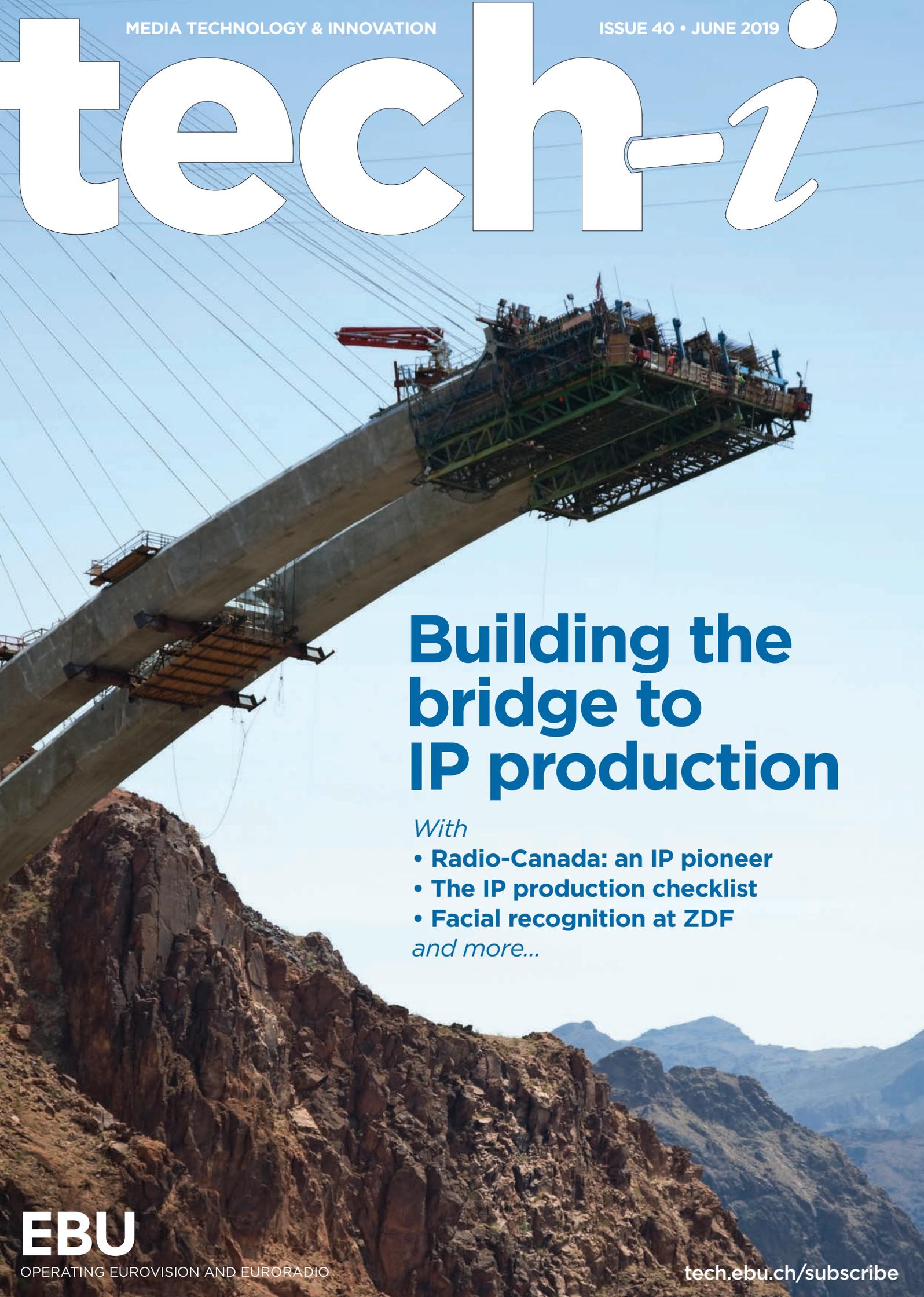


tech-i



Building the bridge to IP production

With

- **Radio-Canada: an IP pioneer**
- **The IP production checklist**
- **Facial recognition at ZDF**

and more...

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Cover story: The shift to IP-based production infrastructures is well under way. While much progress has been made, especially by pioneers like Radio-Canada (see page 10), there are still some gaps to be bridged. The EBU's IP checklist (page 19) helps to identify those gaps.

Editor-in-Chief: Antonio Arcidiacono
 Managing Editor: Patrick Wauthier
 Editor: Eoghan O'Sullivan
 tech@ebu.ch

Design: Louise Tait

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Live IP production goes mainstream

Antonio Arcidiacono

Director of Technology & Innovation, EBU



The media production universe is progressively abandoning green coax cables and moving towards full IP production.

This evolution is not limited to large production facilities, now definitely looking towards Live IP production, but extends to a range of new solutions from very light production using smartphones and tablets to future full SMPTE standards-compliant production facilities. The transition to these innovative solutions is partly dictated by cost limitation imperatives but also, and more often, aimed at providing more flexibility and more sophisticated and richer storytelling opportunities.

Combining full IP production with forthcoming new generation wireless connectivity – 5G being the first promising solution – it would be possible to deploy full IP production workflows with very light wireless infrastructures. You could imagine a large stadium connected by fibre to the cloud, integrated with a local 5G broadband connectivity island: several broadcasters could jointly produce the event, providing distinct stories to their audiences. They would leverage a common set of audiovisual and metadata sources made available by a local content provider delivering the main signals from cameras, microphones and sensors, while individual broadcasters could deploy personalized IP cameras and other sensors able to deliver tailor-made stories adapted to specific audiences. What was only possible for very large events will become the daily production reality.

Strict adherence to agreed open standards covering the full IP stack is fundamental to

guarantee the interoperability of IP production equipment from competing vendors. The EBU has been among the pioneers promoting the development of test procedures guaranteeing the interoperability of equipment to measure and visualize live IP traffic streams (see page 11).

At the other end of the spectrum, we have the availability of personal devices like smartphones and tablets, combined with sophisticated software that can deliver HD images and sound while operated by journalists in the field. This is creating a multitude of new opportunities, not only in terms of cost reductions but most importantly in terms of new programme formats.

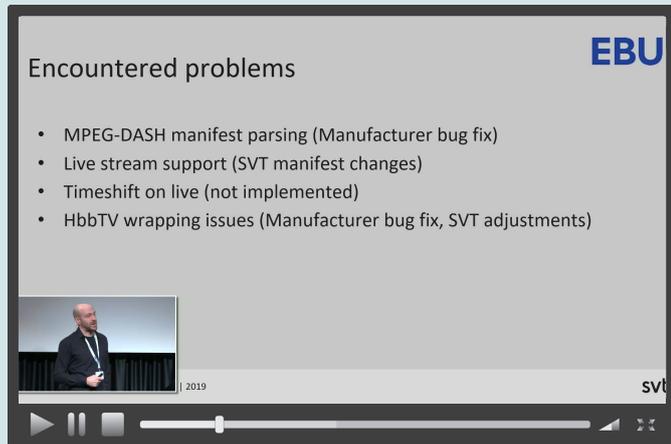
The Live IP production trend will not be limited to these two extreme implementations – other solutions, including proprietary ones, are being proposed to the market. The actual success of those solutions will probably depend on the availability of open specifications guaranteeing their interoperability and scalability.

Finally, the evolution towards IP based production techniques brings with it a typical problem related to launching a new technology: recruitment and training of skilled technicians with IP networking *and* broadcast production experience is today a real challenge. Bringing together IT and broadcast specialists around a common understanding of the key developments and challenges is of paramount importance to support a successful deployment of Live IP production solutions. The EBU has been playing and will continue play a key role.

Conference videos on demand

EBU Members can access a rich library of resources from our events – just navigate to past events section on our website and sign in. Here’s a sample of what is on offer from two of our most recent conferences.

BROADTHINKING March 2019 • tech.ebu.ch/broadthinking2019



HbbTV as a smart TV app solution • **Anders Hebert (SVT)**

DIGITAL RADIO SUMMIT February 2019 • tech.ebu.ch/drs2019



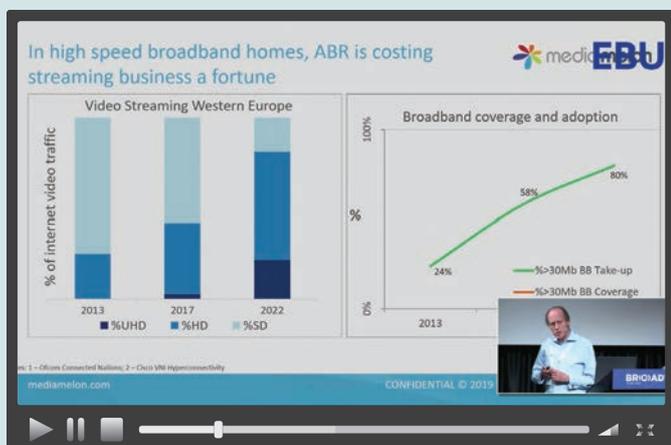
Interview: Digital radio – where to next for Norway? • **Marius Lillelien (NRK) with Graham Dixon (EBU)**



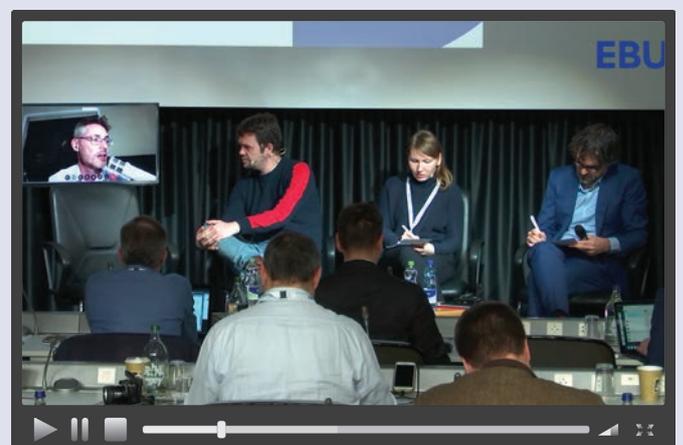
The relevance of telcos in the video distribution landscape • **Mark de Jong (Deutsche Telekom)**



Digital radio experiences – what car manufacturers say • **Laurence Harrison (WorldDAB)**



Using video analysis and real time player data to optimize adaptive streaming • **Simon Orme (MediaMelon)**



Discussion: The second coming of the podcast • **Florent Latrive (Radio France), James Cridland (podnews.net) and Linda Rulle (Radio Latvia) with David Fernandez Quijada (EBU)**

EBU Members called to join final WRC-19 preparations

We are now in the final phase of preparations for the next ITU World Radiocommunication Conference (WRC-19), taking place in Egypt from October into November *writes Elena Puigrefagut*. Around Europe, regulators are finalizing their positions ahead of one last preparatory meeting at the end of August.

For broadcasters, spectrum allocations for 4G/5G mobile services are potentially the most controversial items of the WRC. However, in this regard WRC-19 is to deal only with frequencies above 24 GHz and thus there should be no major impact on broadcasters, who mainly use frequencies below that range.

However, as agreed in 2015, the next conference in 2023 will discuss the future use of the UHF band, which is crucial for DTT services. We expect European delegates to resist any attempt from other regions to either bring that discussion



ITUWRC
SHARM EL-SHEIKH2019

28 October – 22 November
Sharm El-Sheikh, Egypt

forward to WRC-19 or to change the scope of the WRC-23 agenda item.

Additionally, the mobile community has already announced that they would like to extend WRC-23 discussions to other bands, including the C-band downlink (3.4–4.2 GHz); this is an essential satellite band for international broadcasters and for Eurovision services across the world.

The EBU is currently defining positions for WRC-19, as well as an initial position for the UHF item at WRC-23. The latter will

be needed to fully inform EBU's position at WRC-19. This work is done through the *Strategic Programme on Spectrum*.

EBU Members are strongly encouraged to ensure their organization participates in this group. **It is only by sharing your views that you can ensure the EBU's position represents your views. Both WRC-19 and WRC-23 will be decisive to preserve the spectrum broadcasters need to produce and distribute their services.**

See: tech.ebu.ch/spectrum

UPCOMING EVENTS

Metadata Developer Network

The annual gathering of developers working on metadata and AI in broadcasting.

- Metadata from all angles
- Content analysis and data crunching with Artificial Intelligence
- Using MCMA, the Media Cloud and Microservice Architecture
- Smart Data approaches that add value
- Predictive analytics
- Automated enrichment

For both EBU Members and non-members, to share knowledge, learn from your peers, get feedback and collaborate on metadata-related projects.

11-13 June • tech.ebu.ch/mdn2019

Network Technology Seminar

The annual rendezvous for broadcast experts dealing with IP production infrastructure, as well as for IT network and storage specialists who deal with broadcast media content.

- Media transport – a look at everything uncompressed and compressed, for video and audio
- Ready-to-use design patterns
- The Pyramid for Media Nodes – a look at standards and what's missing
- Use cases and new ways of working
- Virtualization and cloud

Join us in person in Geneva or via our live stream. Find pricing details on the website.

18-19 June • tech.ebu.ch/nts2019

White hats, bug bounties and responsible disclosure

THE EBU HAS ISSUED GUIDANCE ON USING CROWDSOURCING TO ASSESS THE VULNERABILITY OF ONLINE SYSTEMS. **ADI KOUADIO** EXPLAINS THE BACKGROUND.

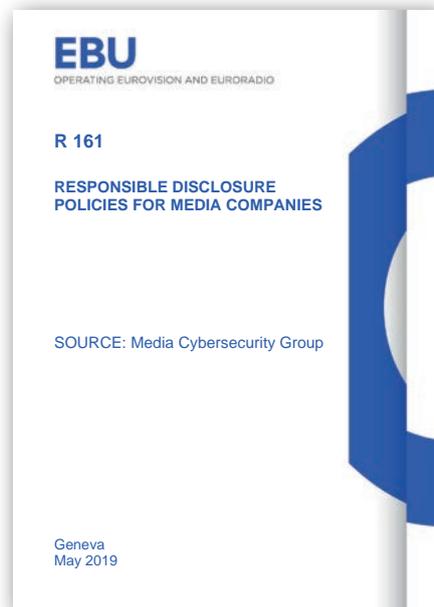
From time to time we read stories about one of the big technology companies rewarding a hacker or IT student for finding a bug in their ubiquitous platforms. The rewards, sometimes undisclosed amounts, range from a few hundred euros for minor bugs to thousands for major bugs. In one notable example in April 2018, the Oath group of companies that includes Yahoo!, HuffPost and AOL, paid out USD 400,000 at a 12-hour live-hacking event involving 40 ethical hackers.

RESPONSIBLE DISCLOSURE

Rewards like these are called bug bounties. They are offered to ethical hackers – or “white hats” – for identifying and disclosing a critical vulnerability in a product before it becomes publicly available for an exploit. The size of the bounty depends partly on the criticality of the bug found but the financial capability of the company under scrutiny is also a significant factor. A **responsible vulnerability disclosure programme (RVDP)** is the means by which a company can have bugs identified in this way. An RVDP defines the perimeter of activity for ethical hackers i.e. what types of vulnerability are rewarded, how to disclose them to the company and what rewards are offered.

An RVDP provides several advantages: it centralizes vulnerability reporting and clarifies the process, rules and rewards. It creates a general incentive for talented white hats to crosscheck the robustness of online platforms. It promotes clarity around your security measures and credits the best contributors (usually in a “hall of fame”).

Since 2010, it is common



EBU R 161 is available from: tech.ebu.ch/publications

for companies, especially in the software domain, to establish such reward systems, in effect outsourcing part of their continuous vulnerability assessment to the community of ethical hackers. Bug bounties have become so popular that there is now a whole segment of bug bounty brokers in the cybersecurity industry. Bug bounty brokers add value by enabling a company to offload the administration of its RVDP in exchange for a commission or a fixed annual fee. The market leaders for bug bounty brokerage are Bugcrowd and HackerOne. Even though bug bounties are typically in the form of financial rewards, this is not mandatory. Public and non-

profit organizations can offer non-financial rewards (t-shirts, mugs, etc...) along with exposure in a hall of fame. However, this may not attract the most accomplished white hats.

MEDIA ADOPTION?

While very common in the IT industry, media companies have been slower to adopt this crowdsourced vulnerability assessment model. Fewer than 10% of public service media organizations currently have an RVDP in force. Those that do include BBC, VRT and NPO. On average, media companies that have deployed an RVDP have received 100 useful bug submissions per year. Most companies agree that RVDPs are an excellent complement to penetration tests, sometimes revealing vulnerabilities that had been missed by the latter.

In this digital age, media companies continuously deploy a significant number of software-based tools and components. In this context, the implementation of an RVDP should be more a question of “when” than of “whether” to have one. Despite the existence of automated vulnerability scanners (essentially for web apps), performing deep vulnerability analysis is too specialized and time-consuming both in terms of computing resources and staff. Crowdsourcing these niche investigations is an excellent complement to automated scanners.

EBU RECOMMENDATION

The EBU Media Cybersecurity programme has issued a Recommendation on Responsible Disclosure Policies for Media Companies (EBU R 161). It outlines the different steps and tools required to establish an internal programme, along with advice on going via a broker. **See: tech.ebu.ch/publications/r161**

A helping hand on AI and Big Data

PIERRE-NICOLAS SCHWAB (RTBF), CHAIR OF THE EBU BIG DATA INITIATIVE, EXPLAINS WHY IT WAS CREATED AND HOW IT HELPS MEMBERS TO ADOPT BEST PRACTICE IN THIS INCREASINGLY IMPORTANT FIELD.

The Big Data Initiative (BDI) was launched in 2015 with the intention to share EBU Members' knowledge around topics which were, back in those days, still new and difficult to get to grips with. Most Members were already collecting and analyzing data for BI (business intelligence) purposes but very few had for example implemented systems to recommend content, let alone experimented with artificial intelligence to improve their users' experience.

BBC and Channel 4 (UK) were at that time considered pioneers with respectively BBC's efforts to create a recommendation engine for their different platforms on the one side, and Channel 4's developments on targeted advertising on the other side. These inspiring examples, together with an EBU Technology & Innovation project to create a recommendation system that could be shared among members (the PEACH project), were at the heart of the creation of the BDI.

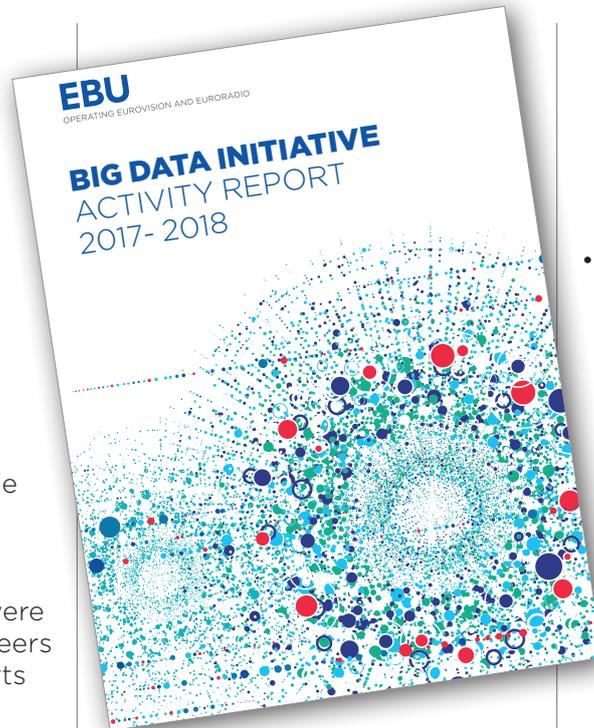
Initially a gathering of various Members willing to get involved on a voluntary basis, the BDI gained an official structure in July 2017. As chair of the BDI I'm delighted to help our fellow Members advance their knowledge and use of Big Data.

BDI OBJECTIVES

The primary objective of the BDI is to help Members address their present and future needs through the dissemination of state-of-the-art information, best practices, concrete experiences and tools.

Topics of interest include (but are not limited to):

- **Recommendation algorithms** and topics related to fairness,



transparency and ethics of recommendation systems. The BDI was certainly one of the first professional groups to bring up issues related to filter bubbles. We even dedicated a special event to the topic, held in Brussels, with Members and external experts.

- Access to **single-sign-on systems** (SSO) and collection of personal data: EBU Members have shown very different levels of sensitivity as far as data collection and privacy go. The BDI has helped members share their experiences, especially before GDPR came into force. In particular, actual feedback on SSO implementation was shared to debunk a series of myths on users' reluctance to share their personal data.

Stressing the importance of data sovereignty – owning data rather than relying on third-party sources – the BDI encourages Members to implement more and better data collection processes.

- **Dissemination of scientific knowledge:** the BDI also serves as a platform to share the latest knowledge on artificial intelligence and in particular on recommendation engines. The EBU has been represented since 2016 at the RecSys conference and a keynote will be given at the FATREC workshop that will be held this year at the SIGIR conference in Paris (21-25 July). The workshop discusses problems of social responsibility in maintaining, evaluating, and studying recommender systems.

To ensure information is spread in the best possible way the BDI organizes regular workshops and sends a newsletter to almost 1,000 subscribers.

Our most recent event, *Data in the Newsroom*, was held at IRT in Munich. We presented various cases (also from non-members) of how to use data and AI to create content (see an example on page 7). Next to the regular presentations, hands-on sessions were also organized for journalists.

Our next event will be hosted by ZDF in Berlin on 16 October. The title will be *Algorithms in Media: Fairness, Transparency and Diversity*.

BIG DATA RESOURCES

Both EBU Members and non-members can subscribe to the BDI newsletter via the website: www.ebu.ch/bdi

Also on the website you can find the *BDI Activity Report 2017-2018* and several other useful resources. EBU Members can join the BDI group and can access presentations from past BDI events.

ZDF's use of AI to facilitate video production

GERMANY'S ZDF HAS BEEN TESTING THE USE OF ARTIFICIAL INTELLIGENCE TO SUPPORT THE WORK OF JOURNALISTS AND ARCHIVISTS, AS EXPLAINED BY **EVA FEIGK**, RESPONSIBLE FOR THE DIGITALIZATION OF THE CURRENT AFFAIRS DEPARTMENT, AND **SEBASTIAN SENG**, IT COORDINATOR OF THE ARCHIVE.

For ZDF's current affairs team, the transition to a cross-media world means publishing more content faster, but with fewer journalists. With more output needed on several publication platforms, there is a constant and urgent need for fresh raw material. Otherwise the news wouldn't any longer be news.

ZDF is fortunate to have lots of new material available in our CMS (content management system), especially from our domestic and international correspondents. But how can this wealth of material be managed when it is not enriched with descriptive metadata to facilitate search, and sometimes even missing descriptive titles? How can the information overload be controlled? How can the best and strongest pictures be quickly selected for social media platforms, while simultaneously providing the same for the prime time television news and prestigious magazine shows that still have millions of viewers?

At ZDF we think that AI is the key technology to solve the problems of missing metadata.

FACIAL RECOGNITION

To gain experience, a proof of concept (POC) for facial recognition was conducted as a collaboration between the archive and IT departments. Having reviewed the tools available from different companies, we decided to implement an event-related test. To have a manageable amount of video content and people, the Bavarian parliamentary election in October 2018 was chosen. ZDF's media archivists manually trained the AI tools to recognize 46 people, using five video files of about 10 seconds each. Analysis of the ongoing cost to value ratio



A screen capture from the facial recognition test undertaken by ZDF during the Bavarian parliament elections.

still has to be completed, but as archive researchers spend a lot of time identifying people, it is hoped that facial recognition technology could deliver potential savings.

The POC demonstrated that facial recognition works very well: of the people the machine was trained to recognize, 97% were recognized correctly. Only 3% were not recognized by the machine. Out of 90 recognitions only one was wrongly detected. During the POC, many more people were automatically annotated, regardless of whether they were significant in the video footage. Better search algorithms may therefore be needed in future, or new criteria, like "size of face", to filter the results.

It became clear that facial recognition in combination with speech-to-text is an important use case in order to get information about "who" said "what" and "when". It will be even more beneficial for news journalists if the AI annotation and quality management are done by media archivists as early as possible in the workflow. Also, automated training via OCR (optical character

recognition) or existing metadata should be improved to reduce the effort required from trainers.

IMPACT ON SKILLS

It is clear that new landmark technology demands new skills. The task of the archivist is transformed from being the "content keeper" to becoming an information broker and AI trainer; and journalists must clarify ethical aspects of using AI. Roles will change and responsibilities and competences will have to be defined for the whole company from the outset. Often there is existing knowledge in various departments. It should be our goal to combine all expert knowledge and establish a kind of AI lab in which people from engineering and development, journalists and archivists find the space and time to try out new stuff. The goal should be to set up AI in a such a way as to be useful for the entire company.

Why shouldn't public broadcasters be among the first to experiment with AI and very transparently make that experience available to a society which worries about the topic?

Can recommendation systems help fulfil the public service remit?

WE INTERVIEWED **BENJAMIN FIELDS**, LEAD DATA SCIENTIST WITH BBC NEWS, ABOUT THE GROWING ROLE AND IMPACT OF CONTENT RECOMMENDATION SYSTEMS.

EBU: Why should public service media (PSM) use recommendation algorithms?

Benjamin Fields (BF):

There's always this kind of struggle between serving the public interest but also being relevant. This is where I see the need for automatic decision-making processes to come to PSM, because ultimately they represent some competitive advantage and competitive potential. If we don't use these tools, we're going to eventually lose the battle for eyeballs.

This isn't to say we should all become Netflix - I don't think we'd win that battle anyway - but we do have to acknowledge that getting people quickly and easily to content that interests them is something we need to do as well as some of our commercial competition does. If we don't, we're

going to slowly become irrelevant and lose our public remit, and that's to society's loss. I see it as a means of making sure that we're serving the public given the tools that are available.

EBU: Why should PSM have their own systems rather than using commercial solutions?

BF: The incentives in commercial recommendation systems tend to be sufficiently different that they don't really serve the needs, at least as I see them, of PSM. They tend to build for something that looks and feels like an e-commerce site and because of that they're very focused on short-term, either click-through or purchase-rate, optimization, with no real facility to do anything broader or more subtle. PSM is about more than just that: it's about making sure that people have a shared understanding of the world around



PHOTO: THOMAS BONIFÉ (CC BY 2.0)

Benjamin Fields, Lead Data Scientist, BBC News

them, that people have a common set of facts. You can imagine recommenders fulfilling that remit through measuring and optimizing things like diversity, novelty, social cohesion. There's a bunch of these other metrics that measure either longer-term behaviour – so not just stuff that's happening in this session right now – but also things that are across more than just one person. If you've got a couple of hundred thousand people, how much are you surfacing lesser known sources to them.

Serendipity, novelty, diversity are classic, fairly well-understood metrics that sit in that space, as opposed to just optimizing for click-through rates. There's also a new block of work about this idea of self-actualization: not just serving content that meets someone's current interests but serving media that helps people work towards the person they want to be.

You might actually lose a few clicks compared to the best recommender, but you might end up with a better service in the medium-to-long term and a better society that you're serving. PSM are uniquely positioned to do that and to work in that fashion with recommender systems.

EBU: How should PSM choose which values and metrics to use?

BF: This is difficult and probably the most important question, more than a particular algorithm. There's a big role for traditional news-gatherers, editors and producers to feed into that process of understanding what will best serve your audience and how that can be best measured and built into the way that recommendation systems behave.

That should happen in dialogue between data scientists, technologists and editorial teams, and the more traditional decision-makers.

EBU: How do you see this field evolving?

BF: The common understanding of the world around us and our reliance on truth is a really tricky future problem. There's this emerging technology that is popularly called "deep fakes": it won't take much resource to be able to create pretty good-looking fraudulent video and audio. The way we think about facts as verified is going to change a bit and that is going to create a big systemic challenge for PSM in general. For the kind of automatic tooling that I work on, it significantly increases the burden of making sure that everyone has some kind of common understanding.

I think that's one of the big emerging problems that may significantly change the way we organize ourselves as an industry and the tools for being successful.

There's also an interesting question about how data science becomes formalized as a practice. The role of data science has existed for 7-8 years – if we look a generation down the road, does data science as a profession look more like a lawyer or more like a software developer? As a practice it's a fast-moving field and not as mature as a lot of other skills.

EBU: Do you think that AI will have some significance in the context of recommendation systems?

BF: I believe AI is quite ethically neutral. The question of whether or not it is a force for good or bad is entirely a question of application. I do think there's a big role: internally we've been using various deep learning techniques for some of our recommender systems for instance.

I think there's definitely a big role for that to play; but also something like search and discovery, which is not quite the same as recommendation, but sort of neighbouring it.

VRT joins the PEACH team

PEACH, the personalization and recommendation ecosystem built by broadcasters for broadcasters, has welcomed VRT (the Flemish-speaking Belgian public broadcaster) to the team.

This EBU project is an active co-development between RTS (Switzerland), BR (Germany), SR (Sweden) and now also VRT.

After a successful test deployment of PEACH in the VRT NU web player portal last year, VRT undertook internal evaluation of several systems that could provide their users with personalized content recommendations. PEACH was selected as the best match for them.

VRT intends to use PEACH for several use cases: it will provide personalized recommendations in VRT NU and will be used to provide personalized content proposals in email newsletters. VRT will also work with the PEACH team to explore the possibility of using the system to recommend news articles in VRT NWS.

See: tech.ebu.ch/peach



sverigesradio



Radio Télévision Suisse



The new Maison de Radio-Canada, with the tower of the existing Maison de Radio-Canada just behind on the righthand side. Inset: François Vaillant, Executive Director Engineering Solutions, CBC/Radio-Canada

Lessons from the vanguard of the switch to IP

WHEN EBU ASSOCIATE MEMBER CBC/RADIO-CANADA DECIDED TO SAY GOODBYE TO SDI WHEN BUILDING ITS NEW FACILITIES, IT WAS CHOOSING TO BE A TRUE IP PIONEER, WRITES EXECUTIVE DIRECTOR OF ENGINEERING SOLUTIONS **FRANÇOIS VAILLANT**.

The construction of the new Maison de Radio-Canada (MRC) production facility in Montreal marks an important milestone in the history of our organization, but also in the future of the broadcasting industry. In 2017, we made a bold decision to become one of the first major public broadcasters in the world to produce and broadcast entirely in IP, Internet Protocol. The implementation of a 100% IP-based model for capturing, producing and broadcasting on all our platforms - television, radio and online - puts Radio-Canada at the forefront of technological innovation for the global media industry.

Every day brings us closer to fulfilling our strategic goals: Flexibility, Agility and Scalability.

Our new production facility will increase our ability to adapt to a rapidly evolving market; help us to meet changing expectations from consumers; improve our operational efficiency; reduce our infrastructure and shrink

our real estate footprint; and improve our risk management.

To achieve all of this, we have been striving for unity from the very beginning, starting from inside the corporation and working outwards. Breaking silos and relying on each other's expertise is a must.

LESSONS SO FAR

While the project is far from complete, we have learned several lessons already.



A visit to the new data centre.

MAIN PHOTOS: RADIO-CANADA/IVANOHD/DEMERS; PORTRAIT: TINA MACKENZIE/CBC/RADIO-CANADA

THE NEW MAISON DE RADIO-CANADA: FACTS & FIGURES

- 11 news studio floors controlled by any of the four automated control rooms
- Three general television studios controlled by either of two control rooms
- 36 studio television cameras and 56 PTZ cameras for visual radio
- Six radio studios with control room, 12 self-operated radio studios
- 272 faders on audio consoles
- 38 editing suites
- Master Control Room designed for the presentation of up to 40 television channels, 40 web streaming channels and 160 radio channels, for the French Services Network and a full backup for the English Services Network
- 1 MW fully redundant power
- 450 Tb/s network capacity, 75 PB storage, 2800 km of fibre optic strands, 800 km Cat6 network cable

Engaging all stakeholders in the process is critical and generates new behaviours. This, in turn, helps to develop the capacity for adaptation within the organization. Internal expertise reveals itself as essential.

The early stages of IP implementation are time-consuming: the cycle to understand, test, and process an RFP (request for proposals), up to planning and installation, takes four times longer than for traditional infrastructure. Furthermore, simulating the desired infrastructure in your own lab, as a proof of concept, is important both to make sound decisions and for building know-how among engineering, maintenance and operations staff.

To get the full benefits of the switch to IP infrastructure, our industry and the available solutions must move more clearly towards virtualization, COTS (commercial off-the-shelf) components and generic storage. Broadcast and IT engineers must seek and require pure software solutions.

Broadcasters also need to develop ways to break the traditional silos between broadcast and IT (including WAN/LAN) engineers. At CBC/Radio-Canada we chose to merge our internal expertise between traditional broadcast and IT teams three years ago. After an initial year of stabilization, we started to see

the benefits in the second year: unified vision, unified direction, standardized processes, unification of implementation and schematics, etc.

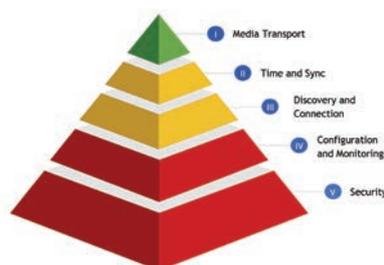
IP is no longer a choice – it has emerged as the only option. For us, we were either the last broadcaster on HD/SDI or one of the first to go IP. We chose the latter.

WE NEED THE FULL PYRAMID!

One of our challenges is that the SMPTE ST 2110 ecosystem we chose for the project is still maturing while we are designing the systems, buying the equipment and installing it. We deal with the uncertainties this creates by being involved with international standardization efforts and by working closely with our providers.

As described in the Pyramid of Media Nodes (tech.ebu.ch/tech3371), SMPTE ST 2110 is not enough – we need full-stack solutions. There is still some work to be done by our industry to reach that point of maturity across the board. (See page 18.)

Technology Pyramid for Media Nodes



EBU LEADERSHIP ON TESTING

As CBC/Radio-Canada is discovering, the move to IP requires new knowledge and lots of hands-on testing of new equipment. The team in Montreal identified gaps in the current measurement equipment and approached the EBU for assistance.

The Live IP Software Toolkit – LIST – emerged from the EBU's early involvement with the development of SMPTE ST 2110. What started out as a project to gain a better understanding of the new IP-based standards is now actively used by broadcasters and manufacturers for test and measurement. LIST (tech.ebu.ch/list) has proved extremely useful for Radio-Canada's Engineering Lab Services, whose director is former EBU employee Félix Poulin.

The EBU played a lead role in a series of tests that took place ahead of NAB 2019, designed to give prospective purchasers and users snapshot of how vendor equipment conforms to key parts of the relevant SMPTE standards. The EBU's Willem Vermost and Ievgen Kostiukevych (pictured) were recognized for their outstanding contributions to the JT-NM Tested programme, the results of which are available online: jt-nm.org/jt-nm_tested



A cost-based argument for combining 5G with broadcast infrastructure

THE EBU'S **MARCELLO LOMBARDO** HAS ANALYSED THE LIKELY COST OF MOBILE BROADBAND INFRASTRUCTURE THAT WOULD BE REQUIRED FOR LARGE-SCALE MEDIA DISTRIBUTION VERSUS COMBINING IT WITH DTT. HE CONCLUDES THAT BROADCASTING RETAINS A CENTRAL ROLE.

5G promises a revolution that will impact on society in many ways, opening the door to new services and business models. New techniques introduced with 5G will make it possible to serve multiple use cases with the same infrastructure. A concept known as network slicing allows for a 5G network's resources to be arranged in such a way as to support several different configurations at the same time.

For broadcasters, 5G offers potential benefits both in production and distribution. Some of the most vocal proponents of 5G technology have suggested that it could, in time, entirely replace current digital terrestrial television (DTT) broadcast networks for distribution of live television. While this could be technically possible, commercial drivers for such a replacement have not yet been identified and the resulting costs for broadcasters and their audiences are entirely unknown.

EXPENSIVE COMBINATION

What is known, however, is that 5G networks based on cellular mobile infrastructure will need to be dense and, in order to be suitable for large-scale distribution of audiovisual content, would need to have very large, indeed nationwide coverage. And this is likely to be an expensive combination.

A question arises whether 5G in mobile networks could be combined with other transmission infrastructures, such as terrestrial broadcast. In order to assess whether such a collaborative scenario really would represent the optimal use of resources, it is useful to evaluate the economic sustainability of the different

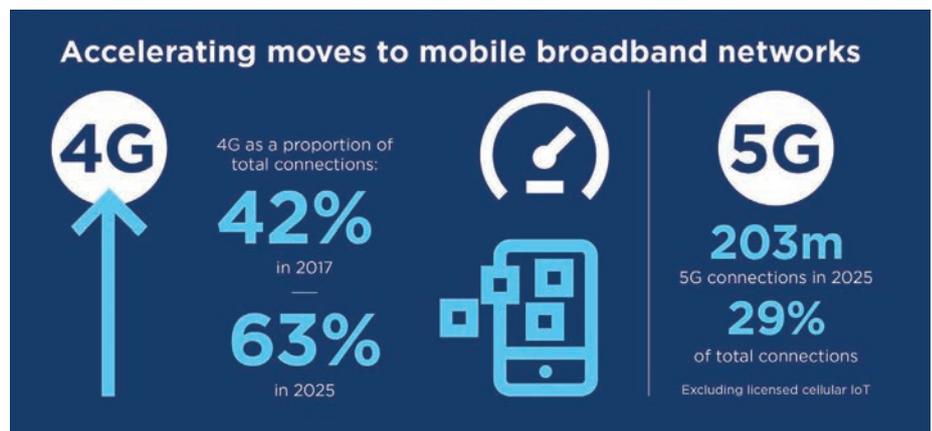


Figure 1: Infographic from The Mobile Economy Europe 2018 (© GSM Association)

platforms. It was with this goal in mind that I undertook a study titled *Cost Analysis of Orchestrated 5G Networks for Broadcasting*. It has been published as an EBU Technical Review article. The study evaluates the operational and capital expenditure associated with two hypothetical types of 5G network for content distribution: one where the mobile (unicast) 5G network is extended by an existing DTT network and one where it is not. The evaluation is for a normalized country modelled against the principal European markets.

The study concludes that being able to use 5G networks in collaboration with DTT networks would retain flexibility while keeping costs low and providing the required network coverage in the shortest possible time frame.

GRADUAL ROLL-OUT

While the first set of 5G technical specifications were completed in 2018 and the first equipment is expected to arrive this year, the network roll-out will take time. As reported in issue 39 of *tech-i*, "5G functionalities will be deployed gradually, perhaps over the next decade, first on top of the existing mobile networks before standalone 5G networks emerge."

We know that even in the most developed countries, 4G coverage did not exceed 95% household penetration until 10 years after first being commercially deployed. More importantly, even after all this time, according to figures published by the GSM Association in 2018, 4G still has a very low adoption rate, accounting for 42% of total

"Collaboration with broadcasting infrastructure would guarantee the continuity of linear television services with large capacity and coverage in a shorter time frame."

“5G networks will need to be dense and, in order to be suitable for large-scale distribution of audiovisual content, would need to have very large, indeed nationwide coverage. And this is likely to be an expensive combination.”

connections (see Figure 1). Assuming these patterns and trends will continue in future, we should not expect similar coverage and adoption rates for 5G to be reached before 2030.

COST OF RURAL COVERAGE

Looking specifically at capital expenditure, the study found that the investments required to achieve widespread 5G coverage are significant, especially for rural areas. In particular, the study revealed that covering the 20% of the population that lives in rural areas costs about half the entire running cost of the network for the whole country. This issue is well known from the earlier generations of mobile networks, such as 2G, 3G, and 4G, as well as from DTT deployments. While the capacity requirements in rural areas will be lower than those in densely populated cities, providing rural coverage requires either viable business models or public subsidies. In both cases lowering the deployment costs would make the task easier.

The study assumes that, as mentioned above, the mobile 5G network will be rolled out as a gradual evolution of existing mobile networks. It makes more economic sense to upgrade what is already available than to build something from scratch. This means that network densification and gradual replacement of legacy cells will result in improved coverage and a constant increase in total network capacity. However, the study suggests that the required growth in network capacity and coverage will require large financial exposure for mobile network operators.

As a possible alternative, the study examined the scenario where the mobile 5G network is used in combination with a DTT network for the provision of television content. This would improve the economic sustainability of the examined model by taking advantage of the high throughput and lower cost offered by existing DTT networks.

COLLABORATIVE SOLUTION

In summary, covering rural areas and developing countries with 5G unicast service could be economically difficult – a mix of technologies could facilitate and accelerate this process. Given the distant time horizon for full 5G deployment in mobile networks, collaboration with broadcasting infrastructure would guarantee

the continuity of linear television services, with large capacity and coverage, in a shorter time frame.

Furthermore, the use of collaborative networks would provide flexibility and optimization of resources, meaning that DTT infrastructure could be used for the delivery of media services such as linear TV to very large audiences and 5G (unicast) mobile infrastructure, where available, could be used for other applications. The coexistence of these different networks would also provide regulatory flexibility for administrations.

All things considered, it is reasonable to state that, given its potentially huge benefits, broadcasters should be engaged with the 5G ecosystem, and with operators, vendors and end-user device manufacturers, to make sure that traditional broadcasting platforms are considered and included in the flexible provision of services that 5G will provide.

The study *Cost analysis of orchestrated 5G networks for broadcasting* is available from: tech.ebu.ch/publications

EBU ACTIVITIES AROUND 5G

Several EBU groups are working on 5G-related projects. Find them at: tech.ebu.ch/groups

Project Group: Mobile Technologies and Standards (MTS)

Standards work, direct engagement with the industry, supporting Members tests and trials, and collaboration with the Spectrum group SPT on network studies

EBU Members only

Project Group: 5G in Content Production (5GCP)

Contributing to 3GPP study on requirements of Audio and Video Production (see page 12).

Open to EBU Members and non-members

Project Group: 5G Deployments

A new group to address non-technical aspects of 5G for public service media.

Open to EBU Members and non-members

Strategic Programme: Future Distribution (FD)

Coordinates all 5G-related activities in the EBU, liaison with other strategic programmes and external stakeholders.

EBU Members only

The digital waters are rising on radio's analogue island

CRITICAL FOR REACHING THE RIGHT AUDIENCES, DISTRIBUTION OF RADIO SIGNALS IS BECOMING MORE COMPLEX. **DAVID FERNÁNDEZ QUIJADA**, MANAGER OF THE EBU MEDIA INTELLIGENCE SERVICE, HIGHLIGHTS SOME OF THE CURRENT TRENDS.

More than 12,000 radio stations could be heard across the EBU area in early 2019. Most of those services still rely on analogue broadcast distribution, making radio an analogue island in the digital media ocean. But things are starting to change:

FM is king

Despite the steady roll-out of DAB+ across the EBU area, FM is still the most-used radio standard, with more than 11,600 radio stations available. It is even expanding in countries such as Ukraine and Belgium but, of course, its nationwide coverage was also shut down in Norway in 2017. Given its universality, popularity with listeners and the massive receiver installed base, FM will remain the main distribution network for radio broadcasting in the short and medium terms.

Medium wave is silently vanishing

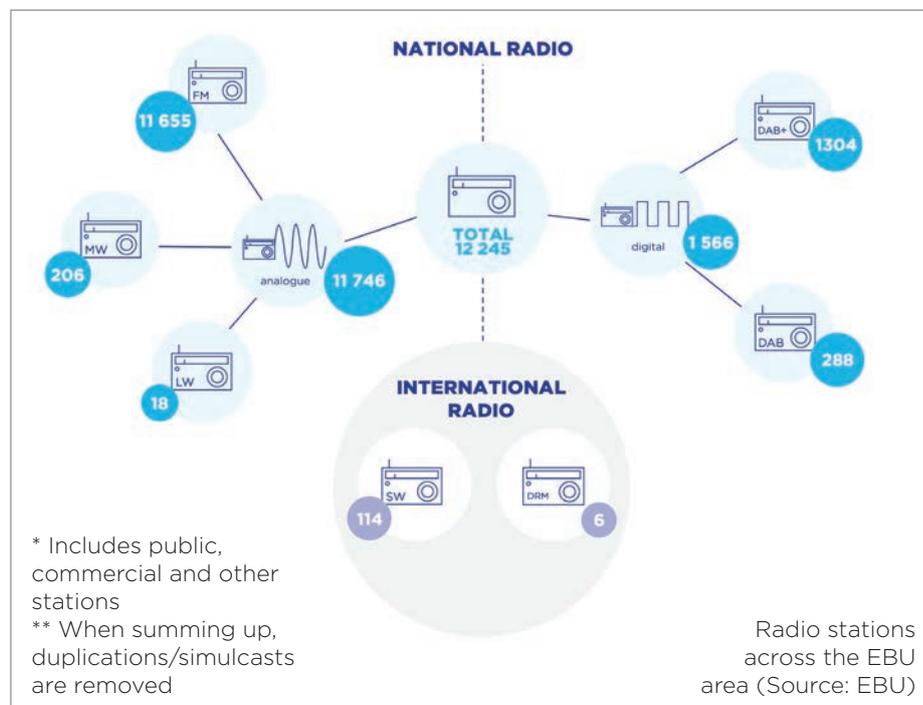
Nineteen markets across the EBU area have stopped broadcasting on medium wave and 13 more only have one service remaining. DRM's (Digital Radio Mondiale) lack of traction argues against digitizing this band.

Long wave is leading the way for medium wave

The decline of long wave started before that of medium wave and in early 2019 there were only 18 active services in the EBU area, including four commercial services. The main reason behind this reality is the perceived decline in usage of this band, rarely available in new radio devices.

Digital radio is progressing

Digital terrestrial radio, mostly



DAB+, is progressing, with more than 1,500 services across 31 markets in the EBU area. Belarus became the 32nd in April 2019. DAB+ may not be the right option for every country, but currently it is the only realistic option for digitizing radio broadcasts.

DAB+ impacting on DAB

The momentum generated by DAB+ in recent years is leading to the demise of DAB, now only available in five markets: Ireland, Romania, Spain, Sweden and the UK. The latter is already transitioning to DAB+ but still has nearly 20 million DAB receivers in people's homes, many of them not compatible with DAB+.

ONLINE TRENDS

And what about online? Of course, broadcasters and new players are investing in the development of online audio, currently based more on its potential than on its reality:

Online is not enough

It represents around 10% of total radio listening, which is 90% broadcast. Online is increasing steadily, albeit slowly.

Exponential growth of online offer

Most broadcast radio stations offer their live streams online and many of them offer exclusive channels, nearly 300 in the case of public broadcasters.

On-demand is booming

On-demand audio is booming, either in the form of catch-up radio or original podcasts. Though still representing only a fraction of radio listening time, its reach is quickly growing.

Find out more at www.ebu.ch/mis-publications, where EBU Members can download the report on radio distribution networks.

A new model to improve QoE measurement

QUALITY OF EXPERIENCE PLAYS A KEY ROLE IN THE SUCCESS OF STREAMING SERVICES. **FRANCESCO DE ANGELIS** (EBU), AUTHOR OF A RECENT TECHNICAL REVIEW ARTICLE ON THE TOPIC, EXPLAINS WHY AND HOW IT SHOULD BE MEASURED.

The availability of cheap powerful devices and high-speed fixed and mobile internet access are changing the way audiences access and consume audiovisual content.

Traditional broadcast channels alone can efficiently support only a subset of all use cases related to media consumption. Today it is necessary to complement broadcasting with other distribution channels, usually based on broadband networks, to provide a comprehensive service.

In such a context, characterized by the presence of several heterogeneous technologies for content delivery, *the level of satisfaction experienced during the consumption of audiovisual services* plays an important role for service providers.

QUALITY OF EXPERIENCE

In the first place, effective audience engagement cannot be completely achieved without providing a satisfactory level of quality in terms of user experience, independent of the technologies involved in the distribution process. Therefore, the audience's degree of satisfaction (or annoyance), better known as Quality of Experience (QoE), represents one of the most important non-functional aspects concerning audiovisual services, and thus

requires coherent definitions and evaluation methods.

Secondly, QoE can be used to drive optimization mechanisms when several distribution options are concurrently available.

Also, measurement of QoE is inherently technology-dependant. In fact, media services delivered through broadband networks are usually encapsulated on top of IP or HTTP protocols (e.g. Dynamic Adaptive Streaming over HTTP – DASH). In this scenario, data loss and corruption can be recovered by resorting to retransmissions and Forward Error Correction (FEC) algorithms. Therefore, common artefacts such as blockiness and slicing are usually solved at the expense of longer delays and stalls in the playout process. Hence, if in classic broadcast networks image quality is the main factor characterizing the quality of services, in broadband networks additional factors must be considered to quantify QoE properly.

NEW MEASUREMENT MODEL

Measurement of QoE turns out to be one of the most appropriate ways to assess the overall satisfaction level of the audience. It therefore constitutes a vital factor for the success of audiovisual streaming services and requires the development of appropriate tools and models.

During the past decade,

several objective QoE methods have been proposed in the literature, having different degrees of complexity and interoperability. *A Lightweight QoE Evaluation Model for OTT Media Services*, published as an EBU Technical Review article in February 2019, proposes a new way of evaluating QoE in DASH services. The new model consolidates several existing methods that estimate and predict how the satisfaction level fluctuates under the pressure of measurable parameters such as delays and stalls. It also introduces additional functions for finer-grained approximations.

The fact that parameters can be customized to consider multiple Quality of Service KPIs (key performance indicators, like number and duration of stalls – see Figure 1), makes the proposed model flexible and modular. Its design means that fewer computational resources are needed (compared to several models based on machine learning techniques) and it can be integrated with off-the-shelf video players, enabling evaluation of QoE directly on a wide range of user devices such as TV sets and mobile devices.

Such features make the model a suitable candidate for lightweight assessment of QoE, providing a complementary tool to help broadcasters meet user expectations when delivering online audiovisual services. The EBU will continue working on further improvements, also taking into account relevant new ITU families of standards.

Download *A Lightweight QoE Evaluation Model for OTT Media Services* from tech.ebu.ch/techreview

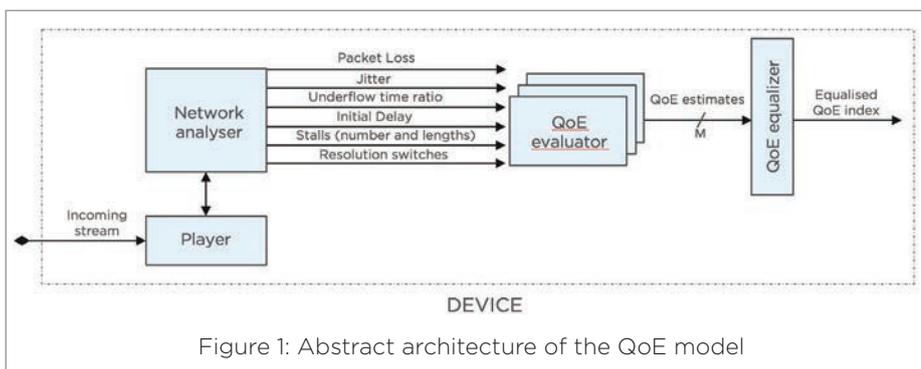


Figure 1: Abstract architecture of the QoE model

Making the case for IP-based production

SOME MAY WONDER WHETHER THE MOVE TO IP-BASED PRODUCTION IS WORTH THE EXPENSE AND THE EFFORT. **DAVID WOOD** IS CONVINCED – AND HE WANTS TO HELP YOU TO CONVINCE OTHERS.



“Today we make good TV programmes – things will be exactly the same with IP production, won’t they?”

“No one claims it will reduce staff. And it won’t be straightforward to implement, at least at the start, not to mention the expense. So why bother to change?”

What looks like a simple argument can be deceptive. Philosopher Bertrand Russell was surprised when he found he needed 14 pages of maths to prove that $1+1=2$. The arguments for IP-based production will not take quite so much maths, but we do need to take time to convince colleagues why this is the most important change in programme production infrastructure of the decade, and why all broadcasters with production centres should now be reviewing what to do.

WHY MOVE?

Firstly, just about every aspect of our lives is being taken over by IT, and programme production is not immune to this. We know that IT systems will become ever cheaper, and eventually they will be all that is available. Our IP production tools are a subset of the tools of IT, and a necessary part of it.

Secondly, remember that making television programmes calls for an array of different equipment: cameras, switchers, editing systems, servers, and the rest. Today, the content is moved from one to another, usually by wires, in a form that matches what each piece of equipment needs. That’s not all you need – there are signals and wires to control the equipment and to monitor it. In technical terms, we have dedicated point-to-point links with interfaces that depend on the format. Each link between equipment is separate. Look around (most of) today’s production centres, and you’ll find them loaded with spaghetti junctions of wires, albeit often hidden.

Thirdly, in our new world, we have to move from vanilla *broadcaster* to *transmedia content provider*. We will need to use new formats and new

delivery platforms. We will not only be making traditional television shows – we will need an array of services for internet delivery, with different qualities and framings. They will need new production infrastructures. But, in a world where the only certainty is change, we can’t possibly renew our production infrastructure every time there is a new standard. Our white knight is IP production.

What we are doing today, metaphorically, is employing a separate postman to send messages to each different address. What we need are rather letters with addresses on the front, and a single postman that looks at the address and takes the letter to the right house. This is exactly what Internet Protocol – the IP in IP production – does. The television content is split into parts (aka packets) and an address and other information are added to the front. Now you only need one distribution channel which runs around everything in the house, dropping off as it goes. The great thing here? As long as all the equipment you use understands the IP standards, you don’t have to add individual connections whenever you add a new media format or delivery platform. If non-technical managers can grasp this basic point, we are half way there.

STANDARDS AND INGENUITY

But we can’t just throw a switch and make the transition. There are challenges. The architecture needs to be developed, synchronization methods need to be devised so that pictures and sound run smoothly, and we need to make sure that the IP can carry the requisite bit rates. What’s more, standard formats are needed for IP interfaces. All this will take time and ingenuity. But it can be done if we are prepared to invest the time and energy that will pay dividends in future. You will be moving from a hardware-centric to a software-centric production centre. You are getting ready to move into the future. It will be worth it.

“In a world where the only certainty is change, we can’t possibly renew our production infrastructure every time there is a new standard. Our white knight is IP production.”

Helping media companies to be more efficient and agile

PARTNER PROFILES IS AN ONGOING SERIES FEATURES ORGANIZATIONS THE EBU COLLABORATES WITH ON TECHNOLOGY MATTERS. THIS PROFILE OF THE ADVANCED MEDIA WORKFLOW ASSOCIATION COMES FROM **NEIL DUNSTAN**.

The AMWA (www.amwa.tv) is a worldwide trade association with 90+ members, composed of electronic media companies and their suppliers along with broadcast consultants and software developers. We work closely with the EBU, SMPTE and VSF (Video Services Forum) as a partner in the Joint Task Force on Networked Media (JT-NM).

All of our technical projects have a solid business basis, and none are allowed to proceed unless the business requirement is understood and approved by the AMWA Board. In one form or another, the goal is always to help our members improve efficiencies, increase agility and drive down costs. This can be in a broadcast workflow or in developing a product.

Over the life of the AMWA, our major initiatives have been in support of:

- an open, interoperable file format for professional media editing via **AAF** (Advanced Authoring Format);
- file-based delivery of programme content from post houses to playout facilities via **MXF** (Media Exchange Format); and most recently
- the move to IP-based infrastructures via **NMOS** (Networked Media Open Specifications).

Fundamental to our approach is that both end users and their suppliers are fully engaged in our developments. We draw on experience across several continents and from a broad range of company types. This helps to ensure that AMWA specifications are usable across the widest range of applications.

As the NMOS specifications have rolled out, we've held about three developers' workshops each year. These provide a



Neil Dunstan,
Director of
Membership
& Marketing,
AMWA

cooperative environment for software writers to efficiently advance their work, achieve the open interoperability that we all seek and get products to market.

In fact, partnerships and collaboration underpin all our efforts, such as the educational aspect of our work with our stands at major trade shows supported by NAB and IBC. In other ongoing initiatives like the IP Showcase, we've worked with marketing organizations such as AIMS (Alliance for IP Media Solutions) and the IABM (International Association for Broadcast & Media Technology Suppliers).

When developing open specifications, wherever possible we draw on existing standards from the broadcast world and, where appropriate, from IT. For us and our members, it is key that we achieve speed, accuracy and efficiency.

NMOS

Current work is to complement

the SMPTE ST 2110 standard and help end users assemble working systems.

Already published are AMWA specifications:

- IS-04 for Discovery & Registration
- IS-05 for Media Device Connection
- IS-06 for Network Control
- IS-07 for Event & Tally
- IS-08 for Audio Channel Mapping

Also published are two "Best Current Practice" recommendations, BCP-002 for High Level Grouping and BCP-003 for NMOS API Security.

Further specifications are already in the pipeline as other end user needs are identified and addressed.

BUSINESS AGILITY IN MEDIA WORKFLOWS

As a likely future project, the AMWA is giving serious consideration to the requirement of media companies for significant business agility and a more flexible financial model.

Thinking is based on the "dematerialized facilities" section of the JT-NM Roadmap. This non-vendor-specific approach will draw heavily on cloud-based systems using COTS (commercial off-the-shelf) devices. It adopts a new way of storing, processing and transporting content, which also works with current standards and specifications.

This will enable previously impossible business agility and scalable systems which run on a common platform. Another benefit is that it will reduce the need for capital-intensive fixed technical infrastructures. In the longer term, this can offer a path to new revenue streams and a closer two-way relationship with consumers.

IN THE SPOTLIGHT

François-Xavier Georget

FRANCE TÉLÉVISIONS

WHAT ARE YOUR CURRENT RESPONSIBILITIES AT FRANCE TÉLÉVISIONS?

I'm deputy director of the technical production department, which gathers and manages all technical resources and staff – around a thousand technicians. They make programmes for the news department, as well as some sports, game shows, entertainment and drama. I am responsible for improving the department's performance in operational, economic and social terms.

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

I previously worked in the French Prime Minister's department, examining technical aspects of political, legislative and regulatory decisions concerning the audiovisual sector. Two personal highlights: the development of the legal framework for deploying DTT in France and the negotiation of the first European telecom package. The latter directives integrate and codify provisions that address the specificities of the audiovisual industry.

WHAT ARE YOUR PREDICTIONS FOR MEDIA TECHNOLOGY IN THE FUTURE?

The range of audiovisual content is constantly growing: there are new modes of consumption and new players to meet evolving audience needs. Technology is no longer a brake on the evolution of consumption and traditional broadcasters won't be the prescribers of technological facilities as in the past. Emerging technologies verify the principle of convergence: previously discrete distribution networks are merging, and AI – beyond profiling, archiving and curation



– will increasingly encroach on the “artistic” disciplines of cameramen, digital imaging technicians and directors.

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

We, as EBU Members, are no longer required to develop technical solutions on our own, but rather to evaluate the technologies available and adapt only the interfaces. Even though our needs have not changed greatly, the financial means are rapidly diminishing. The EBU must be very active in setting up operational technical solutions for the benefit of its Members: under the Technical Committee, the EBU should act with Members to specify and select solutions, only developing the elements that are missing. We need to expand and develop common initiatives like PEACH and FLOW based on clearly identified needs.

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

When one is of technical origin, one never works within a broadcaster only for passion. Given the difficulties of reconciling the needs and wishes of, on the one hand, journalists, producers, artists and entertainers with, on the other hand, the management that seeks to save money, when at the same time manufacturers constantly propose new facilities and formats, one must be robust. Television is a passion that decides a life, but in my case sailing is also something fundamental and essential. I am a sailor.

Your essential IP checklist

Although the shift to IP-based production is now well under way, pioneers like Radio-Canada (see page 10) have found that sourcing standards-compliant equipment is not straightforward. The *Media Node Maturity Checklist* (opposite) was created to guide discussions between customers and vendors and to quickly assess the level of maturity and suitability of a product for deployment.

SHOPPING LIST

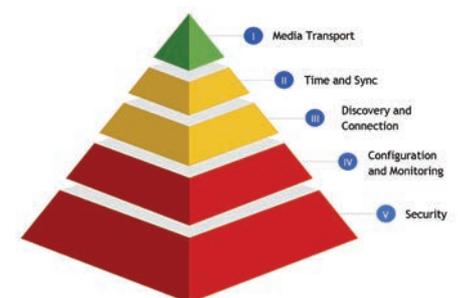
It can be seen as a kind of shopping list that breaks the *Technology Pyramid for Media Nodes* into its component parts. It covers the full ensemble of technologies that SMPTE ST 2110 media devices need to support to enable users to efficiently design, build and maintain operational facilities.

The pyramid and checklist are targeted at broadcasters and system integrators who need to define and design their requirements for a live IP infrastructure. They also provide the industry with a clear understanding of what users expect from mature IP studio equipment.

The details of each criterion are described in EBU Tech 3371, available at: tech.ebu.ch/tech3371

It's important to note that any claims made by vendors are not necessarily verified by the EBU. It is recommended that customers do their own testing and verification before buying.

Technology Pyramid for Media Nodes



tech.ebu.ch/pyramid



MEDIA NODE MATURITY CHECKLIST

Brand / Product / Date:		
I. Media Transport	Single link video SMPTE ST 2110-20	
	Software-friendly SMPTE ST 2110-21 Wide video receivers	
	Universal, multichannel and low latency audio SMPTE ST 2110-30 Level C	
	Stream protection with SMPTE ST 2022-7	
II. Time and Sync	PTPv2 configurable within SMPTE and AES profiles	
	Multi-interface PTP redundancy	
	Synchronization of audio, video and data essences	
III. Discovery and Connection	Discovery and Registration: AMWA IS-04	
	Connection Management: AMWA IS-05	
	Audio channel mapping: AMWA IS-08	
	Topology discovery: LLDP	
IV. Configuration and Monitoring	IP assignment: DHCP	
	Open configuration management - e.g., API, config file, SSH CLI, etc.	
	Open monitoring protocol - e.g., syslog, agent, SNMPv3, etc.	
V. Security	EBU R 148 security tests	
	EBU R 143 security safeguards	
	Secure HTTPS API: AMWA BCP-003	

NOW = shipping now
 19Q3 = shipping Q3 2019

NP = not planned at this time
 NA = not applicable to this product

