

tech-1

Dive into AI and machine learning



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Cover Story: Artificial Intelligence seems to be everywhere these days. This issue of tech-i comes at the topic from several angles, starting on page 6, where SRF's Patrick Arnecke provides practical advice on how to dive into AI and machine learning.

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So long, farewell, auf Wiedersehen, adieu!

Simon Fell, Director, EBU
Technology & Innovation



This is my final tech-i editorial, after four and a half years in Geneva. The two big technology issues when I took up this role were whether and how UHD TV would be introduced and the growth of online content delivery. Not much has changed! Yes, we are further forward with UHD as the first services have launched on satellite and broadband. However, the gnarly problems around HDR standards and the confusion for consumers remain. Some great solutions have been proposed and have begun rolling out, but there is no certainty yet in the consumer electronics world nor any firm commitment from broadcasters to make it happen.

Have we lost our mojo? Or have the budgetary constraints that all broadcasters face held back the innovation and investment needed to launch services that, after all, appear to only partially improve on the great HDTV services that we have today? I firmly believe we will see most major productions made using UHD techniques and that, as usual, this investment in quality productions will pay off in due course when services are introduced more widely.

The growth of online or OTT services and SVOD – think Netflix and Amazon Prime – has prompted a seismic shift in viewing habits. The speed and quality of broadband services to the home now allow for a very good standard of delivery for catch-up services and the competition from SVOD services is pushing innovations such as publishing all episodes at once for binge viewing. Broadcasters are in a strong position given their investments in homegrown content, however they must keep pace with consumer expectations. This has changed the focus of much of the broadcast engineering effort in today's

organizations. Software has come to the fore and teams of developers need to regularly craft new features to satisfy audience needs and increase the usability and stickiness of content in a highly pressured and competitive market for viewers.

I am proud of the work that EBU Technology and Innovation has done with our Members to clarify the technical landscape and guide broadcasters and the industry to solutions that make sense for all parties.

We have faced challenges. For example, the pressure to use broadcast spectrum for mobile broadband has not abated and is a global threat to free-to-air broadcast services. At the same time, the work our Members have done with us to seed the future 5G standards with broadcaster-friendly features sets the foundation for an interesting future if and when such services are in everyday use.

We have developed services such as EBU Flow for multi-CDN operations and PEACH for personalization. We continue to champion the use of DAB+, especially the missed opportunity of fitting receivers to mobile devices, while having an eye to the future with hybrid radio services that combine the convenience of streaming with the efficiency of broadcast. I could mention so much more: our work on QC, media cyber-security, metadata standards.

We are entering a brave new world, where AI suggests what we should watch and machine learning systems comb our content, catching every word and facial expression. It's a world where technologists and people who love a challenge will produce ever greater services to entertain and educate our audiences. I, for one, will continue to watch and listen with interest.

In search of clear thinking on broadband delivery

Speaking at BroadThinking 2018 (left to right): Patrick Arnecke (SRF), Wilfried Dudink (CenturyLink), Paul Szucs (Sony Europe).



BroadThinking is the EBU's flagship event in the domain of broadband technology, writes **Bram Tullemans**. The conference has a wide brief, covering streaming technologies, frontend design, user experience and strategic aspects of media delivery over broadband networks. Running now since 2009, it is the event "where broadcast meets broadband".

One of the conclusions from last year's event was that fragmentation and the coexistence of multiple standards for broadband distribution are still major challenges for broadcasters. We'll return to this topic at BroadThinking 2018, including an update on the streaming format CMAF (Common Media Application Format) and a comparison of the

new AV1 and JEM codecs. These are all potential solutions to the fragmentation problem.

Our multi-CDN project, EBU Flow, was in its early stages when we gathered last year. The platform has been up and running now for more than eight months, so we have a number of findings to report at BroadThinking 2018. We'll also explore how CDNs are likely to fit into a 5G ecosystem and explain how content providers can build their own CDN.

Machine learning is a new topic for this year's BroadThinking. Innovative applications around audience engagement, targeted advertising, personalization or other enhancements to media services will

be discussed from both technical and implementation perspectives, with practical use cases. Data security is an essential element for most of these services. The practical implementation of 'privacy by design' principles, as demanded by the new EU GDPR regulation, will be outlined by a specialist in this area.

As usual, we'll also look at media player technology – and in particular the challenge of standardizing metrics – as well as audience trends, progressive web apps, WebRTC and much more.

BroadThinking 2018 takes place in Geneva on 27-28 March. More information: tech.ebu.ch/broadthinking2018

"Anything can happen at a WRC!"

Last November marked the 20th anniversary of FORECAST, the EBU's annual seminar on media distribution technologies and strategies. The event attracted 115 participants. One strong message to emerge was the need for broadcasters to adapt their distribution models, with internet delivery likely to become increasingly dominant.

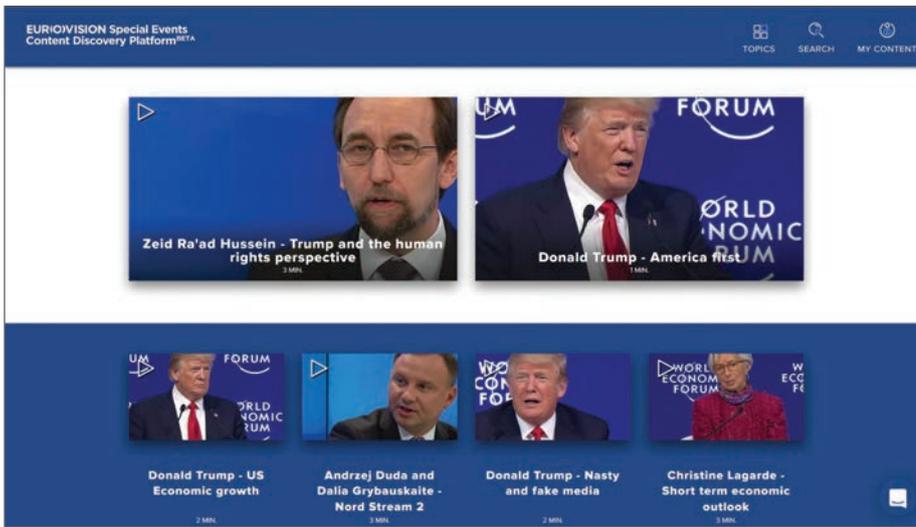
However, according to one of the live polls taken during the event, 60% of participants believed it would take more than ten years before OTT could replace existing television delivery platforms. With the transition to internet delivery being more complex than previous transitions, broadcasting platforms – DTT, satellite and cable – would remain essential to ensure nobody is left behind.

Mobile network operators naturally see the business opportunities in media delivery over broadband networks. But they also recognize the challenges associated with, in particular, traffic management and the new business models. One MNO representative acknowledged that "all challenges cannot be solved alone" and stressed the need

for further cooperation between all stakeholders. The EBU will continue its engagement to seek win-win business arrangements between broadcasters and new broadband distribution models.

With DTT remaining a core delivery platform for most broadcasters, FORECAST also included a warning that the spectrum battle is not over and that the next crunch point may come sooner than 2023. Although the WRC-19 agenda does not include key frequency bands such as UHF or C-band, several speakers raised the prospect of that situation changing (see page 18). One noted the importance of looking back, to avoid making the same mistakes: broadcasters need to understand what can happen at WRC-19 and when. More than 60% of participants indicated that a further reduction of UHF spectrum for DTT would render the offer unattractive in their country.

Presentations and videos from FORECAST 2017 are available to EBU Members: tech.ebu.ch/forecast17



Collaboration results in new digital tools for EUROVISION Special Events

The World Economic Forum's annual gathering at Davos drives the global news agenda for a few days every January. At this year's event, a new platform from EUROVISION Special Events, WEF's broadcast partner for the event, allowed journalists and media organizations around the world to keep pace with the stories as they developed.

The content discovery platform, launched in beta mode for Davos 2018, was the result of collaboration between Eurovision Media Services (EMS), the EBU Technology & Innovation Department and EBU Member Bayerischer Rundfunk (BR).

THREE-MONTH TURNAROUND

It took less than three months for the project to move from the initial idea to a beta launch. This was possible thanks to the enthusiasm, expertise and flexibility of everyone involved. The web interface came from BR, who contributed a white label version of their Mediathek platform. BR developers also participated in the co-development effort to integrate their platform with the Eurovision asset management system.

Eurovision journalists fed the platform with curated video clips from Davos, tagged with relevant

metadata to make them easily searchable. Journalists could access ready-to-use video clips and share content directly on social media. Broadcast quality versions were available for download.

Automated recommendations highlighted content based on specific themes, notable people or trending topics. This drew on the work of the EBU PEACH team, whose co-developed personalization engine had already been deployed on audience-facing services by Members in Switzerland, Germany and Portugal.

By working side by side, broadcast engineers, software developers and news editors were able to adapt the editorial workflow during the event to accelerate the availability of the content on the platform. With a continuous improvement approach, the cross-functional team rolled out 15+ upgrades to support the work of news editors, for instance with automatic VIP face detection and tagging. It was 'agile in action', meeting the needs of the community and delivering real value.

Feedback from the first users has been overwhelmingly positive, laying the foundations for a new generation of digital services for special events.



Moving on to the next challenge

Michael Barroco (below), who leaves the EBU in mid-March 2018, first came to the Technology & Innovation Department in 2010 as an intern working on software development. Joining as a full employee in 2013, he focused primarily on software engineering and user experience projects. He was a key member of the team that developed an ETSI specification for cross-platform authentication, spending six months on attachment in London at the BBC while working on the open source reference implementation.

That project was an important precursor to PEACH, the EBU co-development project that has resulted in the deployment of personalization and recommendations system by several Members. As Head of Software Engineering (since 2016), Michael established and oversaw the

PEACH team, which will continue its work after his departure.

In addition to these and other software development projects, he was instrumental in the creation of the T&I Department's OpenStack private cloud – a key enabler of in-house and cross-organization innovation – and the ebu.io platform as a software collaboration hub for the EBU and its Members.

Michael has decided to leave the EBU to pursue his own technology start-up project. We wish him every success for the future!

Visit ebu.io to access the EBU Code Exchange Platform along with several digital tools and services and a directory of open source resources for broadcasters.

Snapshots of PTS 2018

THE EBU PRODUCTION TECHNOLOGY SEMINAR 2018 TOOK PLACE AT THE END OF JANUARY. THERE WERE AROUND 150 PARTICIPANTS FOR THE THREE DAYS OF PRESENTATIONS, DISCUSSIONS, TUTORIALS AND DEMONSTRATIONS. HERE WE QUOTE JUST A SMALL SELECTION OF THE SPEAKERS. **EBU MEMBERS CAN ACCESS SLIDES AND VIDEOS VIA THE WEBSITE: TECH.EBU.CH/PTS2018**



"Probably the single greatest factor in this AI/ML revolution that we're all seeing right now is the fact that we have cloud computing."
Michelle Munson, Eluvio



"In object-based media, we talk about those individual components of media, breaking them down, and then letting the client - the viewing device - put them back together into an experience."
Chris Northwood, BBC R&D



"As opposed to traditional linear content, where you have one track of audio, one track of video and perhaps one track of subtitles, we're moving to a world where you have multiple individual components of various sorts, all assembled on a common timeline."
Pierre-Antony Lemieux, Sandflow Consulting



"The EBU will be totally committed to innovation, to technology, to working with Members, but also with the wider industry. We can't be too insular."
Noel Curran, Director General, EBU



"We were able to build our entire DAM (digital asset management) infrastructure in less than three months [by using the cloud]."
Callum Hughes, Amazon Studios



"One thing is clear: High Dynamic Range and Wide Colour Gamut have real added value. We could demonstrate this, and we got our 'Wow' effect."
Derya Ademir, SRG SSR



"Many of you probably have heard the phrase 'content is king'; well I would add that data is queen."
Martin Wahl, Microsoft

Dive into AI and machine learning

RECENT YEARS HAVE SEEN MANY ASTONISHING DEVELOPMENTS IN SO-CALLED ARTIFICIAL INTELLIGENCE (AI). SUCH DEVELOPMENTS NOTWITHSTANDING, AI HAS NEVERTHELESS BECOME A HYPED AND MISUNDERSTOOD TERM, WRITES SRF'S **PATRICK ARNECKE**.

If we look at the market today we see numerous technology companies adopting AI as a strategy and investing heavily in terms of money, technical infrastructure and human resources. Eight very influential corporations dominate the market: China's Baidu, Alibaba and Tencent; along with, from the US, Google, Apple, Facebook, Amazon and Microsoft. These behemoths control the vast share of data, platforms, services, intellectual property and talent. Microsoft employs more than 8,000 machine learning (ML) engineers, while more than 5,000 engineers are working on the Amazon Alexa ecosystem and Alibaba has 25,000 engineers on AI-related products and projects. These are stunning numbers compared to anything that we as broadcasters might have at our disposal.

More than 2,000 companies in 70 countries are developing or offering AI services, products and platforms across all imaginable industries. There is substantial and increasing start-up and research funding, and venture capital is flowing. Around 15% of the total capacity of data centres worldwide is now used for ML tasks. AI is considered the new electricity, driving the next industrial revolution that will fundamentally change the ways we work, create, do business and organize our lives and societies.

DON'T YOU MEAN ML?

AI is the science and engineering of teaching machines intelligent behaviour. ML is a subfield of AI whereby we let the machine find its own way to a solution rather than programming it with explicit rules. We define an objective and show the machine data. The machine tries to derive generalizable rules from the structure it sees in the data, using



"We're going to be working with these AIs – I think you'll be paid in the future by how well you work with these bots."

KEVIN KELLY, FOUNDING EDITOR OF WIRED MAGAZINE

this process to train and optimize its function towards the goal. The system programs itself, which has proven to be a powerful paradigm. When we talk about AI today we usually mean ML, which is a more precise and less misleading term.

Of all of the many ML methods, so-called deep learning has yielded the most spectacular successes during recent years. Deep learning uses networks of virtual neurons, which are extremely efficient in learning and detecting patterns. Neural networks have become so important and widely used because they are universally applicable to all kinds of data and tasks – many of them previously not solvable in a satisfying way or at all.

ML AND THE MEDIA

For media organizations, ML in general is fundamental because it enables us to understand, transform and generate our content in totally new ways and with much greater

scale and efficiency. We can start to extract meaningful entities (like people, places and organizations) from our video, audio or text files. Good metadata is a prerequisite for recommendation and personalization, which are in turn mighty levers to increase the value of our content.

Object recognition in images and videos already works beyond human capabilities. However, extracting precise, meaningful and relevant tags or scene descriptions barely works, or not at all (yet). One should expect to get a lot of noise from these systems and expect them to be biased, easily fooled and fail often in recognition tasks that need to take some human context into account. Facial recognition on the other hand already works quite reliably – not least because there is so much commercial and governmental interest. Emotion tracking analyses the emotions we humans express with our faces, voices

or written texts.

Speech recognition is another field where machines have surpassed humans in accuracy, giving us increased quality and scale in transcription and subtitling. Machine translation relies heavily on neural networks, delivering usable results. Neural networks bring new methods to synthesize voices, with authentic results and astonishing advances even in the last couple of months. Since broadcasters usually employ a lot of voices this will be a transforming factor for us too.

CREATIVE APPLICATIONS

There are many applications in the creative area using ML and neural networks. To mention just a few: arbitrarily swapping the style and content of media (Prisma App, DeepArt); synthesizing images (Generative Adversarial Networks); voice generation (Amazon Polly, Google WaveNet and Tacotron 2); voice copying (Lyrebird); image manipulation (Faceapp, Face2Face et al); automatic composition of music (Amper, Jukedeck); logo generation (Logojoy); website design (Wix, The Grid); and text authoring (CyberWriter, Wordsmith, Quill). There are also various attempts to assess the aesthetics of media (EyeEm, Google NIMA) and the quality of text (Responsible, CrystalKnows).

A central notion of ML is that it is horizontal. We eventually will apply machine learning – and thereby “cognify” – almost every task and workflow in our organizations and daily lives. Like electricity or the internet, AI will become ubiquitous and more or less invisible at the same time. A lot of the change to come will be existential. We should therefore report much more on these systems and their consequences – our audiences deserve to be informed and educated on this fundamental shift. At the same time, we ourselves must get to grips with these systems very quickly. Our future success and raison d'être will essentially depend on our ability to understand and work well with smart machines.

“AI is the new electricity. Just as 100 years ago electricity transformed industry after industry, AI will now do the same.”

ANDREW NG, COMPUTER SCIENTIST AT STANFORD UNIVERSITY



DO IT YOURSELF

A first step to assess your own options is simply to try out various smart services:

- Teachable Machine from Google is a playful entry point to deep learning – you train a neural network in your browser, literally in seconds, simply with your webcam.
- Microsoft's Video Indexer integrates all available image and language processing techniques in one unified interface. It gives a good sense of what ML can and cannot do with media today.
- Chatfuel is an easy and free starting point for conversational interfaces (aka chatbots) and their language understanding abilities.
- Use Articulator Lite to experiment with Robot Journalism.
- Cyborg Writer is an “experimental text editor with a neural text synthesizer” that can generate text snippets in the style of Shakespeare, Eminem, Donald Trump, Wikipedia and others.
- Amazon Polly is a powerful, state of the art text-to-speech system that gives a good impression of how usable artificial voices are today.
- Lyrebird's Beta lets you copy your own voice and generate new speech samples by simply typing text.

Look also at workflow automation tools, like Zapier and Microsoft's Logic Apps, that tie in cognitive APIs and let you set up smart workflows without writing a single line of code.

The next step is to learn to call an API, which takes about five lines of simple code. This gives you access to literally hundreds of ML services to try out. Start simple with language APIs (TextRazor, Google Language API, Amazon Comprehend) that extract entities from a text or analyse its sentiment. Free language processing tools like gensim, Spacy and Polyglot are powerful too and trying them is fairly simple.

The popular data science competition platform Kaggle is a perfect stepping stone if you want to dig deeper. You'll find a wealth of datasets, discussion and usable code for almost every conceivable ML task and can even set up a competition yourself with your own data and business problem.

Find links to all resources mentioned in this article at: suisse.ai/links



A new angle on fishing for stories

DATA JOURNALISM PROVIDES FERTILE GROUND FOR NEWS ORGANIZATIONS. IN IRELAND, EBU MEMBER RTÉ HAS PIONEERED THE ANALYSIS OF PUBLICLY AVAILABLE DATA AS A MEANS OF UNCOVERING MULTIPLE STORIES OF INTEREST. INVESTIGATIVE JOURNALIST **CONOR RYAN** DESCRIBES THEIR APPROACH.

Investigative journalism is often dismissed as fishing. The cynical implication is that ‘hacks’ blindly cast a rod in the hope that anything will bite. To those who work in this field, however, their stories speak more to the skill and nuance of knowing what you are after, where to focus, when to flick the bait and how to reel in. Anglers will understand.

But that does not really explain investigations involving big data. Trawler crews would probably relate more to that. It is still fishing, but a lot of the process happens away from the game – building appropriately sized nets and planning where to cast them. Get it right and catch more than you could ever imagine; get it wrong and get dragged down with too much of the wrong thing.

This work with data is still relatively new and faces different criticisms – too much preparation,

too much information and not enough impact. The processes involved are still not very well understood, be it their complexities, their implementation or their potential.

EMERGING FIELD

There are different types of data journalism. The range can be seen in showcases of standout stories. The Global Editors Network’s data journalism awards for 2017 shortlisted some of the best projects produced by newsrooms across the world. The first grouping is the most identifiable: visualizations and graphs to make a lot of data digestible. Stories like FiveThirtyEight’s data analysis of gun deaths in the US or The Guardian’s breakdown of the voting base underpinning the Trump presidency are both on the awards

shortlist.

Another category, rapidly emerging, is the effort to organize, distil and spot stories when large amounts of data are leaked. Typically, this has been happening with unstructured data dumps like email servers or PDFs, as with Der Spiegel’s “Football Leaks”.

But there is another way.

For the past three years we at the RTÉ Investigations Unit in Ireland have been among a number of news operations looking at how to get publicly accessible data sets to communicate with each other, to find ways of matching records, and using these links to establish patterns. In 2017 our pilot work underpinned a successful pitch for large scale funding from the third round of Google’s Digital News Initiative.

“Rather than investing in data to tell us a story, we tried to bring data together to point us to many stories.”

DATA FOR LEAD GENERATION

The concept is a subtle shift. Rather than investing in data to tell us a story, we tried to bring data together to point us to many stories. In 2015 we worked with a software developer to come up with objective criteria to detect political impropriety by examining financial behaviour, asset declarations and ownership interests.

Rather than going after individuals and building cases against them, we put our early efforts into helping to inform the computer code that scoured records relating to every single publicly-elected representative at every level of government in the country. We emerged with strong initial leads – 40% of politicians had failed to declare at least one property in their ethics returns. From here we let the code filter out those who were most likely to fit past models of poor behaviour across multiple criteria. Our tactic was not to let that information serve as the story; we used it as a signpost to find those likely to be engaged in questionable activity. It culminated in a television programme, Standards in Public Office, that broadcast footage of three of those politicians soliciting financial rewards from an undercover reporter in return for doing secret work.

That project relied on a computer code to find likely relationships between public land ownership records, corporate directorship registries, electoral records, ethics declarations and debt lists. There are other projects experimenting in this area.

IMPROVED REGULATIONS

For us a key obstacle to overcome has been linking data collected by various bodies for their own purposes. So straightforward a concept hardly bears thinking about, but a lot of the useful data that

is available is difficult to dig into because of relatively simple problems at source, e.g. naming conventions can change, or addresses are not kept. At a European level, opportunities are coming on stream that, if maximized, can change all that.

The Anti-Money Laundering: Beneficial Ownership Directive, and in particular its push for beneficial ownership registers, should help to strip away one of the major problems interpreting corporate data. It requires public register keepers to also publish who controls, and more importantly who benefits, from companies rather than merely directors paid to run them. Separately, EU tendering rules introduced a requirement to publish the official company number with all successful awards – if done consistently it will open up this data to easy automatic interrogations. The only problem so far is a lack of appetite to ensure the right number is captured. Already there is confusion, with VAT numbers appearing sometimes and company numbers other times.

The next challenge for data journalists is to extract as much value as possible from data sets without making a habit of doing the work of public bodies. Tackling the structural problem closest to the data source avoids a labour-intensive process that requires large investment in cleaning and converting information down that line and creating something that can be easily analysed and matched across data sets.

MACHINE READABLE

As data journalists well know, the practice of publishing public records as PDFs strips away so much potential from the information and dramatically increases the amount of time required to turn a story around. The knock-on effect of this is that those commissioning stories are more likely to lose faith with the rewards of data journalism if it takes too much time to get to the story. This is why it is important that newsrooms start to set the agenda in terms of public information rather than suffer because of how it develops.

One of the greatest tools in this fight is the revised Reuse of Public Sector Information Directive, an EU-wide measure to help release the value that is held in public datasets. A critical development in this directive is the right for members of the public to request access to public data to re-use but – critically – to have that released in a “machine readable fashion”.

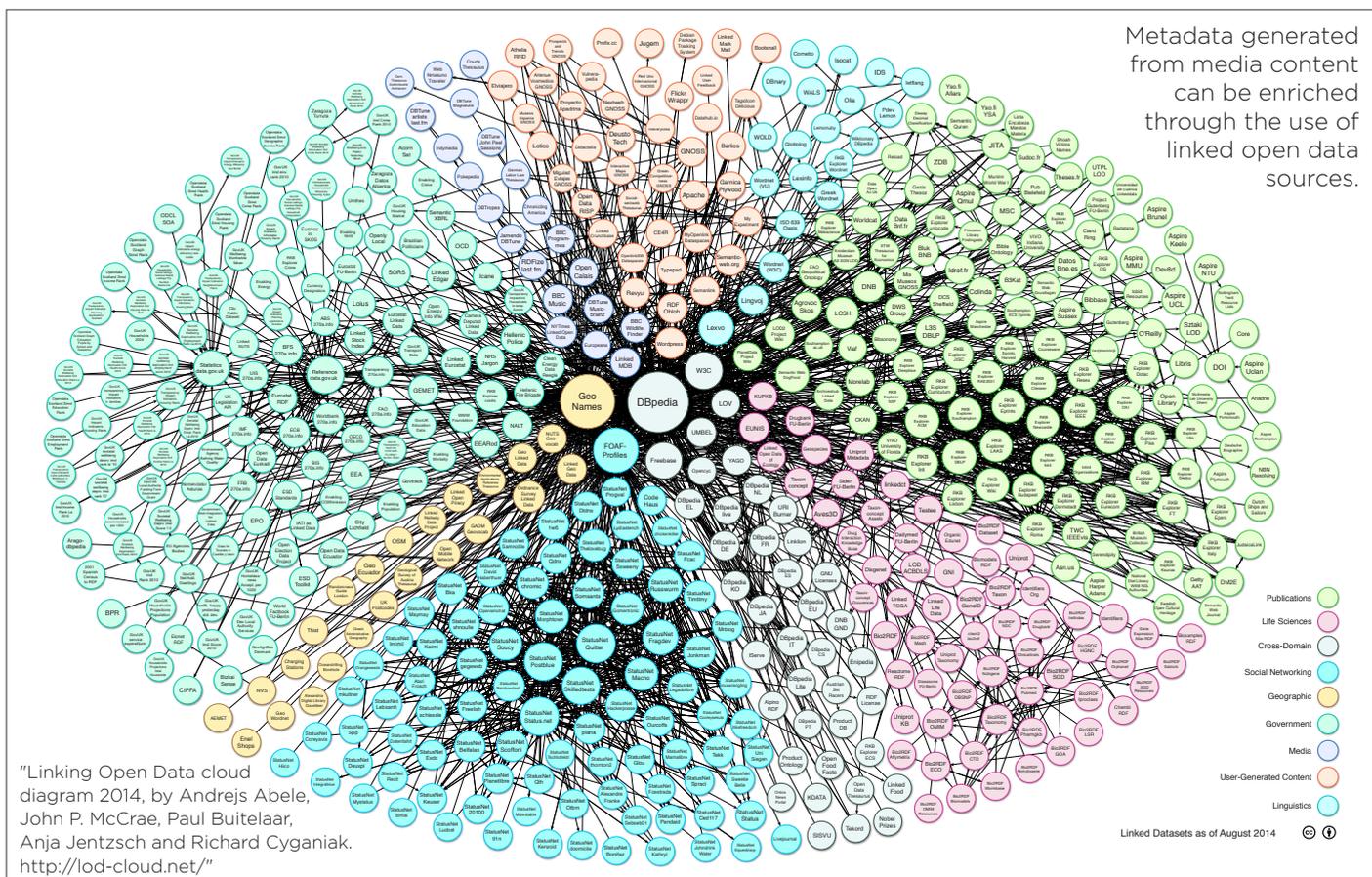
This ambition, to put the onus on public bodies to release material in a way that complies with open data standards, has great potential for data journalism. If persistence makes public bodies start to adopt this at source, it will eliminate one of the prohibitive roadblocks to this type of journalism – the investment needed to make interesting data usable.

This movie season, Hollywood’s attention has again turned to investigative journalism, to the backstory of the Pentagon Papers in the Washington Post. The story hammers home the message that the only way to exercise a right to free speech is to assert it. For data journalism, the effort to obtain data that can be used in a fashion that delivers on its potential without crippling newsroom budgets requires something similar.

Conor Ryan spoke about data journalism at the EBU Production Technology Seminar 2018. EBU Members can find videos of the presentations on our website: tech.ebu.ch/pts2018

AI by any other name?

AN EBU REPORT TO DEMYSTIFY AI, ML, DEEP LEARNING, NEURAL NETWORKS AND COGNITIVE WORKFLOWS IS UNDER PREPARATION. IN THE MEANTIME, THE EBU'S **JEAN-PIERRE EVAIN** DESCRIBES AI-RELATED ACTIVITIES UNDERTAKEN IN THE TECHNOLOGY & INNOVATION DEPARTMENT.



The fact that AI is seen as "new" reveals the extent to which enthusiasm around these technologies may be masking considerable confusion. More worrying than the lack of understanding of the link between, say, AI and automatic metadata extraction, is the fact that some people say they want to use the cloud but consider service-oriented architectures irrelevant. This suggests the EBU can play a valuable role in demystifying AI and raising the overall level of understanding around these technologies and their use.

OPERATION DEMYSTIFICATION

A report that aims to demystify artificial intelligence, machine learning, deep learning, neural networks (deep or recurrent) and cognitive workflows is in preparation by the EBU's Strategic Programme on Media Information Management and Artificial Intelligence. See: tech.ebu.ch/groups/mim

AI AND AME

When we sought expressions of interest in work related to AI, most of the responses came from people doing Automatic Metadata Extraction (AME). This is a topic the EBU has worked on for many years. The main aim of our AME work is to generate richer and cheaper metadata. We hope this renewed interest in AME in the context of AI will attract more human resources contributing to this effort.

The paradigm has changed significantly with increased processing power, storage, reference

data and the rapidly growing range of cloud-based AME tools on offer: face detection/recognition, mood detection, voice recognition, speech-to-text-to-speech, speech analysis, automatic translation, scene detection, summarization, etc.

The accessibility and ease of use of these tools as microservices, or online, has changed the perception of AME and attracted attention. One can now touch and measure the efficiency of AME and its potential impact on business (e.g. machine vs human performance, reduced operational costs, enriched service offer). However, this is a double-edged sword, as vendors know the extent to which broadcasters can financially gain from using these tools and will surely adapt their pricing accordingly. Some broadcasters take the approach of

"AI is far from being new technology."

integrating open source solutions in-house. Of course, it is for everyone to decide the best possible combination of these different approaches.

AI AND BIG DATA

The PEACH platform, co-developed by the EBU and specific Members, provides user data collection, data processing and an analysis interface for data scientists, using state of the art technology like Spark clusters and Jupyter Notebook. Automated processing based on AI algorithms is used to create recommendation models, which are delivered to mobile and web applications through REST APIs. Members create, maintain, improve and share algorithms and best practices to analyse data and recommend personalized content to the user in unique ways. The goal is to deliver the right content at the right time to the right person on the right device.

AI AND SEMANTIC DATA

Semantic data is an integral aspect of AI. The main principle of semantic data is about linking identified resources and associated metadata in the form of simple statements. Data enrichment happens naturally, by extracting information from linked open data sources. Reasoning and inference exploit the structures of ontologies to highlight hidden knowledge. Metadata generated by AME tools can also be ingested into knowledge graphs.

EBUCore, EBU\$port and the EBU Class Conceptual Data Model (CCDM) all exist in RDF (Resource Description Framework) as ontologies modelling audio-visual resources, sports and workflows.

AI AND MICROSERVICE ARCHITECTURES

AME in the cloud is directly associated with microservice architectures. As shown in 2017 at NAB and IBC, the FIMS (Framework for Interoperable Media Services)

project integrates service-based AME processes across cloud platforms (Amazon, Azure, Google, IBM...). The respective engines are exposed through cloud service wrappers and asynchronous RESTful interfaces with minimized input/output payloads and searchable semantic data.

FIMS will publish a set of best practices, useful patterns, libraries (NPM packages and GitHub) and frameworks for applying cloud technologies in a service-oriented architecture with all the advantages

it brings (flexibility, scalability, no vendor lock-in, etc.).

CONFUSION REMAINS BUT NOTHING INCURABLE

Representatives from IBM Watson, Microsoft Cortana and Amazon Alexa stressed in a statement made at CES 2018 (a conversation led by Tom's Guide editorial director Avram Piltch) that AI is far from being new technology, which is very true.

So, is the EBU working on AME, semantic data, big data and personalization or service-oriented architectures? No, our activities are on AI and microservices! It seems it is all very much a matter of trendy terminology.

NEED SUPPORT ON METADATA AND AI? JUST ASK!

The Strategic Programme on Media Information Management and Artificial Intelligence (MIM-AI) is one of the very active expert communities within the EBU.

A lot of work is done to maintain the two flagship specifications, EBUCore and the Class Conceptual Data Model (CCDM), which attract a lot of attention from data architects and developers. Adoption has followed accordingly. EBUCore focuses on audiovisual objects (audio, video, persons, organizations, locations, events, props...) while the CCDM extends EBUCore with new objects in production workflows from commissioning to distribution. The importance of semantic modelling is growing rapidly and the choice, made several years ago, to develop ontologies has proved appropriate. The use of RDF/XML or JSON-LD as representation languages allows for the simplification of the model originally hidden in the EBUCore schema and supports issuing simpler metadata documents.

The FIMS project is also doing intensive work around the workflow integration of cloud microservices, connecting a variety of AI metadata extraction tools across platforms (Amazon, Google, IBM, Microsoft). FIMS defines RESTful interfaces and libraries as well as a set of best practices to deploy automatic metadata extraction. Of course, FIMS also defines interfaces for other core processes such as ingest, transfer, transform, quality analysis and repository management. FIMS uses semantic data based on EBUCore.

There is a lot of expertise in the MIM-AI community, which is easy to join from the project webpage: tech.ebu.ch/groups/mim. People are willing to help. Once a member of the community, it is easy to use the reflectors to ask questions or request assistance. This is being done on a daily basis. Or more simply, never hesitate to contact Jean-Pierre Evain (evain@ebu.ch).

You are more than welcome to join and make the community stronger. You may also want to join or contribute to our Metadata Developer Network Workshop on 5-7 June 2018 at EBU headquarters in Geneva (tech.ebu.ch/mdn2018).

Making sense of HFR specifications

HIGH FRAME RATE SERVICES ARE NOT YET DEPLOYED, BUT THE STANDARDS ECOSYSTEM IS LARGELY COMPLETE. THE EBU'S **PAOLA SUNNA** TAKES A LOOK AT WHO HAS SPECIFIED WHAT.

The benefits of high frame rates (HFR) – meaning, in Europe, rates above 50 fps – have been extensively researched. The most significant motion artefacts in moving pictures are motion blur and strobing (or judder). They are related and arise from a combination of the object's motion speed, the frame rate and the exposure time of each frame (see boxed text). Increasing the frame rate used can reduce both motion blur and strobing, resulting in sharper images and an improvement of the perceived picture quality. To get the maximum benefit from video with a high number of frames per second, a complete chain approach must be adopted; from camera to display. The technical standards for that chain are created by various organizations, such as the ITU, SMPTE, DVB and ATSC. Here is an overview of the most important specifications that already support HFR.

ITU-R BT.2100-1

The ITU defines the baseline parameters for video technology, which are used throughout the complete chain. In June 2017, the Geneva-based organization published Recommendation BT.2100-1. It defines image parameters for High Dynamic Range (HDR) in both HD and UHD using the BT.2020 wide colour gamut. But it does not stop there. BT.2100-1 also includes support for HFR, among others in 100 and 120 Hz.

Parameter	Values
Image container shape	16:9
Container pixel count horizontal × vertical	7,680 × 4,320 3,840 × 2,160 1,920 × 1,080
Sampling lattice	Orthogonal
Pixel aspect ratio	1:1 (square pixels)
Pixel addressing	Pixel ordering in each row is from left to right, and rows are ordered from top to bottom.
Frame frequency (Hz)	120 , 120/1.001, 100 , 60, 60/1.001, 50, 30, 30/1.001, 25, 24, 24/1.001
Image format	Progressive

Image parameters defined in ITU-R BT.2199-1 Source: BT.2100 (06/2017)

ITU-R BT.2077-2

The second ITU document relevant for HFR is BT.2077-2. It defines serial digital interfaces for UHD studio signals with 3,840 × 2,160 (4k) and 7,680 × 4,320 (8k) pixel counts, various frame rates up to 120 fps, and 4:4:4, 4:2:2, and 4:2:0 sampling structures at 10 and 12 bit. Single and multilink electrical and optical interfaces are specified for bit rates from 6 to 24 Gbit/s.

DVB-UHD

DVB uses a phased approach for UHD services, taking account of the expectation that services would start at different times. UHD Phase 1 is 'only' concerned with providing more pixels (4k), but DVB phase 2 includes HDR and HFR (up to 120 Hz). The authors of the DVB

specifications anticipated that HDR services would start from ~2017 and HFR in ~2019.

UHD Phase 2 compression is based on the HEVC Main 10 Profile tier, but only 10 bits are supported. The Level for bitstreams depends on the framerate: it is 5.2 for HFR (above 60 Hz), 5.1 otherwise.

Temporal sub-layering for backward compatibility is optional. When used, it allows the sending of a single stream (up to 120 Hz) that can also be decoded by a UHD Phase 1 receiver at half the frame rate. In that case the receiver will simply discard the information necessary to build the HFR stream (e.g. 100 Hz) and only keep what is necessary for the backward compatible (e.g. 50 Hz) stream.

ATSC 3.0

Similar to the DVB approach, the ATSC 3.0 broadcast television standard, originating in the US, also allows frame rates of up to 120 Hz and temporal sub-layering for backward compatibility. In addition, optional temporal filtering has

"Increasing the frame rate used can reduce both motion blur and strobing, resulting in sharper images and an improvement of the perceived picture quality."

been included to mitigate possible strobing during rendering of the backward temporal sub-layer on devices that do not support HFR.

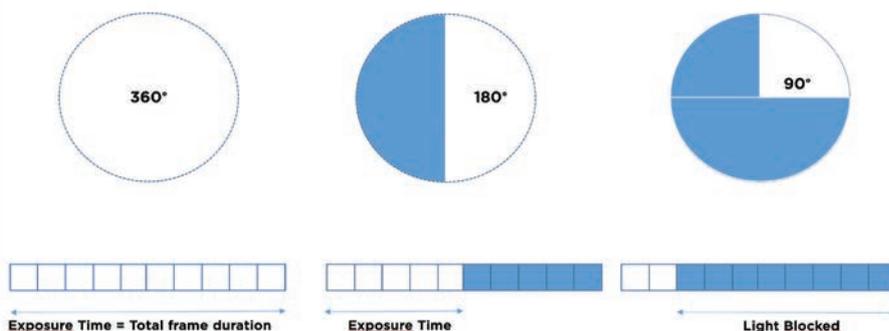
HDMI 2.1

HDMI Version 2.1 is the most recent update of the HDMI specification (2017) and supports a range of higher video resolutions up to 10k and refresh rates up to 120 Hz for UHD. Future generations of television receivers may include the capability to decode images up to 120 Hz, and this will require the use of the HDMI 2.1 specification for receivers.

With the standards ready, it is now up to equipment manufacturers to build HFR support into their products (cameras, mixers, consumer displays, etc.) and for broadcasters to consider where it fits on their roadmap.

MOTION BLUR AND STROBING

For a given frame rate motion blur and strobing can be controlled to a certain extent by changing the exposure period during each frame. This is often referred to as changing the “shutter angle”. The larger the angle, the longer the period the camera uses to record the light coming through the lens. A 360 degree shutter angle combined with a 100 Hz frame rate means each frame is exposed for 10 ms.



A large shutter angle value can produce a high level of motion blur, because any object that moves during the exposure window will appear blurred; the camera effectively combines all positions the object has been at. A smaller shutter angle value reduces motion blur, but it increases strobing; the object appears to jump from one place to the other between frames. The optimal shutter angle thus is a compromise.

Increasing the frame rate used allows both motion blur and strobing to be alleviated at the same time. The choice of frame rate and shutter angle is in practice influenced by a range of factors, such as programme genre (artistic intent), available light, and the amount of motion in the scene.



The EBU created HFR test material at the 2014 European Athletics Championships in Zurich. The sequences can be ordered from: tech.ebu.ch/testsequences



The secret sauce for radio success

THE EBU'S **MARCELLO LOMBARDO** (PROUDLY ITALIAN!) EXPLAINS WHY USING HIGH QUALITY INGREDIENTS WITH A TRIED AND TESTED RECIPE MAY NOT BE ENOUGH TO ENSURE SUCCESS.

Imagine for a moment that you are a restaurant owner whose core proposition is lasagne. Having been in the business for some time you know what goes into preparing the perfect lasagne. It requires high quality ingredients, knowledge of your customers' tastes, culinary skill, love, passion and, of course, "grandmother's secret ingredient" to give it a unique taste.

Nevertheless, even if homemade lasagne is far superior in taste, in this fast-paced world some people prefer to buy frozen lasagne from the local supermarket. It's cheaper than going to a restaurant and it saves them the time and trouble of preparing and cooking one at home. While it's much less satisfying, at least it deals with the hunger.

LASAGNE = RADIO?

Well, at the risk of stretching a metaphor to its limits, the differences between homemade and frozen lasagne are similar to the differences between live radio and on-demand streaming services; one is built with curated and unique programming, while the other – usually cheaper, in some way – is mainly designed to deliver instant gratification.

The question, then, is how do we convince our customers, the listening public, to choose homemade radio

lasagne over frozen on-demand lasagne? And how do we preserve the unique identity of our restaurant in an increasingly competitive marketplace without reverting to an off-the-shelf franchise?

Changing the recipe is not up for discussion: the core product must remain the same and we should aim to avoid lowering the overall quality. Nevertheless, we must acknowledge the fact that audience expectations are shifting towards having the content they like, when and where they want it.

Our restaurateur is left with two courses of action, both of which he should embrace. The first is to improve the tools and the technology, so that it will be easier and faster to cook the lasagne; the second is to market the lasagne more effectively so that potential customers will understand what they are missing when they choose the frozen product.

INTERACTIVE; ADAPTABLE; ACCESSIBLE

So, how we translate upgrading the kitchen and marketing the lasagne

more effectively into the radio domain? There are three pillars: interactivity, adaptability and accessibility.

Improving radio interactivity concerns refreshing the user experience. We want to meet and exceed audience expectations by providing an up to date and consistent listening experience in line with currently available technologies.

Improving radio adaptability implies creating the right tools to make sure that radio can retain a prominent place in new devices for the foreseeable future.

Finally, improving radio accessibility simply means ensuring that the open, equitable, direct link between broadcasters and their audiences is maintained, without the necessity of a third-party gatekeeper.

Summing up, don't give up on your tried and tested recipe – complete with grandmother's secret! – but do move with the times by adding interactivity, adaptability and accessibility. Cook it all in the oven for 45 minutes at 200 degrees and voila! Buon appetito!

The EBU Strategic Programme on Radio brings Members together to collaborate with the wider industry and device manufacturers on improving the user experience for radio. See: tech.ebu.ch/groups/radio

It's voice activation, for crying out loud!

DAVID WOOD SHARES SOME THOUGHTS ON HOW CONTROL OF THE HOME MEDIA EXPERIENCE MIGHT DEVELOP IN FUTURE.



The idea of yelling orders at the television instead of the family is not new. In the 1990s, in the EBU, we were discussing how (what we then called) “intelligent agents” would be the future of television. The viewer would see, on-screen, an artificially generated, sympathetic and agreeable person. She would have a dialogue with the viewer and make suggestions for programmes and channels that the viewer would be likely to enjoy, and then call up the programmes.

“Should broadcasters be worried about voice activation in the long term? The answer is probably yes.”

Today we don't have these kinds of visuals on the television screen helping us, but a close relation, voice activation, is one of the hottest games in town. What has happened over the last two decades? Are there aspects of voice activation that broadcasters should now be concerned about?

FROM CONTROL TO ANSWERS

In recent years voice activation has become the common currency of just about anything that can be electronically controlled. Control of media in the home, including radio and television, can potentially now be achieved by a whole raft of means and devices. There are discrete voice activated remote control units for television – those things that slip down the back of the sofa. There are voice activated plug-in media adaptors – the ones that connect to OTT (over-the-top) television services delivered by broadband, and usually plug into a USB socket on the display. There are also smart TV sets that have voice activation built into them. Finally, there

Ideas from the 1990s – an intelligent agent in the television.



are those voice-controlled intelligent personal assistants – objets d'art that sit on the coffee table, microphone at the ready.

In broad terms, these devices do two things. The first is simple: switch devices and equipment on and off, and change sources and

destinations. The second is more elaborate: provide the user with guidance about what they may like to experience, or answer questions they may have. For this second category you need a more sophisticated device that can convert the incoming voice to text, submit the text to a search engine, return the response, and convert that back to a voice.

In many cases, the basis of the systems for voice recognition is software that uses modes of AI: deep learning and machine learning. We may also be using the mode of computer-to-computer communications, the Internet of Things.

LINGUISTIC CONUNDRUM

Voice control units for televisions are not available in all countries of the world. It's no surprise. There are over 7,000 spoken languages in the world. Covering them all will take some time - even for widely spoken languages. There are 23 languages spoken by (cumulatively) half the world's population. It will be a challenge for voice-to-text conversion and possible translation.

Should broadcasters be worried about voice activation in the long term? The answer is probably yes. Voice activation can become a gatekeeper to content. The device will act on the instructions it has been given about what to do in given sets of circumstances. In some senses, there is someone or something stepping in between the viewer and the content. More than that, voice activation systems are being developed on the assumption that there will come a point in time when they will bring financial gain for the developers. It may be necessary to pay the gatekeeper if you want your content in the public eye. It is likely that you will be paying a company on the west coast of the USA. Maybe you should come up with your own system?

For television the day after tomorrow, perhaps we should be asking whether voice control could be supplemented by or replaced by gesture control? The living room would be a quieter place. And will television sets ever be offering a physical-looking on-screen form of interlocutor, in the way we imagined all those years ago? I have a feeling the answer is yes. What do you think?

Why is audio-on-demand on the rise?

ALONGSIDE THE INCREASED PROMINENCE OF VOICE INTERFACES, THE GROWTH IN PODCASTS OVER THE LAST FEW YEARS HAS PUT AUDIO, AND SPECIFICALLY AUDIO-ON-DEMAND, FIRMLY IN THE MEDIA SPOTLIGHT. **DAVID FERNÁNDEZ QUIJADA**, SENIOR MEDIA ANALYST IN THE EBU MEDIA INTELLIGENCE SERVICE, REPORTS ON HOW RADIO PRODUCTION CAN BENEFIT FROM THIS GROWTH.

Nowadays, embracing audio-on-demand is a must for any radio manager. EBU Members that have already started offering exclusive on-demand content were asked to rank seven perceived benefits highlighted in the industry literature. To that end, a questionnaire was circulated among those in charge of development or production of audio-on-demand services within their organizations.

Two benefits emerged as the most appreciated (Figure 1): the opportunity to supplement their linear offer in genres currently underserved; and promoting new formats that might be seen as too risky for conventional broadcasting. In other words, innovating beyond the current offer.

In this sense, the audio-on-demand sector for radio-like services privileges speech over music – already massively served by streaming services such as Spotify – and bets low on sport, a bedrock of linear radio where liveness is highly valued.

At the same time, some genres and formats seem more appealing

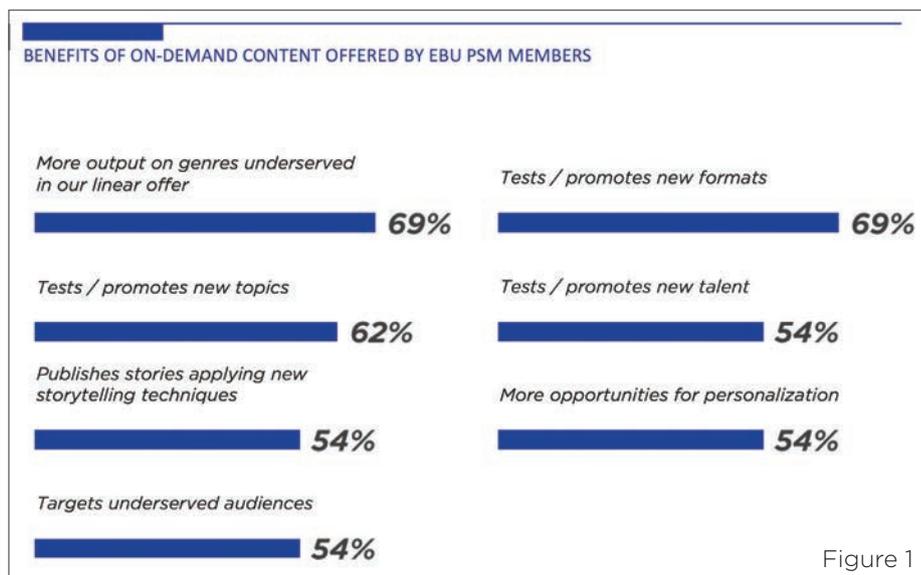


Figure 1

as consumption-on-demand (Figure 2): notably the arts, culture, education and science have found that on-demand gives them the prominence they often lack in linear schedules. They can go into greater depth in their subject and cater to specific communities of interest. The recipe for success among original on-demand creators seems to be focusing on audiences, together with good and in some cases sophisticated storytelling,

good sound design, and powerful imagery.

The next most highly ranked benefit, closely linked to the two already mentioned, is the promotion of topics not covered by their linear channels. The logic is the same: expanding the limits of traditional radio in search of underserved audiences who share an interest in a given topic.

Finally, a slightly lower consensus was reached on another four benefits: promoting new talent, using new storytelling techniques, the opportunity to personalize content – *The Inspection Chamber*, the recent BBC drama for Amazon's Alexa is a good example of both of these – and targeting underserved audiences, notably young adults, who make up the bulk of audio-on-demand listeners and are traditionally hard to reach through public radio.

More information available to EBU Members in the Media Intelligence Service's report Audio-on-Demand at:

www.ebu.ch/mis-publications.

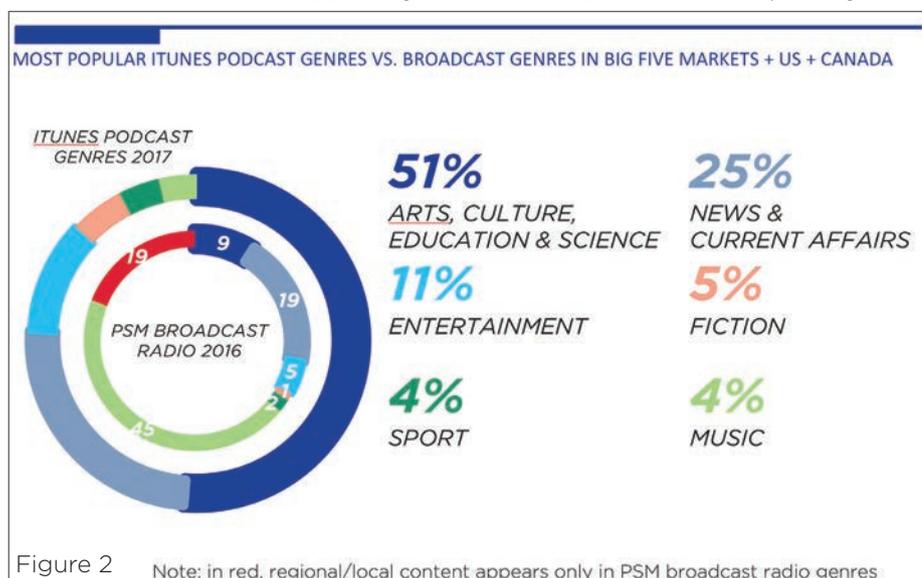


Figure 2 Note: in red, regional/local content appears only in PSM broadcast radio genres

OTT and IP on the DVB World 2018 agenda



DVB World 2018 is almost upon us, writes **Peter MacAvock**, DVB Chairman. The conference, a must for anyone in the DVB community, this year visits Warsaw for the first time. Poland has become a centre of excellence for technology in the media industry in recent years, with a number of major manufacturers and service providers establishing research, development and testing centres in the country.

With DVB embracing the challenges of hybrid television, and even the potential for an all-

broadband future, DVB World 2018 will focus on ground-breaking work in the key areas of live OTT services and targeted advertising. Additionally, the work on candidate technologies for updates to the DVB-T2 terrestrial broadcasting system will be covered, alongside a look at how both cable and satellite services are likely to evolve. We're also looking forward to hearing from one of DVB's luminaries, Prof. Dr Ulrich Reimers, who will ask which of the lessons we have learned in the first 25 years of DVB can help us to shape the next 25 years of digital

television.

DVB's important work on IP continues, notably through the newly established Commercial Module group, DVB CM-I, looking into requirements for standalone live television services over IP. One key partner in this work will be the HbbTV organization, the owner of DVB's preferred hybrid platform. That close relationship will be reflected throughout the programme of DVB World 2018.

Warsaw, 12-14 March 2018. See: www.dvbworld.org

Sharing digital broadcast experiences in Asia-Pacific



Towards the end of 2017, the ABU contributed to a digital broadcasting conference and workshop in Bangkok, writes **Amal Punchihewa**, ABU Director Technology & Innovation. It was organized by the ITU and the National Broadcasting and Telecommunications Commission of Thailand (NBTC) in Bangkok. NBTC is the regulatory body in Thailand and is a member of the ABU.

The idea was to share knowledge

and experience based on work done by the ITU and NBTC on digital broadcasting, including DTT, digital radio and community television. Broadcasting practitioners and policymakers from APAC and ASEAN Member States were also in attendance to exchange their views and experiences of digital broadcasting deployment.

There were over 120 participants from Asia-Pacific countries at the conference, representing a

wide range of broadcast-related organizations. The ABU presented updates on technological and global trends.

The workshop was focused on digital radio, with over 100 participants from across Asia-Pacific. Among the topics covered were masterplans, business models and digital radio broadcast trials. ITU, NBTC and ABU highlighted outcomes from various studies they have carried out.

Amal Punchihewa, fifth from right, with fellow speakers at the ITU/NBTC conference and workshop, 12-13 December 2017 at the Century Park Hotel in Bangkok.



The other spectrum battle: C-band, 5G and the position of broadcasters

BROADCASTERS HAVE BEEN FOCUSED ON THE FIGHT TO SECURE THE UHF BAND FOR DTT, IN THE FACE OF PRESSURE FROM MOBILE BROADBAND SERVICES. A PARALLEL BATTLE, LESS PUBLICIZED BUT ALSO IMPORTANT, RELATES TO THE USE OF THE C-BAND. **ELENA PUIGREFAGUT** (EBU) EXPLAINS.

The C-band refers to the band of radiofrequency spectrum between 3.4 GHz and 4.2 GHz, which is allocated to the Fixed Service (terrestrial radiocommunication service between specified fixed points) and to the Fixed Satellite Service (downlink). European broadcasters with international programmes (e.g. BBC, TVE, RTP) use the part of the band above 3.6 GHz for global satellite distribution of their programmes to the Americas, Asia or Africa. Some broadcasters also use the C-band for fixed links (e.g. RTBF, RAI).

The EUROVISION satellite network makes extensive use of the 3.4-3.8 GHz band for all coverage in Asia/Africa/America. Furthermore, C-band is critical for satellite services in tropical regions as it suffers less from the attenuation effects of heavy rainfall than the Ku and Ka bands. Generally speaking, most C-band use is in the 3.6-4.2 GHz range, with less use from 3.4 GHz to 3.6 GHz.

The EBU has always defended the C-band for satellite services and will continue to do so. Our position is that in the lower part of the band incumbent satellite services need to be protected from interference from mobile broadband and that the higher part should be retained exclusively for use by satellite. Nevertheless, C-band is one of many radiofrequency bands that the mobile industry and regulatory bodies consider as having potential for use by 5G networks. The huge interest in 5G and the fact that satellite use of the C-band in Europe remains limited guarantees an interesting spectrum battle ahead.

THE STORY SO FAR



In January 2018, Deutsche Telekom, Huawei and Intel were among those trialling the use of C-band spectrum for 5G.

As with the discussions around UHF and DTT, it all started at the World Radiocommunication Conference in 2007 (WRC-07). The 3.4-4.2 GHz band was in the list of candidate bands for allocation to mobile broadband services. Nevertheless, regulators gave the priority to satellite services and agreed that other use could be decided at a national level with agreement between neighbouring countries. In Europe regulators started the process of harmonizing the lower part of the band, 3.4-3.8 GHz, for mobile broadband services, with CEPT decisions and associated EC decisions. They kept the higher part, 3.8-4.2 GHz, for exclusive satellite use. Although not optimal, this was a pragmatic compromise for broadcasters.

At WRC-15, the C-band was again on the table for potential allocation, but mobile operators did not achieve their goal of a harmonized worldwide allocation. The band 3.4-3.6 GHz was identified for mobile broadband in Region 1 (mainly Europe, Middle East and Africa)

and Region 2 (Americas); in Region 3 (Australasia and most of Asia) it was identified for certain countries via a footnote. And the 3.6-3.7 GHz band was also identified for mobile broadband in Region 2 for certain countries, again via a footnote.

C-BAND KEY FOR 5G

All seemed crystal clear, but the availability of 400 MHz (3.4-3.8 GHz) in Europe for mobile broadband services makes the C-band very attractive for 5G. Europe has identified it as one of the key bands for the launch of 5G. Some administrations have offered this band for 5G trials this year (e.g. Denmark, Italy, Slovenia) and Deutsche Telekom, Intel and Huawei have already conducted trials in the 3.7 GHz range in Berlin.

The USA is following a similar road (although it isn't always clear who is following who!). The FCC considers what they call the 3.5 GHz band (3550-3700 MHz) as critical for 5G network deployments. It has even gone a little further, opening in August last year a Notice of Inquiry

for ideas on how to optimize the use of spectrum from 3.7 GHz upwards.

The most surprising idea came from Intelsat and Intel, a joint proposal that would allow incumbent satellite operators to collaborate with terrestrial networks on ways to clear the 3.7-4.2 GHz band based on 5G needs and the presence of existing Fixed Satellite Service systems. The proposal, now also supported by SES Global, surprised many because satellite operators have always claimed that spectrum sharing between satellite and mobile services would not be viable due to technical restrictions. Broadcasters have

unanimously rejected it.

In the meantime, some European countries have already prepared an auction process for the C-band. This has involved national consultations (as in, for example, Switzerland) on the principle of protecting incumbent satellite services and focusing on the 3.4-3.8 GHz band only. In the UK the discussions have taken a different turn. The regulator is not so keen on offering protection to incumbent satellite services in the lower part of the C-band and wishes to open the debate on the higher part, the 3.8-4.2 GHz band. (In fact, Ofcom has already announced that

a consultation will open this year.) While for now this concerns only the UK, it is conceivable that a similar approach could be taken elsewhere in Europe, such is the enthusiasm for 5G.

As we prepare for WRC-19, it is essential for broadcasters to make their voices heard. While 5G holds much promise for media distribution, C-band remains a valuable resource for the core activities of many EBU Members. You are encouraged to join the discussions by engaging with our Strategic Programme on Spectrum. See: tech.ebu.ch/spectrum

IN THE SPOTLIGHT

Richard Waghorn

DIRECTOR OF TRANSFORMATION AND TECHNOLOGY, RTÉ, IRELAND

WHAT ARE YOUR CURRENT RESPONSIBILITIES AT RTÉ?

I look after the technology strategy and the delivery of technology services to all users, as well as the free-to-air DTT platform, Saorview. I am also leading the transformation programme as we move towards becoming "One RTÉ".

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

Can I have three? I have played a leading role in the launch of three free

TV services - Freeview in the UK, Freesat in the UK, and most recently here in Ireland, Saorview Connect – our free internet-connected product for the DTT platform.

WHAT ARE YOUR PREDICTIONS FOR MEDIA TECHNOLOGY IN THE FUTURE?

In the immediate future it is about moving to cloud. Last year we went live with our private cloud and now the vast majority of our applications (including playout automation) are running in the cloud. Longer term, I

believe AI and blockchain are going to have huge positive impacts for production and distribution, but maybe it is too soon to tell.

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

From a technology perspective, the main challenge is dealing with legacy infrastructure. Over the last few years we have been working hard to simplify and de-risk our technology environment, making it more agile and flexible to support business demands. But we have more to do, as the other challenge RTÉ faces (like many EBU members), is funding!

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

Ever since I went to Morocco as a teenager and hiked up the highest peak in the Atlas mountains, I have loved travelling and exploring. So far I have clocked up visiting 90 countries but there so are many more to see. I really enjoy wildlife photography and have been fortunate enough to photograph lots of animals in their natural habitat. You can see my photos online at richardwaghorn.com.



