infrastructure. The EBU is the contract owner for all external Flow partners, which means participants only need to deal with one organization for their content delivery and for first line support, letting them focus on producing great content.

## HIGH LEVEL TESTS

The pilot was designed to allow us to prove or disprove certain theories associated with a multi-CDN setup. Each high level test is being carried out by several participants. (Please note that all charts show only snapshots in time.)

### *Is Flow 100% redundant?*

Figure 1 illustrates that Flow has 100% redundancy: out of the three CDNs that are part of the Flow mix (Fastly, Edgecast, Level3 (Centurylink)), there is always at least one available. There are dips in the availability percentage, however, if we take the 80% as a benchmark (recommended by Cedexis), then all three CDNs are available to serve traffic. The lower graph shown in Figure 1 highlights that as the availability of the CDN decreases, in some cases the decisions going to

Figure 1: CDN Availability and Decisions (Source: Cedexis)

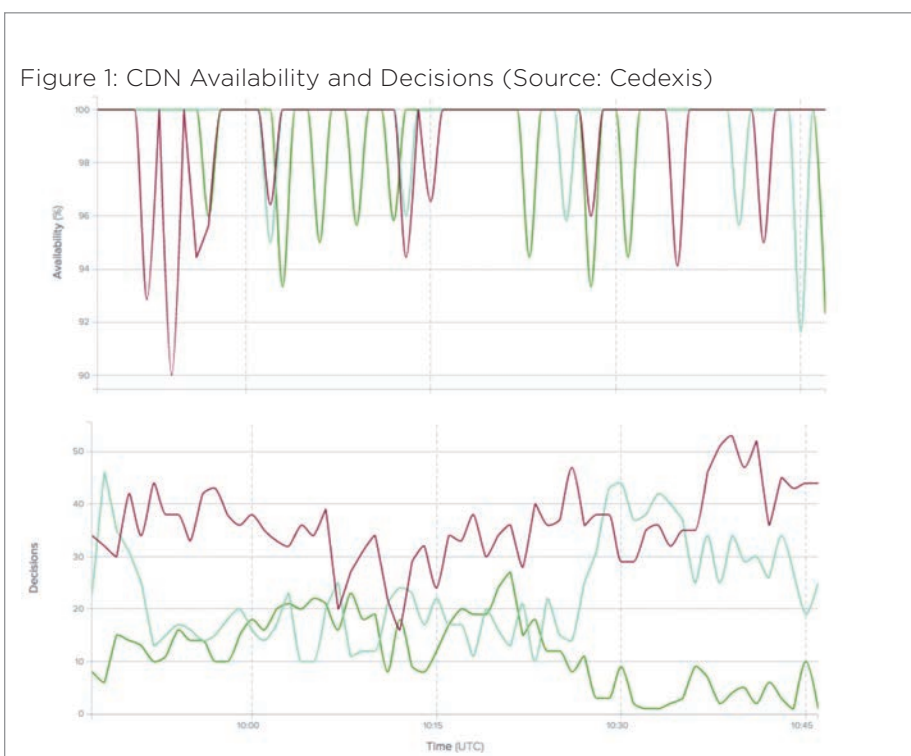


Figure 2: Playback Failure (Source: Mux)

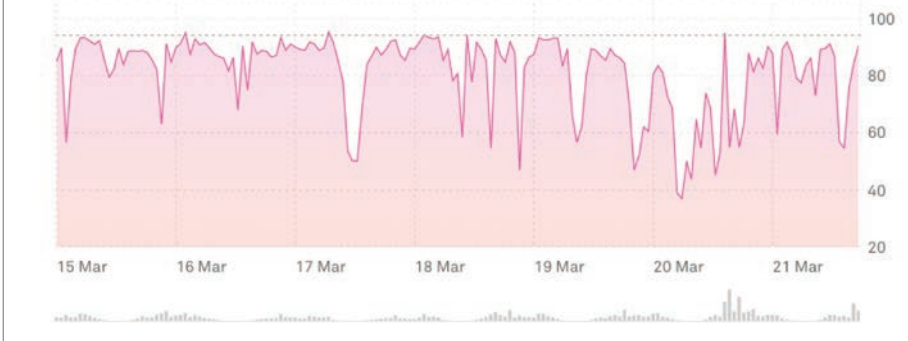
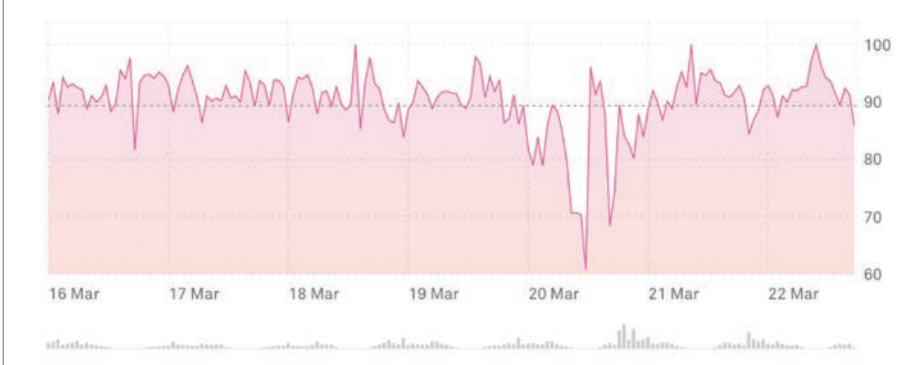


Figure 3: Video Quality (Source: Mux)



that particular CDN decrease. We have seen the situations illustrated in these graphs playing out throughout the pilot.

**Are there any cost savings?**

Looking first at content delivery costs, there has been a reduction for some of our participants and some Members would not be able to achieve these prices on their own. However, in addition to reducing the costs associated with content delivery, there is also a need to look at the rate of switching, which increases the overall costs. Thanks to EBU aggregation these switching costs have been reduced significantly. It is important to note that although the switching costs are part of the package, one important justification for this cost is to avoid a vendor lock-in. For many Members, the issuing of tenders can also reduce their overall costs as it creates price competition among those responding to the tenders.

**Are there improvements in QoE?**

As part of the pilot, participants could elect to include QoE data capture. At the time of writing, this has only just been implemented.

The idea behind this is to not only capture QoE data to improve the service to the end user, but also possibly to use the near real-time QoE data to allow CDN switching mid-stream, seamlessly for the end user. Figures 2 and 3 depict the actual participant data, with the dotted line showing how their quality compares to the average of all other organizations within the QoE system. Early indications are that

this data will help to improve QoE for the participants' end users.

**Is there better delivery throughput and stack capacity?**

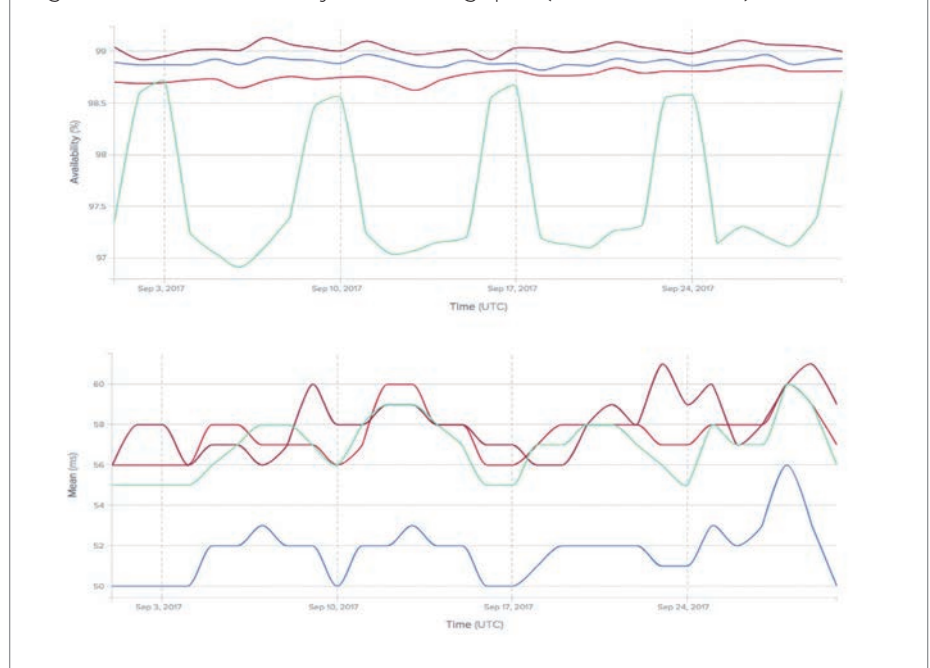
In terms of stack capacity and throughput (Figure 4), the pilot demonstrates clearly that a multi-CDN approach has benefits compared to single CDNs. By focusing on an individual line, you can see where the peaks and troughs are for that single CDN. The graphs show that when troughs occur it would clearly be better to switch from one CDN to another, which is what would transpire in a multi-CDN setup.

**Is there a reduction in the use of support services?**

Our support desk received only two phone calls throughout the first year of operation. One related to a problem in the production of the cache headers from the content provider's side. Overall, we expect the number of support requests for content delivery to be greatly reduced.

We are now coming to the end of this pilot and test period. The complete results will be presented in a white paper that will be published for Members later this year.

Figure 4: CDN Availability and Throughput (Source: Cedexis)



# Embracing DVB-T2 and HEVC in Oman

PART, THE EBU ASSOCIATE MEMBER IN OMAN, IS A REGIONAL PIONEER IN DIGITAL TERRESTRIAL TELEVISION, BECOMING THE FIRST COUNTRY IN THE MIDDLE EAST TO DEPLOY DVB-T2 WITH HEVC. THE PROJECT IS DESCRIBED HERE BY ITS MANAGER, DR **ABDULLAH AL ARAIMI**, DIRECTOR OF FREQUENCY PLANNING WITH PART.

The Sultanate of Oman has been working to move forward in applying the latest technology in the broadcasting field. The plan started with the establishment of a digital studio complex in Muscat, which was opened in 2012. The 21,000 m<sup>2</sup> complex includes four news studios, four production studios and three transmission studios for television; ten edit suites each for television news and production; two radio news studios and six radio edit suites; a dubbing theatre; a master control room (MCR); and graphics facilities for both news and general television production. There is also an auditorium with a capacity of 700 people.

## IMPLEMENTING DTT

In late 2014, the Public Authority for Radio and Television (PART) released a tender for the first phase of a nationwide DVB-T2/HEVC digital terrestrial television (DTT) network, with 69 sites to be established on a turnkey basis. The contract, amounting to more than OMR 10 million (EUR 22 million), was awarded in May 2015. Many leading vendors participated in the tender.

The project was designed by an in-house team at PART, which was also assigned as a consultant for the project. The implementation period was 28 months. It comprised the supply and installation of the complete DVB-T2 signal processing and transmitter infrastructure, consisting of a HEVC headend, transmitters from 50 W to 5 kW for 56 sites, and transposer systems for 13 sites. This phase would enable PART to achieve almost 85% of

countrywide coverage for indoor fixed reception.

PART's strategy of relying on in-house expertise to execute technical projects had started with the earlier DVB-T2 pilots. Three projects, in Muscat, Barka, and Salalah, were carried out, using MPEG-4 video coding. The measurements of the bit rate and signal field strength for the pilot projects provided insights about the entire system and the actual performance of DVB-T2 coverage.

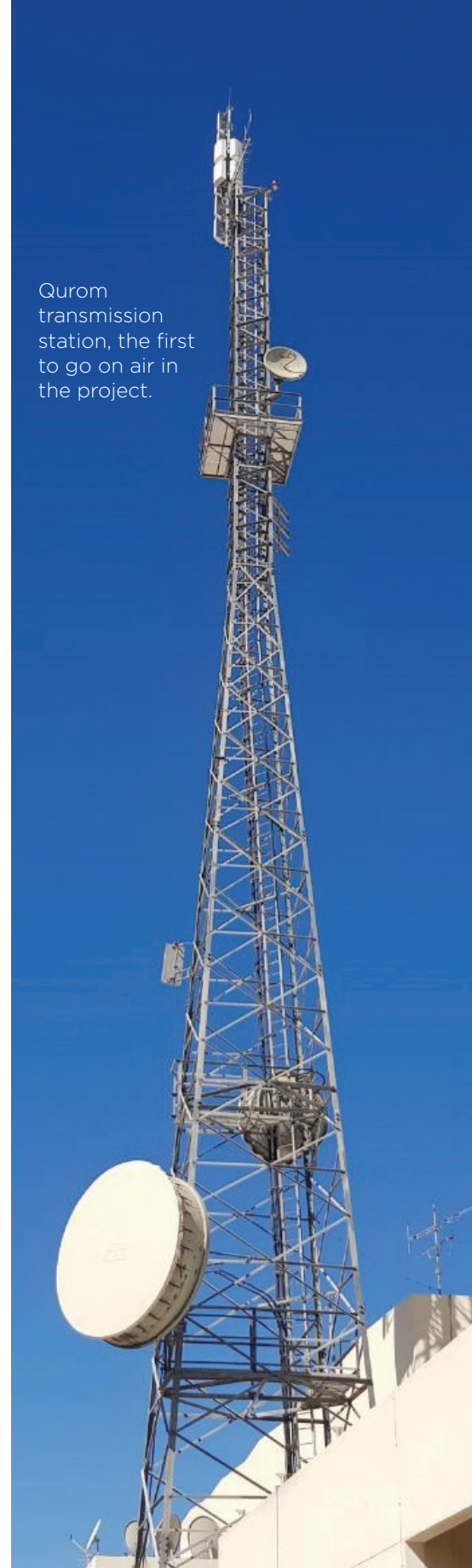
The implementation of the main project was started as means of implementing the international GE06 agreement for the transition to digital broadcasting. The project consists of two phases: the first shall enable PART to achieve countrywide coverage, while the second phase will cover the small areas which are not covered by the first phase.

## CHOOSING HEVC

From the outset the project had included MPEG-4 video coding. However, owing to the acceleration in compression technology, High Efficiency Video Coding (HEVC) was shown to deliver better performance (it requires around half the bit rate for the same content) compared to MPEG-4. Moreover, it positions PART well for any eventual migration to UHD services. After studying the future of HEVC, and its availability in the markets, the project committee decided to go further and use HEVC instead of MPEG-4. As a result of this decision, the Sultanate became the first country in the Middle East using this technology.

One aim of the decision was to

Qurom transmission station, the first to go on air in the project.



use the combination of DVB-T2 and HEVC for mobile reception. Our experimental results show that this goal is close to being achieved, with just a slight change of the parameters for fixed reception (using 64QAM modulation and receivers with a diversity antenna system).

# Online advertising in Europe is booming

ADVERTISING EXPENDITURE IN EUROPE IS AT AN ALL-TIME HIGH, MOSTLY FUELLED BY ONLINE ADS. **CARINA HAUPT**, MEDIA ANALYST, SHARES SOME OF THE KEY FINDINGS FROM A RECENT EBU MEDIA INTELLIGENCE SERVICE REPORT ON EUROPE'S ADVERTISING INDUSTRY.

As digitalization grows and new technologies evolve, advertisers spend an increasing amount of their budgets online. While expenditure in traditional media is stable (television and radio) or even declining (written press), the internet is becoming the dominant player in the advertising market (Fig. 1). In 2015, the internet overtook television to become the leading medium overall in terms of advertising expenditure in Europe, and in 2016, a total of EUR 42 billion was spent on online advertising.

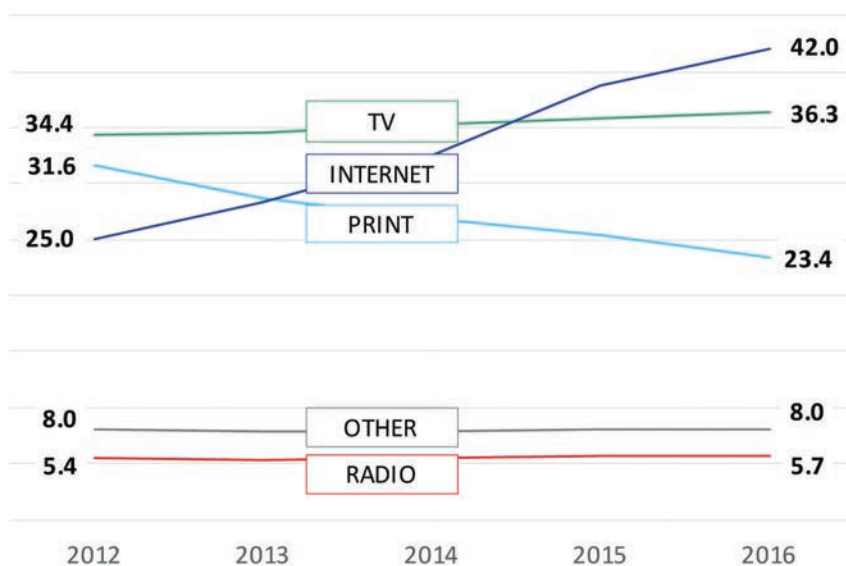
## GROWTH OF MOBILE

Mobile internet is the biggest contributor to the growth of online advertising, mirroring the increasing usage of mobile devices. Data from 12 key global markets shows that in 2017, mobile took up one quarter of the ad-spend cake (Fig. 2), making it the second largest medium after television and leaving desktop internet behind for the first time. This share is expected to grow as forecasts see mobile as the main driver of global ad-spend by 2020.

## DIGITAL DUOPOLY?

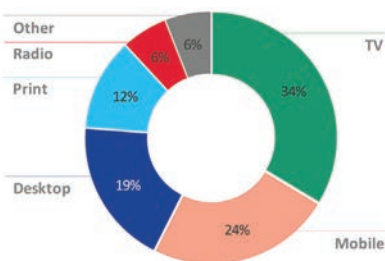
Although the digital advertising market is growing, only a few players are benefiting: in 2016, more than half of global online advertising expenditure was shared between Google (42.9%) and Facebook (14.5%). With a global reach of 80.7% and 60.4% respectively (Fig. 3), these platforms have in effect become a duopoly in the digital advertising market. Despite increasing competition from other players, such as Amazon, digital advertising remains a highly concentrated market. The dominance of internet

Figure 1: Advertising expenditure by media in Europe (EUR billion, 2012-2016)



Note: Figures aggregated from 35 European markets; OTHER = cinema + outdoor advertising. Source: EBU based on WARC

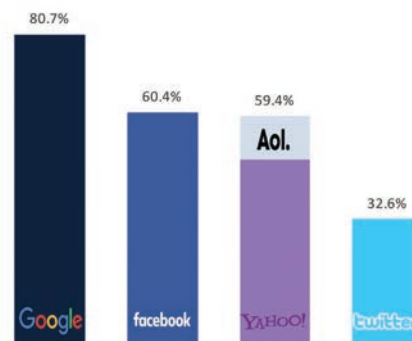
Figure 2: Global share of advertising expenditure by medium



Source: WARC based on 12 key markets (AUS, BRA, CAN, CHN, FR, GER, IND, IT, JPN, RUS, UK and US)

giants impedes minor players from accessing the market and generates major concerns about transparency issues in the digital advertising

Figure 3: Global reach, all internet users (% , Q1 2017)



Source: GlobalWebIndex

industry.

EBU Members can access the new report on advertising trends at: [www.ebu.ch/mis](http://www.ebu.ch/mis)

# What is ‘standard’ practice today?

SOMETIMES THE DEVELOPMENT OF A FORMAL STANDARD TAKES SO LONG THAT COMPANIES OR NATIONS TAKE THEIR OWN DECISIONS. **DAVID WOOD** ASKS WHETHER THERE IS A WINDOW BETWEEN ‘TOO EARLY’ AND ‘TOO LATE’.



What is the right balance between moving quickly to prepare common international technical standards, and allowing adequate discussion and time for their preparation? And why does it take so long to prepare a standard? This topic has arisen recently in standards developing organizations (SDOs).

## WHICH TYPE ARE YOU?

Management theory may point to one reason for lengthy standardization processes. It says (for the sake of our discussion here) there are two kinds of person. There are those who love the processes of creating standards and enjoy the debate and the discussion. Equally, there are those who only look forward to the result. They want to quickly pass through the discussion phase and applaud the achievement of a common standard.

While both kinds of person are found in SDOs, perhaps if the mix of delegates comprises more of the first kind, standardization can take a long time. One director of an SDO told me that delays occurred because some process-oriented delegates would metaphorically often “throw stones over the wall and run away”!

I confess that in my early career, I was a process-oriented engineer, but over time became results-oriented, possibly as a result of being asked to chair standards groups and being exposed to people who played the game well.

As a model for behaviour in SDOs, I take Horst Schachlbauer, from the IRT in Munich, who died last December. He was instrumental in the move to worldwide digital television standards in the early 1990s and, later in the decade, he led the seminal joint work by the EBU and SMPTE in recognizing what the analogue to digital switch in programme production would need. Much of what is being done today derives from his early inspiration.



Horst Schachlbauer,  
1941-2017

## THE CHARM FACTOR

There is more. Apart from a solid technical basis, Horst applied charm to the equation, and we can secretly admit that this also works. Reading recently about the early days of the EBU in the 1920s (or IBU as it was then), it was thanks to the charm of the Belgian chair of the IBU Technical Committee, over drinks and meals, that there was international agreement on a frequency plan for broadcasting. Horst was also a bon viveur and great company – “one last beer before we go?” Let’s not forget that personality plays a role.

In terms of timescales for standardization, there have been occasions when companies slow down the process – either to give them time to catch up technically, or because they see a common standard as not in their company’s interest. Across the world, there are more companies doing ever more R&D, and thus the pace of potential technical change is accelerating. There are equally ever more groups and alliances working on new technology, many with the aim of preparing standards. At the same time, standards are being developed in open source groups that give all those with a good idea, wherever they are, the chance to help build a new standard. The formal SDOs like the ITU, IEC and ISO are not the only players in town for standards.

So where does this leave us? Is the principle that common international standards allow greater competition and more informed purchasers still true? If so, is it attainable and how best to achieve it?

It seems to me that the first thing SDOs have to recognize is that, to be successful, they have to start early and work hard, and that a clock is ticking towards the point where their work will be finalized too late to be applied. They need to devote their full energy to the task of standardization. Horst Schachlbauer would be the first to sign up to that.





# Building a strategy for a successful second century

FOR THIS NEW SERIES, EACH ISSUE OF TECH-I WILL FEATURE AN UPDATE FROM ONE OF THE EBU'S PARTNER ORGANIZATIONS IN THE TECHNOLOGY DOMAIN. WE KICK OFF WITH **SMPTE**, WHOSE EXECUTIVE VICE-PRESIDENT IS **PATRICK GRIFFIS**.

One of my duties as Executive Vice-President of SMPTE is to lead the strategic planning process for the Society. We have been engaged in developing a set of strategic objectives and vetting them against a set of guiding principles which includes elements such as global focus, being best in class for our field of interest, and being inclusive in all our activities.

## THREE PILLARS

At our annual strategic planning meeting this past February, the SMPTE Board of Governors examined the Society's mission and guiding principles. The Board agreed that SMPTE is a global professional association of technologists and creatives driving the quality and evolution of motion imaging and that, whatever we do, we need to make sure that we're inclusive, objective and fiscally sound. The Board restated its commitment to the three SMPTE pillars – standards, education, and membership – and to understanding the collective needs of SMPTE stakeholders while harnessing the synergies between SMPTE and the HPA (Hollywood Professional Alliance).

As part of this extensive conversation, we discussed the ways that SMPTE is adapting as the industry transitions from traditional ways of making stories to emerging methods. We examined what it will take for the organization to navigate this transition and also to grow and evolve with the industry. To focus our strategy, we addressed SMPTE's three pillars once again.

Regarding standards, we asked ourselves how the Society can best adjust to the rapid evolution of media technology. While we



Patrick Griffis

feel that standards will continue to serve as the foundation of our work – and the way the industry establishes interoperability – we also have begun exploring additional processes and documents that will ensure SMPTE adapts to the new ways that people work, and particularly with the migration from industry-specific infrastructure to internet protocol (IP). One notable example of recent work is the pilot SMPTE Specification process we've undertaken with the Digital Production Partnership (DPP) in developing a specification for Interoperable Master Format (IMF), for broadcast and online applications.

## NEW PODCASTS

Concerning education, we've determined that our role in assisting individuals to establish critical skill sets remains vital to the industry. At the same time, we've decided that SMPTE ought to spend more time helping professionals understand new standards and related technology, and how they can be

applied in real-world facilities and applications. As part of renewed efforts to share the SMPTE story, we will be launching a series of thought leadership podcasts with experts who can discuss hot topics concerning the issues facing media and entertainment professionals today.

Looking at membership, we agreed that a healthy future for the Society will depend on the continued creation of tighter, deeper connections across the global network of our members. We also recognize that, like many other organizations today, SMPTE must continue its work on encouraging inclusion across our ranks and fostering a multidimensional community. We've made this goal part of our guiding principles, and it will shape our decision-making as we move ahead.

The number of SMPTE Sections globally continues to grow. We have several new, or revitalized sections and at least three or four subsections, and we are committed to giving these sections the new tools they need to improve outreach and education efforts and to offer more localized programming that enriches SMPTE relationships at the local level. We're also focusing on meeting the needs of members throughout the membership life cycle, from students to young professionals to established experts to retirees, who want to volunteer and give back.

As SMPTE continues into its second century supporting the motion imaging industry, these strategies allow the Society to remain a dynamic organization with the means to enable – and even drive – ongoing creative and technological advances.

# Radio wises up to smart speakers

IT SEEMS SMART SPEAKERS ARE HERE TO STAY AND IT'S CLEAR THAT RADIO BROADCASTERS MUST HAVE A PRESENCE ON THEM. BUT HOW CAN EBU MEMBERS GO BEYOND SIMPLY MAKING THEIR LIVE SERVICES AVAILABLE? **BEN POOR** (EBU) SETS THE SCENE AND WE HIGHLIGHT SOME INNOVATIVE MEMBER PROJECTS.

For a market not even four years old, smart speakers have moved firmly into the mainstream of consumer devices. Amazon's Echo arrived in late 2014, followed by Google Home in late 2016. Projections from Juniper Research suggest the global installed base of 33 million units in 2017 will jump to around 255 million units by 2022. In the UK, Radiocentre predicts that households owning at least one smart speaker will grow from 9% to nearly 40% by the end of 2018. Even if this is overly optimistic, it is clear that consumers are attracted to smart speakers.

But what are they using these devices for? The good news for radio is that research shows that, for many people, smart speakers could be driving more radio listening. For example, while radio consumption on smart speakers is still dwarfed by traditional devices in the UK, people use smart speakers more for live radio than for streaming services (RAJAR MIDAS Winter 2017).

## Swedish Radio MAGNUS SUNESON



"Although these devices don't currently support the Swedish language, we have been developing our applications since 2016. Our focus is on improving the voice user experience (UX) and experimenting with new features, like personalization. For example, enabling a listener to 'tag' the current show or track being played, which are then saved to their Spotify account. Based on this sort of interaction, we can then recommend shows to them, revisiting one of the original benefits of radio as a place to discover new content."

As the number of households owning one or more such devices increases, could they engage a new generation of radio listeners, attracted by being able to use a single device for many different functions? In the same way that consumers moved from single-purpose mobile phone devices to multifunctional application-focused smartphones, what can a smart speaker radio app offer listeners?

Certainly, radio broadcasters are

rising to the challenge. Having a platform that can easily support IP-streamed audio alongside interactivity through voice control creates opportunities. This includes the ability to create a mixed service of linear and non-linear content, driven by voice commands; interactive dramas that involve the listener as an active participant; and integration with other internet-based services, creating a link from radio content that is valuable to the listener.

These platforms also provide a possible evolution to a more visual experience. Amazon have the Echo Show and Spot devices that include a visual display, and Google is targeting integration with Android phones as well as television displays using Chromecast. For radio broadcasters this means having multiple options for reaching and interacting with listeners.

EBU Members have formed a new group to share information and collaborate on voice-controlled devices, across both radio and television services. Coming together means that European public service media are well placed to take full advantage of these new platforms and reach new audiences.

See: [www.ebu.ch/groups/vox](http://www.ebu.ch/groups/vox)

## Radio France PIPPA RIMMER & MATTHIEU BEAUVAL



"Smart speakers could quickly replace home radio sets and also take over in the connected car. Being able to offer well-packaged news content and live streams is mandatory, but these platforms could also provide a great place to innovate and design what could be the future of radio in the upcoming 'vocal' era.

For example, our 'Focus' Digital News Initiative (DNI) project gives users a richer news experience when they ask to 'focus' on a particular topic. The application then pulls out content from our extensive audio archives and proposes relevant excerpts.

We've also been looking at the possibility of reaching new listeners by releasing an Alexa skill in 2017 for the UK market to access our Fip brand. It was an opportunity to test out a skill in a country where the Echo had been fully released, but also to test how a brand could build on its already strong international audience."



## VRT FLORIS DAELEMANS



“We’re collaborating with national newspaper *De Standaard* in an effort to develop an interactive current affairs podcast, provisionally called *The Weekly*. The podcast explores a current topic every week over a 25-minute episode. Very often when you tell a story, there is so much underlying information that could be added to the storyline. For example, when you talk about nuclear energy, the decay time of plutonium could be mentioned. That subtopic is perfect material for a what we call an ‘explainer’ – additional content that gives you a more in-depth explanation of a linked topic.

By offering this additional content in an interactive manner through voice control, we give the listener control over how deep they want to dive, and how long they want to listen. The biggest challenge right now is to come up with the right voice user experience. This is very much emerging technology, so there are no firm answers yet. But it gives us the opportunity to build a lot of prototypes, and to go out and do lots of user testing. In the end, it is the listeners who will tell us what they want.”

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## IN THE SPOTLIGHT

### Manuel Gómez Zotano

RTVE, SPAIN

#### WHAT ARE YOUR CURRENT RESPONSIBILITIES AT RTVE?

I am the Director of User Experience and Digital Development. Primarily I am in charge of the operation of our online services and their technical evolution. I also take part in innovation and research processes and I advise senior management on decision-making in that domain.

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

I would highlight four achievements: the deployment of HbbTV in Spain; the consolidation of RTVE as a digital leader on the internet; the deployment of RTVE’s internet-based services for the Rio 2016 Olympic Games; and the launching of our personalization project, myRTVE.

#### WHAT ARE YOUR PREDICTIONS FOR MEDIA TECHNOLOGY IN THE FUTURE?

Two main trends will come to

the fore. On one hand, content personalization and recommendation tools will become mandatory in online services, supported by big data and machine learning technologies. On the other hand, we can’t ignore technologies that channel and foster audience participation.

#### WHAT, FOR YOU, ARE THE MOST IMPORTANT CHALLENGES FACING EBU MEMBERS TODAY?

We need to find ways inside the EBU to improve synergies with a view to obtaining mutual benefits and sharing projects or developments, while also respecting the legal constraints under which many Members need to operate. We need to coordinate better to benefit fully from the experience and diversity we have within the EBU.

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

I like academic research. I finished my PhD last year and I am now working on new ideas. I like teaching and I like walking with my partner by the seaside in the town where I was born, Manilva, in the south of Spain.



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