

tech-i

IP production & ST 2110: it's elementary!

Plus

- SRF'S ALL-IP OB TRUCK
 - SPECTRUM STILL AT RISK?
 - GRADE 1 MONITORS FOR UHD
- and more...*

- 3 Digital Radio Week
- 4 PTS 2018; HbbTV
- 5 IMF report; Open Source Meetup
- 6 WRC-19 preparations
- 7 Cloud security
- 8 Introducing SMPTE 2110
- 10 IP-based OB truck
- 12 NRK's Origo
- 14 Project Kelvin
- 15 Media consumption trends
- 16 David Wood on UHD flavours
- 17 Updates from DVB and ABU
- 18 Grade 1 monitors
- 19 In the spotlight: Bruno Tézenas du Montcel

Cover Story: The publication of SMPTE ST 2110 represents another significant milestone on the road to fully IP-based production. Willem Vermost introduces the new standard (page 8) and we learn how Switzerland's SRF is taking on the orchestration challenge (page 10).

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Investing in content and technology

Simon Fell, Director, EBU Technology & Innovation



In the last issue of tech-i, I referred to some of the cloud and machine learning tools that are emerging in our business. Since I wrote those words we've had IBC 2017, where the wisdom seemed to be that the cloud, AI and voice user interfaces were the most important areas of innovation. While the first two are undoubtedly making inroads, I have yet to see any broadcasting equipment controlled by voice. (By the time you're reading this, we may have learned more at the EBU Cloud Intelligence Seminar – tech.ebu.ch/cis.)

What I think we can say for certain is that, for broadcasters, digital transformation is moving to the mainstream. Broadcasting, in all its forms, is still the primary means of accessing the great radio and television content produced by EBU Members. However, eyeballs and ears are being diverted to new platforms where attractively (re-)packaged content entices the audience.

A recent study by our Media Intelligence Service found that in 2016 EBU Members spent a total of €18bn on original programming – in many different languages of course. In the same period, the big tech companies invested €10bn in programming, albeit globally promoted and primarily in English. This investment by Big Tech in the production of television content – mainly drama – with corresponding increased promotional budgets, has caught the attention of viewers and media executives alike. However, for sheer diversity and volume of television and radio produced weekly, EBU Members have much to offer their citizens. We should reflect on the value for money delivered by public service media before we all get carried away with the glossy new services.

Still, we should not be complacent, and it is encouraging to see the diversity of online and digital offerings from our Members. Investment in digital content is a difficult bet since, at this stage, the returns are not as obvious as they are with the mass audiences drawn to big television shows. Nevertheless, digital content is where the energy and investment are headed, with all broadcasters chasing audiences on the various social media platforms and digital outlets. This is where technology can play a role in providing new ways to immerse the audience in content.

We have recently seen some cracks appearing in the VR veneer, with Nokia pulling out of further VR camera development. AR – augmented reality – is now seen as the next big thing: just watch the innovation swerve to follow that path over the next year. We have seen some great demonstrations, some of which require the skills of a 3D Post VFX house to pull off and others that emulate or even replicate the cool tools championed by the likes of Snapchat. Where this leads for audience interaction we have yet to see, but I'm intrigued to see what great content ideas emerge in future.

All of this primes us for the era of Mixed Reality: even more SFX but with holographic characters inserted into the scene. Quite a challenge for production with extensive render times and limited flexibility, however it truly does deliver an immersive experience.

That said, I wonder whether it's all getting too complex and too much like hard work for the poor audience. "Alexa, turn on my big screen and put on Blue Planet II. Oh, and while you are at it, order me a pizza!" Now that does sound immersive!

Digital Radio Week: an innovation destination

Since 2010, the EBU's Digital Radio Week has been an annual highlight for innovators in radio technology, writes Ben Poor. The 2018 edition promises to be bigger and better than ever.

It will start on Monday 12 February, with the popular **RadioHack**, a two-day event that brings together "hackers" from across Europe and beyond, to collaborate intensively and produce prototypes of new ideas. Whether you're handy with a soldering iron or have an amazing concept for the future of radio, it's a great place to find like-minded technologists.

The centrepiece of the week is the **Digital Radio Summit** on Wednesday 14 February, where the future of digital radio across broadcast and broadband will be covered. The theme this year will be



“a new and fresh user experience”. With more competition to traditional radio listening than ever, what will radio have to do to survive and thrive? This theme is also picked up by the **RadioDNS General Assembly**, with the Hybrid Radio experience now becoming part of the mainstream for many devices, including for automotive.

The week will conclude with a brand-new event for EBU Members, a **Radio Archive Workshop**. Archives can sometimes be seen as

a challenge. This interactive event will share best practice and ideas for technologists and content producers alike, in order to be able to transform archives into a valuable asset for audiences.

When it comes to innovation in radio technology, platforms and services, the EBU Digital Radio Week offers something for everyone.

Digital Radio Week 2018 runs from 12 to 15 February. Information and registration: tech.ebu.ch/radio2018

EBU recommendation on digital radio updated



EBU R 138, on Digital Radio Distribution in Europe, has been updated. Since it was first published in 2013, the recommendation has served as a key guideline on the digitization of radio services.

The main thrust of the update, overseen by the newly re-formed Strategic Programme on Radio, is an emphasis on better engaging current and future audiences through an enhanced service offering. A lack of available spectrum means that this is not possible with analogue services in most countries. Digital radio, on the other hand, allows broadcasters to create new services and provide new content, especially when using

a combination of broadcast and broadband.

As consumption patterns for both linear and non-linear radio change, there is a growing need for new user experiences. This includes experiences that can be delivered over broadcast, such as visuals, text, station branding and programme guides. But public service media should also explore and exploit the potential for new service offerings on broadband-enabled devices.

To ensure that radio remains open to all and that broadcasters can keep a direct link to their audiences, the use of open standards is vital both for the audio and for the new user experiences. Consequently, R 138 recommends the use of the RadioDNS open standards for hybrid radio.

Smarter content creation at PTS 2018

We have really been pushing the limits at the EBU Production Technology Seminar, *writes Hans Hoffmann*.

Always a key fixture in the calendar, our challenge has been to keep pace with the massive technology developments that are transforming and disrupting our industry.

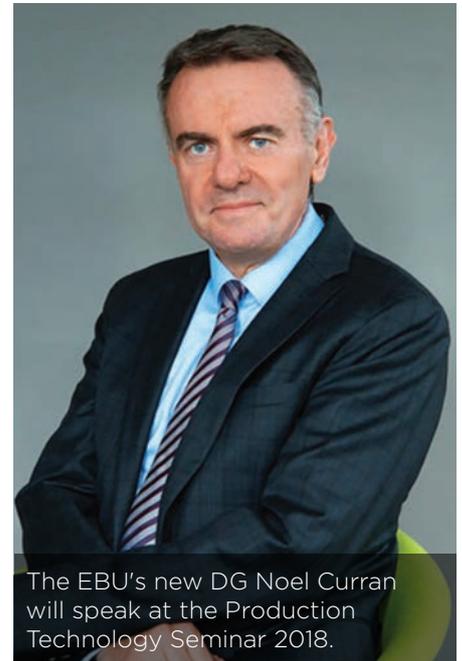
PTS has been bursting at the seams in recent years: squeezing more presentations and use cases into the programme, more attendees into the room and more technology demonstrations into the building. While we can't make our excellent conference room any bigger, we have managed to find more space for demos. And we've also decided to make the event a little longer, continuing into the afternoon of the third day.

We have a wide and varied programme once again for PTS 2018. We will hear about some of the innovation strategies that are underpinning technology

developments at Members; we will examine AI, machine learning and deep learning to see what impact they might have on programme production; we will catch up on Live IP developments, with the arrival of SMPTE ST 2110 and progress towards dematerialized facilities; and we will hear about advanced workflows in immersive video, audio and radio production. I'm particularly looking forward to the results of the latest experiments on new video compression formats.

Our popular tutorials will feature once again, with HDR, advanced sound systems, data science and augmented reality on the menu. We're also cooking up many exciting tech demos – check the website for details.

As always, EBU Members and their R&D centres will be well represented on the programme, along with valuable contributions from elsewhere, including Amazon Studios. And we're looking forward



The EBU's new DG Noel Curran will speak at the Production Technology Seminar 2018.

to hearing from the EBU's new Director General, Noel Curran (pictured), who will share his vision for media creation.

Don't delay in reserving your space! See: tech.ebu.ch/pts2018

HbbTV comes of age



If the buzz at the recent HbbTV Symposium was anything to go by, HbbTV is coming of age, *writes Peter MacAvock*. Among the 250 people who gathered in Rome were application developers showing their latest innovations, consumer electronics vendors and broadcasters.

HbbTV is now the cornerstone interactive technology for DVB services. Spawned from DVB's MHP – a technology ahead of its time, but widely deployed in Italy and in cable services – HbbTV is installed in almost all connected television sets and has seen significant success in many

markets. Germany was the pioneer and HbbTV's success has seen both UK, where MHEG-5 is commonplace, and Italy, where MHP still dominates, lay down aggressive plans to migrate their interactive television services to HbbTV.

This year's symposium included the first showing of the HbbTV Awards. The competition drew applications from around the world in categories ranging from innovative use of the HbbTV specifications through to compelling marketing propositions for encouraging take up of the technology. The Judges' Grand Prize was awarded to Tivù for 'a collection of shortlisted entries using many of the latest HbbTV features'. In addition to the awards, other highlights of the symposium included a round-up of HbbTV around the world, the latest developments from the organization itself, and how it might address the GDPR directives coming into force in 2018.

DVB retains a close liaison with HbbTV, jointly funding the development of testing and interoperability tools for the DVB-DASH specification and jointly organizing promotional activities.

IMF: Interesting for Members in the Future

The EBU has published Technical Report 040, an evaluation of the Interoperable Master Format (IMF) for use by broadcasters, *writes Frans de Jong*. The report is the result of work performed in the EBU IMF-TV group, with support from the Digital Production Partnership (DPP) and North American Broadcasters Association (NABA).

“IMF is an internationally recognized SMPTE standard for the interchange of file based, multi-version, finished audio-visual content [but] currently IMF is not on the radar of most EBU

members” the report states. This is especially because most broadcasters do not have complex versioning requirements and use codecs that are not standardized for use with IMF, such as AVCUltra, DNxHD, XDCAM-HD422 and ProRes.

However, the format is seen to have strong potential for future media workflows for a number of reasons, including growing OTT offerings, the addition of ProRes as an IMF supported codec and the new side-car mechanism, which will allow additional files and data to be associated with IMF. Broadcaster

workflows could also benefit from easier audio mapping and IMF's support for increasingly popular access services, such as subtitling.

The IMF-TV group will now focus on providing assistance to Members who want to use the format to solve workflow problems. This may be done by supplying test material, by sharing best practices on legacy format support and by providing an overview of products that already support IMF.

The EBU will also host the IMF User Group meeting on 2 February 2018. See: tech.ebu.ch/imf

Open source moving to the mainstream

The EBU has long had a commitment to the benefits of open source for broadcasters, *writes Ben Poor*. Our Open Source Meetup at IBC has, from humble beginnings, grown year-on-year to the point where this year more than 100 visitors and exhibitors attended the gathering. It provides an opportunity for a catch-up on the latest developments in open software-based solutions for media. The popularity of the meetup reflects the fact that the use of open source in professional production workflows has moved into the mainstream for more and more broadcasters.

Broadcasters and other media organizations can benefit both from using open source projects and from sharing their own work. Sharing is not only good publicity; it takes advantage of a wider community – contributing bug fixes, extra test cases, documentation, extensions and integrations with other systems. It can even be a highly effective means of identifying future development and innovation talent, and catalyse an internal innovation culture that can

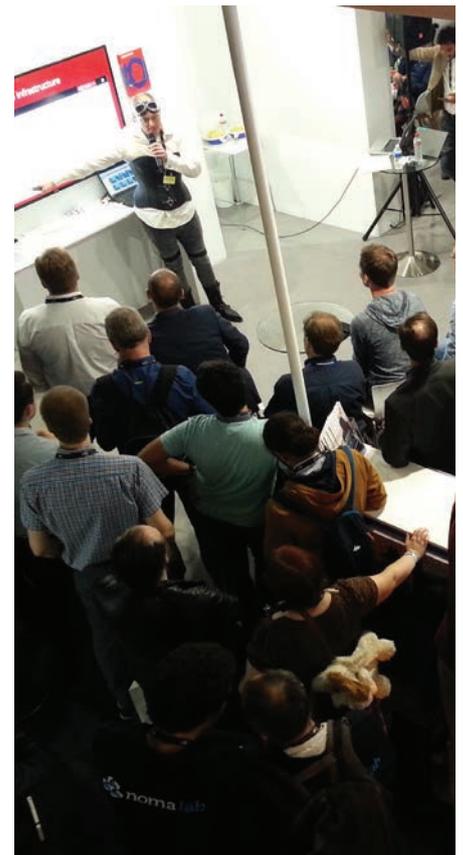
work across departments.

At our IBC gathering, a set of lightning talks offered ample evidence of the tangible benefits for broadcasters and vendors alike in looking to open source. This year's talks clustered around production workflows and video coding, with both new initiatives and updates on familiar projects. Contributions from EBU Members were to the fore, with NRK, Swedish Radio, RTS, BBC and CBC/Radio-Canada among the presenters.

SPREADING THE WORD

The specific application of open source for broadcasters was also part of the EBU contribution to the recent ASBU Week of Technology in Tunis. Presenting some of the motivations for looking at open source components for production workflows, we provided an overview of some of the higher profile projects that broadcasters elsewhere have embraced.

This included tools for audio (Audacity, FFmpeg) and video



(CasparCG, Blender), as well as a complete open digital radio broadcasting platform (www.opendigitalradio.org) that is powering a number of low-cost DAB+ transmissions across Europe.

Download the slides from our IBC 2017 Open Source Meetup: tech.ebu.ch/osm2017

Expecting the unexpected at WRC-19

A UNITED FRONT FROM BROADCAST ORGANIZATIONS HAS ENSURED THAT UHF SPECTRUM IS PROTECTED FOR NOW. THE THREAT, HOWEVER, HAS NOT GONE AWAY. THE EBU'S **WALID SAMI** AND **ELENA PUIGREFAGUT** EXPLAIN WHY.

During past ITU World Radiocommunication Conferences (WRC), broadcasters have strongly defended the 470-862 MHz band, the UHF spectrum dedicated to digital terrestrial broadcasting services.

Allocating part of this spectrum to mobile services for IMT (international mobile telecommunications) applications implies the release of the bands from broadcasting, since sharing the spectrum between IMT and other services is extremely difficult. At WRC-07 and WRC-12, successive identifications for IMT in the range 694/698 MHz to 862 MHz led to a loss for broadcasters of around 43% of this spectrum.

In Region 1 – mainly Europe, Middle East and Africa – great success was achieved at WRC-15, where administrations agreed to retain the 470-694 MHz band for broadcasting services and to review the use of the whole 470-960 MHz band only at WRC-23, pending confirmation at WRC-19. In the rest of the world only a handful of countries in Regions 2 (Americas) and 3 (Australasia and most of Asia) added the identification of the band or part of the band (the so-called 600 MHz band) for IMT, by means of footnotes to the table of frequency allocations. The key to our WRC-15 success was the cooperation of the broadcast industry across the world. As we begin preparations for WRC-19, it is time to question whether this



success will be threatened.

OFF THE AGENDA

The WRC-19 agenda does not include any item related to the UHF band. Studies for further allocations to the mobile service and identification for IMT applications (including 5G) are looking at frequency bands above 24 GHz.

Yet there are several signs of increasing pressure to open the subject of IMT allocation in the UHF band at WRC-19. Direct consideration would require a modification of the agenda, which is difficult at this stage, although not impossible. Another possibility for administrations at WRC-19 is to try adding their names to newly created footnotes, where applicable.

It is certain that the most efficient way to secure the allocation to broadcasting in the UHF band is to *use* the band, deploying digital terrestrial television (DTT) networks that meets the needs of citizens.

However, in many parts of the world,

DTT deployment is slow, because of financial constraints, lack of technical expertise or organizational difficulties. It is therefore important for public service media (PSM) and commercial broadcasters that still rely on the terrestrial platform to make sure that their administrations are aware of their plans for using the UHF band for DTT and possibly for programme-making and special events (PMSE) purposes.

In Europe the EBU works to keep the UHF band as a basic resource as DTT is considered a pillar of the distribution strategy of PSM organizations. At the same time, the EBU supports relevant development and standardization activities, in particular in DVB and 3GPP, to ensure that future networks, both broadcast and fixed/mobile broadband, are capable of meeting PSM requirements.

More globally, the World Broadcasting Unions Technical Committee has published the position that any further reallocation of UHF spectrum would lead to an additional reduction of services available, possibly fatally weakening the terrestrial television offering in some countries.

GET INVOLVED

The Strategic Programme on Spectrum is preparing EBU positions for WRC-19. See: tech.ebu.ch/spectrum

How to secure a cloud

THE SHIFT TO THE CLOUD IS WELL UNDER WAY, BUT THERE ARE REAL SECURITY CONCERNS. **ANDREAS SCHNEIDER** INTRODUCES R 146, THE NEW EBU RECOMMENDATION THAT GUIDES BROADCASTERS THROUGH THE MINEFIELD.

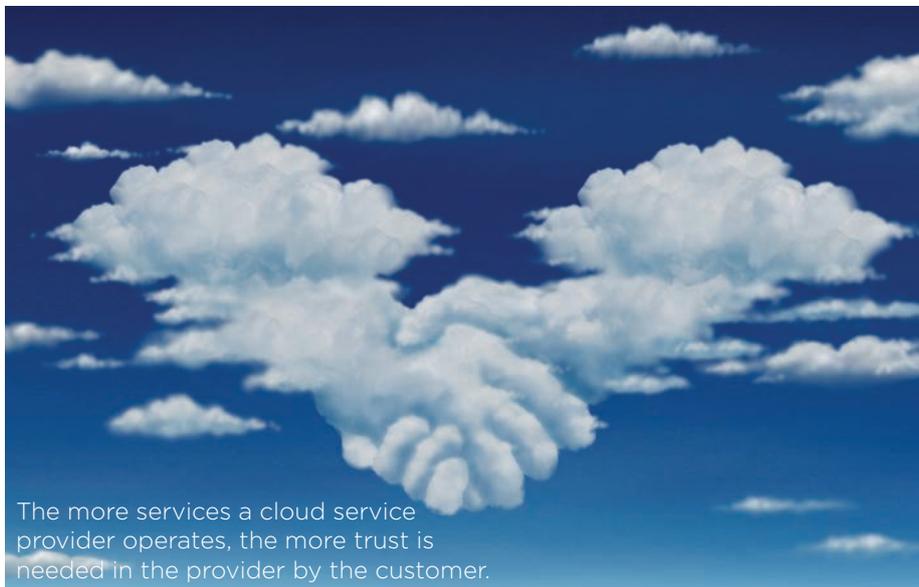
The broadcast industry is undergoing a tremendous technological change. The familiar green SDI cables are disappearing; new market players offer services exclusively over the internet. We are witnessing the decline of traditional broadcast along with a shift to broadband, driven by customer habits and the business itself. For the IT industry, the cloud is the next logical and evolutionary step to a highly standardized service model; for the broadcast industry it is a revolutionary step, as it removes many technological boundaries that limit the way that most media companies produce and offer content.

DISTRUSTING THE CLOUD

Driven by business needs and cost, cloud services are often quickly and autonomously adopted by business departments, leading to their uncontrolled usage. For most information security professionals, this is one reason why the cloud symbolizes the decline of control and data privacy. Broadcast engineers tend to distrust these new technologies because decades-long experience with physical systems is no longer there.

The more services a cloud service provider operates for the cloud customer, however, the more trust is needed in the provider by the customer. The amount of trust required increases even further as the importance of the data being processed or the service provided increases.

EBU R 146*, concerning Cloud Security for Media Companies, will help media companies to get ahead of this development and keep control over the “cloudification” of their data and technology. It describes typical deployment options usually offered by today’s cloud service providers, ranging from IaaS (Infrastructure as a Service) to SaaS (Software as a



The more services a cloud service provider operates, the more trust is needed in the provider by the customer.

Service), and how to put them to use based on business needs. EBU R 146 gives guidance on how to classify internal data and on how to assess cloud service providers. It also provides an architectural overview regarding security as part of cloud services design or during the migration of services to the cloud. Offering a basic cloud adoption procedure which can easily be followed and applied, it allows for a targeted risk analysis of cloud services and cloud service providers.

R 146 IN PRACTICE

If we take, as an example, a media company that considers taking its transcoding service into the cloud, EBU R 146 can be used as a practical guide for the required steps of assessment and evaluation, and for the decision-making process.

First, the company in question needs to know which specific data will be processed, and how sensitive this data is in terms of data classification. This classification determines regulatory requirements regarding data privacy, protection of journalistic sources, and so on. EBU R 146 helps the company to identify

the cloud service providers which fulfill the architectural and regulatory requirements, taking the internal assessments into consideration.

Once a suitable cloud service provider has been found, our example media company must assess which new threats apply to the service being operated in the specific cloud environment. For finally choosing the appropriate security measures to implement, the needed service quality and compliance, EBU R 146 provides a range of options and guidance on how to combine them adequately.

The shift to the cloud is happening and cannot be avoided or ignored. EBU R 146 is a useful tool to actively manage this change based on well-elaborated standards.

**EBU R 146 should be read in conjunction with EBU R 143, Cybersecurity for Media Vendor Systems, Software & Services, and EBU R 144, Cybersecurity Governance for Media Companies.*

Andreas Schneider is chief information security officer for SRG SSR in Switzerland and chairs the EBU’s Strategic Programme on Media Security.

SMPTE ST 2110: how far does it take us?

SMPTE ST 2110 IS THE FUNDAMENTAL STEPPING STONE TOWARDS IP-BASED LIVE PRODUCTION. BUT, ASKS THE EBU'S **WILLEM VERMOST**, WHAT DOES IT ACTUALLY DELIVER FOR BROADCASTERS?

The challenge of doing *more* with *less* – to produce more content with fewer resources – is not new for broadcasters. Many new platforms have become relevant for broadcasters, requiring *more* content. These platforms support new media formats; and broadcasters that want to remain relevant and competitive need to be able to adopt and adapt these new formats at a faster pace than ever before.

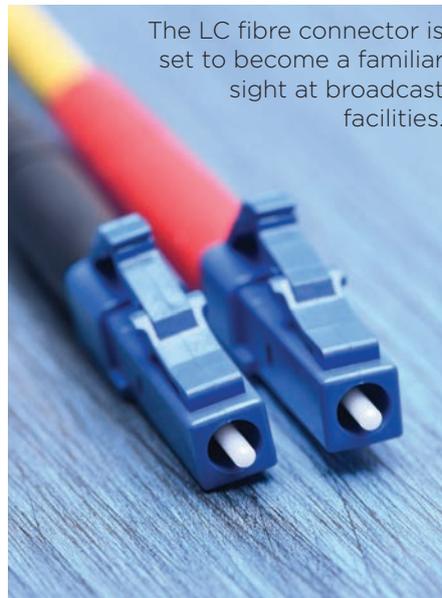
This means public service media (PSM) organizations should be making content targeting any resolution on any device at any time, to be capable of maintaining a presence on all relevant platforms. *Less* can mean a reduction in budget, time or staff resources. However, resources can only be reduced by so much while the pressure to produce more content rises.

PSM need to find new ways to increase efficiency and effectiveness in production. Most notably, new technological solutions are needed to automate processes and enable new and better automated workflows.

HOW TECH CAN HELP

In the world of telematics, a layered approach is nothing new. The Open Systems Interconnection (OSI) model shines as a bright star over the challenge. The idea of having a network that is not aware of the content it transports – resolution, frame rate, colour schema, etc. – is beneficial. As an example, we could think about the move from SD to HD. In the absence of an OSI approach, this resulted in cumbersome projects, ripping out complete infrastructures from the video mixer until the last cable.

To adopt an OSI model in broadcasting, we turn to a well-known



The LC fibre connector is set to become a familiar sight at broadcast facilities.

technology, used on a massive scale and therefore developing quickly: IP. Looking at the roadmap provided by the Ethernet Alliance, 400 Gbps will be standardized this year and the breathtaking prospect of Tbps has appeared on the horizon.

Our answer, then, is to move SDI as we know it to IP. In the contribution and distribution domain this step was taken by introducing SMPTE ST 2022-6. This standard encapsulates SDI into IP packets. A few successful proofs-of-concept were built, with the best known – VRT's Live-IP Studio – even using this contribution standard in a live production area.

It's not only video that SDI transports. It ties the video to embedded audio and ancillary data. This can result in a loss of efficiency of up to 39% of the bandwidth. It became obvious that we needed to move away from this concept and start thinking about the transport of all the individual elements (video, audio, ancillary data).

ELEMENTARY STREAMS

And so it was that media engineers

from around the world made the pilgrimage to room E106 at the RAI exhibition centre during IBC 2017. They came to bear witness to the 19-inch racks housing the collective efforts of more than 50 vendors to demonstrate real-world IP interoperability based on the “to be” SMPTE ST 2110 standard suite and AMWA NMOS specifications – a single set of common IP interop standards and specifications to enable the flexibility and efficiency of IP in real-time media.

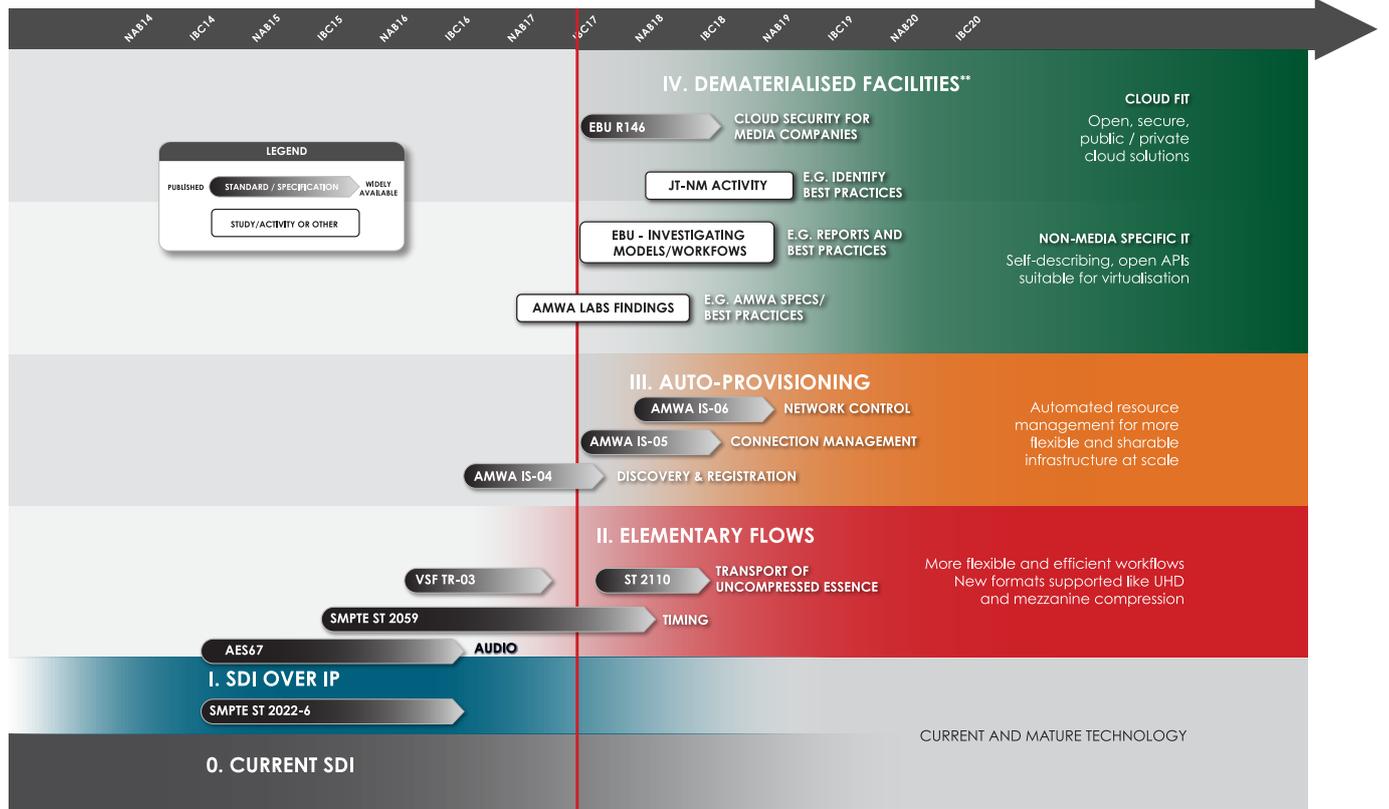
Before anyone could complain about the fact that they had made a similar pilgrimage to Las Vegas just six months earlier, for NAB 2017, and still the standard had not been finalized, the official announcement was made: “SMPTE Approves ST 2110 Standards for Professional Media Over Managed IP Networks”. Joy to the world, we have elementary streams!

WHAT 2110 IS...

The SMPTE 2110 standard is a suite of documents. These documents describe the transport of elementary streams over managed IP networks.

- SMPTE 2110-10 - System Timing and Definitions
- SMPTE 2110-20 - Uncompressed Active Video
- SMPTE 2110-21 - Traffic Shaping and Delivery Timing for Video
- SMPTE 2110-30 - PCM Digital Audio
- SMPTE 2110-40 - Transport of SMPTE Ancillary Data

The first document describes the basics and ties all the documents together. It specifies the general requirements of the IP streams, the use of RTP, the calculation of the timestamp, how SMPTE ST 2059 PTP timing is used for SMPTE ST 2110 and a few other common



**Additional information on Dematerialised Facilities at jt-nm.org. * JT-NM assumption as of August 2017 and will evolve over time. Visit JT-NM.org for the latest update. Feedback to jt-nm-info@videoservicesforum.org

JT-NM roadmap of networked media open interoperability.

specifications.

SMPTE ST 2110-20 is based on IETF RFC 4175 (RTP Payload Format for Uncompressed Video). It describes the packing of the active video into an RTP stream. There is support for different colour sampling, HDR, HFR and WCG, and it supports resolutions up to 32k x 32k.

The most theoretical part of the whole suite is SMPTE ST 2110-21, which constrains the packet delay variation of a sender in order to protect the network from dropping packets.

The elementary audio flow SMPTE ST 2110-30 is based on AES-67. It allows many things, but a few are mandatory to support: a sampling frequency of 48 kHz, a packet time of 1 ms, one to eight channels per stream and 16 and 24 bit depth.

AND WHAT IT IS NOT...

Just having elementary streams is not enough to fulfil a simple use case like: “I want to connect a camera to a monitor and I immediately see a picture”. For a fluent experience,

extra functionality is needed. This functionality is part of separate layer called auto-provisioning, not covered by ST 2110.

As with SDI, when plugging a camera into a monitor you would expect it to simply work. Devices on a computer network need to get an IP address, to be setup with a multicast address they are allowed to use. To make this happen, the network needs services like discovery and registration, connection management, etc.

In order to have a reliable network, centralized logic is needed to control the video path through the network. Open specifications are available or being developed for these purposes: AMWA IS-04, AMWA IS-05 and AMWA IS-06. This layer is key to dealing with the challenge of workflow automation. Without open standards or specifications this layer will be the ultimate vendor lock-in.

DEMATERIALIZED FACILITIES

As we tend to say during each IP Master Class, the move to IP is not just about changing to some fancy

new technology. (Indeed, IP is anything but new!) Beyond SMPTE ST 2110 and the activities around auto-provisioning, are the studies around “dematerialization” of facilities. The goal is to shift to being scalable, flexible and shareable, in order to be able to remain relevant. If we think about shareable infrastructure, we think about the way the IT industry shares resources. They virtualize functionality and spin it up whenever it is needed. Overnight, CPU cycles could be used to transcode. During the day the same CPU cycles could be used to act as a video mixer. Expanding a broadcaster’s facility would be nothing more than adding compute power.

Work on the bigger picture continues. SMPTE ST 2110 paves the way towards a fully IT-based media facility. It is IT, but not as we know it. The fact that it is based on multicast and uses a massive amount of bandwidth demands careful network design and control. It is the fundamental stepping stone towards IP-based live production.

On the road to a full IP broadcast facility

SWITZERLAND'S SRF WILL MOVE INTO ITS NEW BROADCAST CENTRE IN 2019. TO GAIN THE NECESSARY KNOWLEDGE FOR MOVING TO AN IP-BASED PRODUCTION ENVIRONMENT, BROADCAST SERVICE PROVIDER TPC DECIDED TO START BY CREATING THEIR FIRST FULL-IP OB TRUCK. TPC'S **SANDRO FURTER** TELLS THE STORY..



The new SRF broadcast centre in Zurich, scheduled to open in 2019.

How can we avoid sleepless nights for the engineering team when they must build a full-IP broadcast facility? This question stands at the beginning of the roadmap for Metecho, the project to build a new campus building for Swiss public broadcaster SRF. tpc, as a subsidiary and technology leader in broadcast, will realize this challenging full-IP project, including several studios, postproduction facilities, new nationwide MCR and a centralized ingest and playout centre.

In autumn 2019, the new broadcast facility for SRF, SRG and tpc will open its doors. Based on a full-IP

solution using SMPTE ST 2110, all broadcast production for news and sport will be handled on a completely new IP infrastructure. Before the Metecho project began, tpc had decided to develop its knowledge in IP during the period when ST 2110 was still evolving. Our experts joined several technology groups, including the ST 2110 drafting group and AIMS.

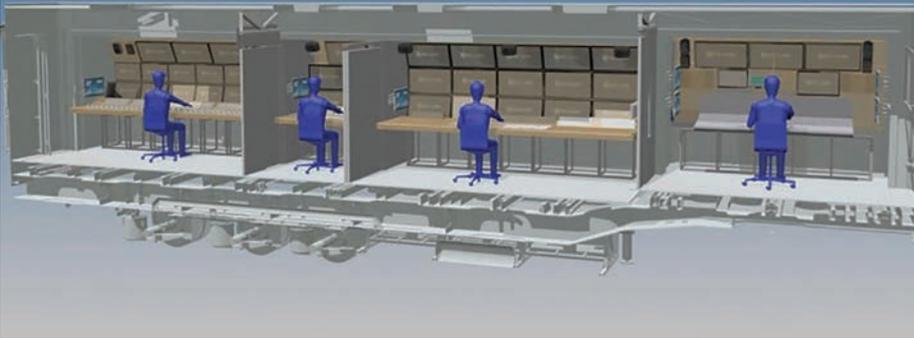
LAB VS. REAL ENVIRONMENT

Following research at NAB and several visits to proofs-of-concept, we decided we would not build our

own IP lab; instead we would build a new OB truck in full IP. The new vehicle, called UHD-1, is set to go into operation in Q1/2018 and will be completed in full IP based on ST 2110. It will be the biggest OB truck in the tpc fleet, carrying core technology from Imagine Communications, Arista and many others.

One of the goals of this project is to get operational feedback from production people on an IP-based vehicle. This focus on a real IP environment is the enabler for the next step: How do we orchestrate an IP facility? How do we measure?

The UHD-1 OB truck will be on the road in 2018.



Which training do we need for our technicians and operators? An IP lab would help us answer a few of these questions, but going on air with a full-IP truck is much more useful for our next project. What we have learned from the engineering and architecture design of UHD-1 is being transferred to the design in Metecho. UHD-1 is thus our real-world lab for the transition to IP.

FOCUS ON ORCHESTRATION

“Interoperability is a must!” With this maxim we started our full-IP approach. We have not focused on testing ST 2110 devices as we believe in a robust implementation of the standard by the vendors. What we need is the framework behind the new standard: how do you orchestrate a complex IP environment?

We raised a lot of questions during our workshops and came up with challenges for our vendors. We miss a lot of functionality in solutions available on the market today. Three main topics we have identified are audio handling, device management and security.

As Switzerland has four official languages, we see great potential in using essence streams for audio, planned as of today to appear in ST 2110-30/-31, with 2- or 6-channel configurations. The handling of these audio flows, including a metadata concept, is a challenge and we’re still searching for the right solution for that.

For device management we had

plans to use NMOS, but as of today there are no finalized solutions available on the market. Since our project schedule does not allow us to wait until NMOS is standardized and implemented by vendors, we will build our own solutions and look for a flexible orchestration system that is able to handle device management, including discovery, configuration management, IP multicast configuration and stream management.

The focus on security is not about hardening our IP network against attacks. We believe that misconfigurations and malfunctions have a bigger impact on security and reliability and we are thus trying to find the right solutions to secure the operations of our IP network.

TECHNOLOGY CERTIFICATION

To prove what we have seen during the past months, we decided to organize a challenging TCS – a Technology Certification System in the studios of tpc. Nine vendors had

the chance to present their solutions for an orchestrator in a strictly defined scenario. Two networks, one from Arista and one from Cisco, served as a basic infrastructure beside PTP and legacy signals. How do the vendors interact with this IP network provided by us? How do they integrate new devices, and how do they control them?

After announcing the TCS, we held a three-week staging period and received the proposed solutions of six vendors on site at tpc. The short time frame for staging and configuration resulted in a good overview of the market, and we are now able to understand the readiness and openness from the different vendors seen during the TCS. With this additional knowledge and behind-the-scenes insight, we came to a conclusion: the orchestrator we are looking for is not yet there. This led to the decision to seek in the next step (TCS Phase 2) potential partners who are interested in creating a flexible orchestrator suited to our needs.

WHAT’S NEXT?

By the end of Q1/2018 we will evaluate potential partners for delivering the orchestrator for the real-time network. We have defined a catalogue of functional requirements for the orchestrator, the broadcast controllers and the common network architecture. TCS Phase 2 will hopefully give us the right answers so that the period of sleepless nights will end soon. This milestone will mark the point of no return: the final decision to go full IP – or to end up with a mess of green SDI cables!

ABOUT TPC

tpc switzerland ag is responsible for production and technology for television, radio and multimedia for SRF (Schweizer Radio und Fernsehen). It is a subsidiary of SRG SSR and is Switzerland’s leading broadcast service provider, with extensive expertise in planning, creating and managing audiovisual projects, also for external clients. With a staff of 900, tpc has its own state-of-the-art studios, workshops and mobile resources that provide the foundation for quality solutions that combine innovation with the best in technology.

The automagical workflow at NRK

NORWEGIAN BROADCASTER NRK IS COMPLETELY TRANSFORMING ITS PRODUCTION AND PUBLISHING WORKFLOWS. THE ORIGO PROJECT HAS ALREADY DELIVERED IMPRESSIVE RESULTS, SAYS **GEIR BØRDALEN**, HEAD OF INVESTMENTS.

Sometimes we need new tricks to solve old problems. And broadcasting is full of old problems that need new magic. Technology sometimes feels like magic. Arthur C. Clarke (co-writer of 2001: A Space Odyssey) said that “Any sufficiently advanced technology is indistinguishable from magic.” So, what is “advanced technology”? And how do we make it “magical”?

THE HARD WORK

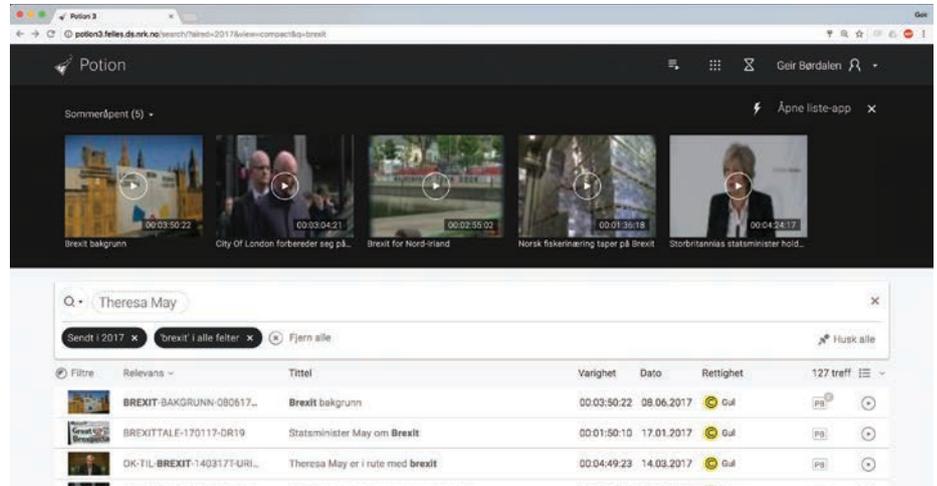
Nothing magical happens without putting in the hours and doing the hard work – from the data infrastructure to the user interfaces. And if you are doing it without the end users, don't bother – it will not succeed!

The “magical” is all about doing the right it, and somewhat about doing it right. Our experience started with building a solid foundation for our metadata – we call it the Metadata Bank. The Origo project started this work in 2015, with a foundation based on getting all the old media formats digitized, getting the metadata into the bank, organizing the data in a flexible model, and exposing them in easy formats for the users (firstly, our own media staff, secondly, the audience). The radio archive is the first repository in the Metadata Bank (see separate box).

When building the next repository (on-demand video clips) the software foundations make it possible to

BUILDING THE BANK

The metadata bank is built on the foundation of a Virtuoso (open source) graph database and a common data model (EBCore, CCDM). Search indexes are built with Elasticsearch, and a RESTful API is exposed for all internal systems (RDF, xml, json). NRK's radio department now has a complete implementation of this from the radio production system (DAVID Digas), via Sigma transcoding (internal) and the radio archive (storage on EMC Isilon).



Screenshot of the Potion search interface.

copy a lot of the functionalities. We use Docker as the implementation tool for our Java backend – and just recently we also are in the process of porting to Docker for the frontend .net implementations. This makes rolling up (or down) software versions really easy (and down to minutes).

FAREWELL TO SERVICE WINDOWS

When you are building foundations for ALL production and ALL publishing, the solidity of your structure is crucial. You really need to have NO down time for your users at all. Having four different development levels (dev, staging, preproduction and production) and Docker implementation makes this level reachable. At NRK we have implemented this structure for all

projects related to Origo and our publishing platforms for web (called “the programme player”, <http://tv.nrk.no>).

We've had instances where errors have been identified, fixed, rolled out and tested within 57 minutes, using the new Origo methods. Using an agile approach has changed completely how we maintain our software infrastructure. The era of service windows is over!

THE MAGIC POTION

One of the main goals of Origo is to make friendly, flexible and common user interfaces for all basic functions – upload, search, edit, publish, archive. Our users were burdened with 11 different search interfaces for archives, planning and production systems. All were different in design and used different search terminology. To really “find” something, you needed to be a wizard.

In Origo we aim to design interfaces so that not only the wizards can find. Instead we want everyone to feel like a wizard: finding programmes no one knew were there, finding quotes no one remembered, finding pictures that were hidden under a digitized curtain. With these tools we aim to be better storytellers, better journalists, and



"We've had instances where errors have been identified, fixed, rolled out and tested within 57 minutes, using the new Origo methods."

better publishers.

Our first tools are Potion, the Radio Archive and Foss (Norwegian for waterfall). Potion handles search, workflows and (soon) upload in video material; the Radio Archive handles radio; and Foss handles live event streaming and also automated recording of streams in future. And all three harvest metadata from the Metadata Bank, with links to all the media files (on data tape, disc or cloud).

AUTOMAGICAL WORKFLOWS

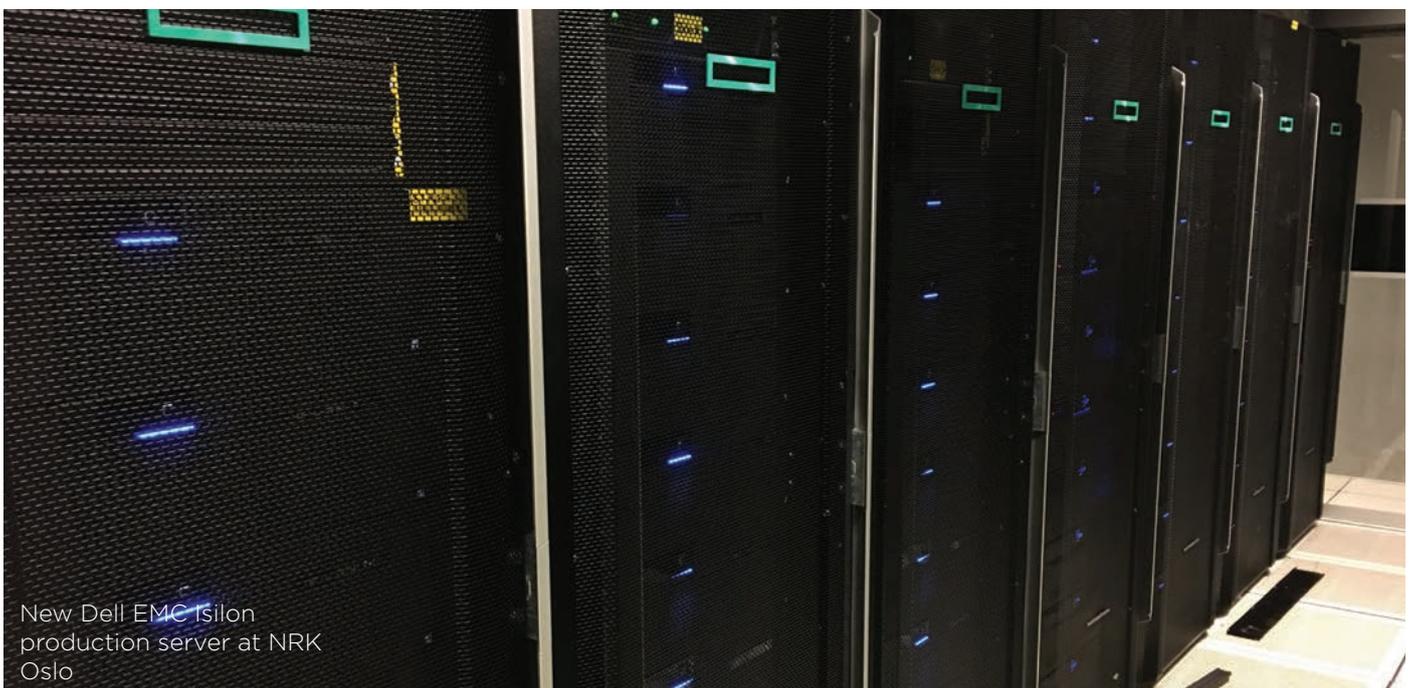
Potion is built on our knowledge of NRK's internal workflows. This knowledge starts with thorough work on architecture, building NOW and FUTURE workflow drawings in BPMN (Business Process Model and Notation) schemas. We also use service design techniques (from Stanford University) to get a good view into the users' daily work and how they imagine working (with

new tools) in the future. Then we build the process and the interfaces, and work with them on how to get from existing workflows to the future versions. This can be achieved in short and effective workshops. Still the process modelling this in software may be a lot of work – and take time. But a careful preparation process helps us build "the right it".

NRK management, of course, is very keen on measuring how well we perform in the Origo project. Comparing old and new processes may in fact be done 'clockwise'. (Anyone remember the old John Cleese movie...?) In on-demand clip publishing we found that "time to air" workflow duration was reduced by an average of 65%. And that is only the beginning. We still have many of "not feasible workflows" to improve.

NEXT MAGIC

Origo now works on television production and MAM, media asset management (together with Spanish MAM vendor Tedral). Next year we have a lot of new production workflows to build – and to remove our old production infrastructure, the Programme Bank. Music infrastructure is also up for a big change. So, more magic to build. But because it's agile, one on top of the other.



New Dell EMC Isilon production server at NRK Oslo

Taming the player metrics jungle

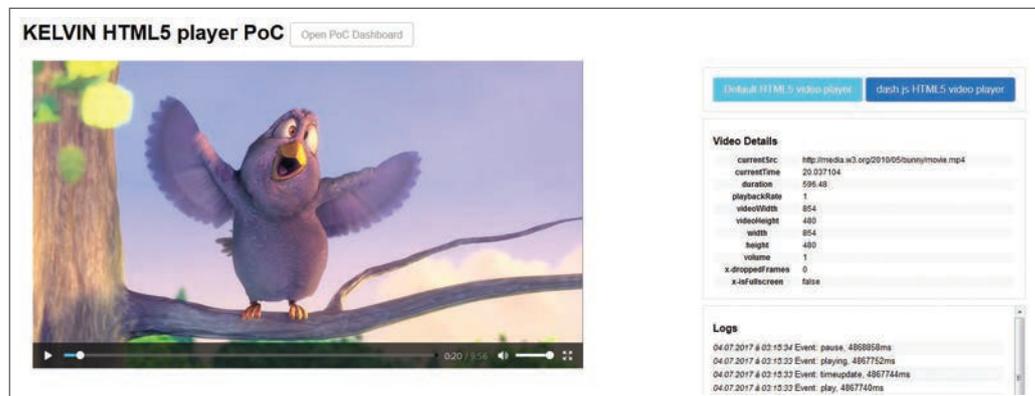
THE EBU'S **BRAM TULLEMANS** REPORTS ON PROJECT KELVIN, A RECENT INITIATIVE TO EXPLORE THE CHALLENGE OF FINDING A STANDARDIZED WAY TO COLLECT, PROCESS AND EXPLOIT USAGE DATA FROM ONLINE MEDIA PLAYERS.

Virtually all broadcasters now provide video content via one or more web-based players. They use the data retrieved from these HTTP-based streaming services in their distribution, personalization and audience measurement solutions, but they face challenges in this area. A lack of standardization for retrieving relevant metrics means there is a data integrity issue; there are operational challenges related to collecting, processing and managing data on playout performance; and legal data privacy requirements, like the new EU GDPR, have an impact on data collection strategies.

To investigate these challenges, the EBU initiated Project Kelvin. The aim was to propose a workflow that starts at retrieval of metrics from online media players and ends in a managed environment where the derived data points are exposed. A high-level framework architecture was drawn up and tested in a proof-of-concept. Sixty specialists, drawn from EBU Members and relevant industry vendors, were invited to evaluate the core assumptions through an extensive questionnaire.

COMPARABLE METRICS?

The respondents validated the identified challenges and established that the most urgent task would be the standardization of relevant metrics and how these are retrieved, i.e. how players should behave to create identical metrics. At present, different browsers, player applications and metrics solutions generate different data around identical playout sessions. This means the results from different solutions are not comparable. Standardization could improve this



situation. Most current activities concentrate on so-called Quality of Experience (QoE) metrics, like video start-up time, re-buffer ratios and average bitrates applied to optimized content distribution.

In the absence of standardization, it is not surprising that the collection of media player usage data today sees many alternative methodologies aggregating different sets of data from streaming media services. Often the data collectors are black box solutions that aggregate data from the content provider's video publication portal but are controlled by third parties that provide data-driven services. Even when the process is transparent, different organizations can still be confronted with alternative interpretations of how and what usage information is collected and processed into actionable data.

The GDPR regulation is making content providers rethink how they organize the collection and storage of usage data, applying Privacy by Design principles. Personalization services, content distribution and audience measurement depend heavily on usage data. Each stage in the data processing (e.g. collection, storage, use) raises specific governance issues and situations where users' personal data are at stake. Content/media providers, considered as data controllers, are held accountable

by authorities, with a growing set of legal requirements for keeping users' personal data safe and secure throughout the data lifecycle. There is also an impact on relationships with third-party service providers that collect data, as the responsibility for data governance, including the safeguarding of personal data, needs to be transferred contractually from the content provider to the third-party company.

For the functional, operational and data governance challenges identified, Project Kelvin proposes the use of a single collection methodology for usage data, controlled by the content provider. The proposed solution should provide a uniform and clean dataset for upstream consumption, evolving the content provider into a data curator via its data warehouse or market. Many respondents to the questionnaire asserted that the framework architecture should not prescribe any specific technical solution. All service implementations can be acceptable, as long as the information is collected and preprocessed in a similar fashion, delivering fully comparable and exchangeable data.

EBU Members can engage with discussions arising from Project Kelvin in our strategic programme on Online Services: tech.ebu.ch/bis

Of streams and screens

A RECENTLY PUBLISHED REPORT FROM THE EBU'S MEDIA INTELLIGENCE SERVICE CAPTURES THE MAIN MEDIA CONSUMPTION TRENDS. **ALEXANDRA BRENKMAN**, SENIOR MEDIA ANALYST, SHARES SOME OF THE KEY FINDINGS.

Our Media Consumption 2017 report puts “traditional” television and radio into the wider context of media consumption, exploring what types of video and audio content are being watched and listened to, and on which platforms and devices. In addition to the topics mentioned below, it looks into the impact of mobile devices and the role of social media.

VIEWING STABLE, OR IS IT?

With an average 3 hours and 40 minutes daily viewing time in Europe, traditional television is in good health. Viewing time is very stable overall, but a closer look at age groups shows that a decline among younger age groups is compensated by the growth in viewing time among older people.

The figures also hide contrasting national realities. Around one third of EBU markets show a significant decrease in viewing time. There are clear trends by region. In the Nordics, people have traditionally been relatively light users of television, of which they tend to watch less and less, while it's in this region that the appetite for online viewing is biggest (Figure 1).

ONLINE KEY TO YOUNG AUDIENCES

Even though public service media are important players in the on-demand market, online represents only a small portion of their total viewing volume, the lion's share still being achieved through traditional television.

The on-demand services of SVT and NRK, both leaders in their country, deliver a modest 6% of total minutes viewed. RaiPlay, the most used on-demand platform in Italy, accounts for a marginal 0.5% of Rai's total viewing. On the other hand, online distribution is increasingly key for youth content. Viewing of NRK Super, the children's brand of the Norwegian broadcaster, is equally distributed between online and broadcast television.

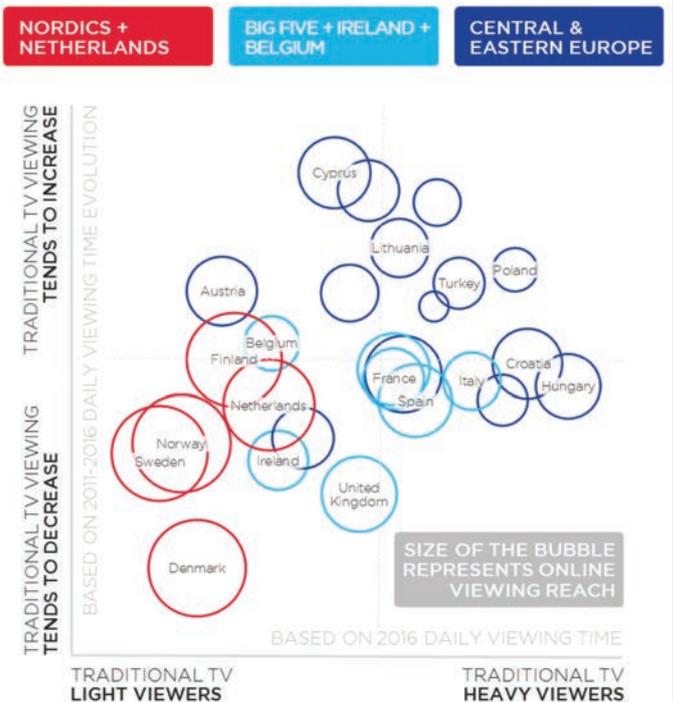
STREAMING ON THE MAIN SET

With the adoption of connected televisions growing, they tend to overtake computers as the most-used device for online viewing. For NRK TV, 48% of all streamed minutes were captured by televisions over the first eight months of 2017, up from 11% in 2014 (Figure 2).

VOICE CONTROL

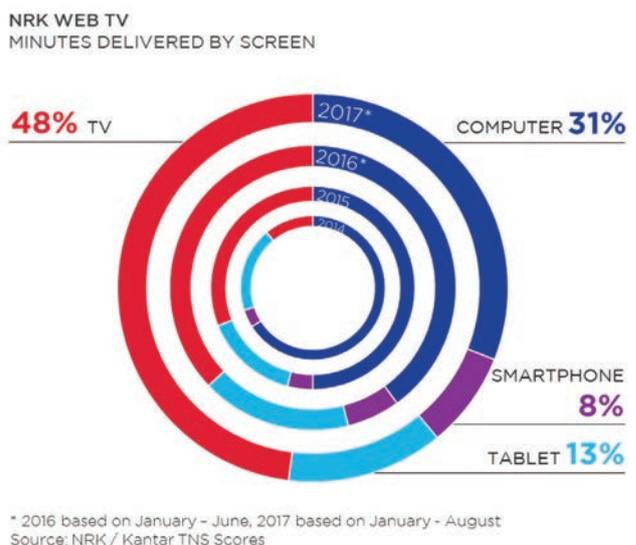
While voice-activated assistants have been available on smartphones for several years, it is with the arrival of screenless devices such as Amazon Echo and Google Home that the interest in voice-controlled interfaces has

Figure 1



Source: EBU based on Eurodata TV Worldwide & relevant partners / Eurostat

Figure 2



gained momentum. In the US, 7% of households had a voice-controlled home assistant by early 2017, while in the UK sales of the Amazon Echo have been strong since its October 2016 launch. Several other providers, among them Deutsche Telekom, are launching their own ‘smart speakers’ to stake a claim in this growing market.

See: www.ebu.ch/mis

Blowin' in the wind?

THERE IS A CONFUSING ARRAY OF UHD TELEVISION SETS AVAILABLE IN OUR SHOPS TODAY, AND MORE ARE ON THE WAY. **DAVID WOOD** ASKS HOW THIS HAPPENED.



How many roads must a man walk down, before it is really UHD?

It's five years since the world agreed on the unique specification for UHDTV – BT 2020. We thought, at that time, that there would be only two UHD variants, corresponding to 4K and 8K image resolution. The other features, such as the choice of frame rates, would be available in all systems and would all support each other, to make the step from HDTV to UHD sufficiently large to justify the cost.

In practice, the features are being taken up piecemeal, being progressively added to television models. Part of the reason is because DVB introduced phases in its UHD delivery system specifications, to respond to the wishes of its members to start services at different times; and it has been taking varying amounts of time to develop the decoders for the different features.

PHASED INTRODUCTION

DVB's Phase 1 specification was for UHD services to be introduced in 2014/5 and Phase 2 for 2016/7. Phase 2 also has a feature (High Frame Rate, HFR) for services starting in 2018/9. The cumulative result is the multiplicity of UHD television sets mentioned above.

Increasing the selling proposition in steps over time could provide reasons for the public to buy a new model at shorter intervals, which may make commercial sense to the manufacturers. There are drawbacks too – it can be confusing for the public, and those who serve content to UHD audiences have to make difficult decisions about what models to target.

Today, purchasers can find several groupings of UHD televisions in the shops. Roughly, these are as follows:

- equipped with a 4K display but almost without UHD capabilities;
- meeting the DIGITALEUROPE (the European consumer electronics manufacturers association) UHD baseline;
- “ULTRA HD PREMIUM”, meeting the Phase 1 specification;

- UHD Phase 2 compatible;
- UHD Phase 2 compatible, but additionally with support for one or more systems of High Dynamic Range (HDR) “dynamic metadata” that are extensions of the HDR feature of Phase 2.

TWO HDR SYSTEMS

The HDR feature included in Phase 2 exploits the higher peak screen brightness that will be in UHD displays in the coming years. HDR can be provided by either of the two systems in the DVB specification itself, HLG10 and PQ10 (see page 19). There are also extensions on offer, currently outside the DVB specification, but that can be used with it, to improve the image quality:

- HDR10 – PQ10 with static metadata – used by Blu-ray;
- PQ plus dynamic metadata, from Dolby;
- SL-HDR1 from Philips/Technicolor, which is either PQ or HLG plus dynamic metadata;
- HDR10+ from Samsung, which is PQ10 plus dynamic metadata.

The dynamic metadata systems in the last three are different from each other.

RESOLUTION AHEAD?

If the situation today sounds complex, the future may make things even more so.

The first area may be displays with and without the HFR capability of Phase 2, slated by some for 2019. Waiting in the wings are the systems of Next Generation Audio. These are systems for enhancing the television experience with higher quality sound. The DVB specification, as it is today, allows two systems, which have different audio coding methods.

And finally, we come back around to the resolution of the image. In addition to 4K images, the next decade may also bring 8K services – displays were already on show at IBC 2017.

How many categories of UHD televisions will eventually be in the shops? How will the public understand the differences? How will broadcasters decide which to target? We know where Bob Dylan would say we'll find the answers.

“If the situation today sounds complex, the future may make things even more so.”

Looking to DVB's future with an eye on the past



DVB World is certainly one of the most enjoyable events of the year for me, writes Peter Siebert, Executive Director of DVB. For three days we take a step back from the day-to-day work of defining commercial requirements and setting specifications and instead look at the impact our work is having. It is an excellent event for the broadcast community to meet and interact. We put a strong focus on enabling people to discuss and exchange ideas.

Media delivery is becoming more complex, with broadcast and broadband technologies coming together in new ways to enable exciting platforms and services. This means we still have lots of work to do in the DVB Project, to ensure that

these new services can benefit from the kind of interoperable standards that underpinned the success of the first wave of digital television. These new trends have driven the conference programme, where we touch on recent trends like targeted advertising, DVB to the car, and broadcast and 5G.

With DVB heading into its 25th year, we're delighted to welcome an old friend back for DVB World 2018. Prof. Ulrich Reimers, who chaired our Technical Committee from 1993 to 2012, will deliver the opening address in Warsaw. He plans to examine some of DVB's great successes from its first quarter century, but also some of the specifications that did not live up to expectations. There are certainly lessons to be learned, and who better

to point us in the right direction than Ulrich Reimers!

We have many exciting speakers lined up for DVB World 2018. Please join us in Warsaw, 12-14 March.

See: www.dvbworld.org



WRC-19 and satellite broadcasting in Asia-Pacific



In the Asia-Pacific region, satellite takes on a particular importance in the context of preparations for the WRC-19 conference, writes Amal Punchihewa, ABU Director Technology and Innovation. I was pleased to be a presenter and panellist at the recent International Satellite Symposium in Bangkok, where we could address some of the

challenges faced by broadcasters in the Pacific.

While Pacific island countries do have adequate frequencies for terrestrial coverage, the combination of multiple sparsely populated islands, spread over a wide area, with small populations and economies makes it challenging to plan and invest in digital terrestrial television

and radio services. Satellite thus plays an important role, and at the symposium we heard from emerging and established operators about various cost-effective solutions for both broadcasting and broadband services.

Almost all satellite operators and providers are members of the ABU. Hence, we have a duty and a responsibility to take the necessary action not only to preserve frequencies currently used for satellite broadcasting but also to assure the future availability of spectrum for emerging satellite broadcasting services. I know our members welcomed our contribution to the discussions. Unless we – the unions and broadcasters – work with relevant organizations such as the Asia-Pacific Telecommunity and the ITU, broadcasters may lose spectrum essential for current and future broadcast services.



Amal Punchihewa (middle), ABU Director Technology and Innovation, at the International Satellite Symposium in Bangkok, 30 August – 1 September 2017

Making broadcast monitors show the truth

MONITOR MANUFACTURERS LIKE TO REFER TO THEIR EQUIPMENT AS EBU GRADE 1, AS A SIGN OF OUTSTANDING QUALITY AND STABILITY. THE DEFINITION OF A GRADE 1 MONITOR HAS NOW BEEN REVISED, EXPLAINS THE EBU'S **FRANS DE JONG**.



For many years EBU Tech 3320 has been the reference document for professional video monitors. By providing strict requirements, the EBU ensures production staff can guarantee the visual quality of their content in a consistent way. For media professionals the monitor is a measurement device – its main task is not to show a pretty image, but to show the image 'as it is'. Contrary to consumer displays which might apply 'image enhancements', broadcast video monitors must show the whole story, faults and all!

In September 2017, the EBU published version 4.0 of EBU Tech 3320, User Requirements for Video Monitors in TV Production. It adds UHD, High Dynamic Range (HDR, see opposite) and Wide Colour Gamut (WCG). However, to reflect the current state of the art in display technologies and to take into account ongoing standardization work, the Grade 1 definition for HDR has been split into two: Grade

1A and Grade 1B. The intention is to remove this split in the future, when HDR and WCG technologies are stable and ubiquitous.

Backwards compatibility for HD and SD signals is of course important. The new monitor specification addresses this. First of all, the standard dynamic range requirements are largely unchanged. Secondly, support for interlaced signals is still classified as 'highly desirable' for Grade 1 HDR monitors, even though most newly used formats are progressive. And finally, 1080p images with HDR and WCG are supported, because they are part of the international standards package and broadcasters may wish to start using HDR without going to UHD.

The updated monitor requirements are the first in a series of HDR related publications the EBU strategic programme on Video Systems is creating.

More at: tech.ebu.ch/hdr

GRADE 1

These monitors are in all respects capable of accurately displaying the signal they are presented with. Grade 1 monitors are used as a 'measurement instrument' for camera control, colour grading, QC, etc. They are expensive, but very high quality and stable. The standards for HDR cannot be accurately implemented in current monitors. For this reason, the EBU has split HDR Grade 1 monitors into 1A (the ideal) and 1B (currently feasible). Grade 1B monitors offer all 1A characteristics, but have a reduced colour gamut and/or luminance range reproduction.

GRADE 2

For many applications where picture quality control is not performed, wider tolerances than Grade 1 can be accepted. For example, the monitor's luminance range may be limited or a pixel-mapped image mode might be absent. Grade 2 monitors with such wider tolerances are typically used in control walls and edit suites, where complex colour correction is not carried out. Grade 2 allows monitor designers to trade off characteristics such as quality and cost with other requirements such as size and weight.

GRADE 3

The lowest grade broadcast monitor is used for signal presence monitoring. Typical applications are audio production areas, dubbing suites, commentator positions and audience displays in the studio. Grade 3 monitors could be similar to high-end consumer displays, but include some special features, such as professional interfaces and mechanical robustness. Grade 3 is only defined for SDR monitors.

HIGH DYNAMIC RANGE STANDARDS: HLG VS PQ

HDR can use two different standards for production and exchange: Hybrid Log Gamma (HLG) and Perceptual Quantizer (PQ). EBU Tech 3320 supports both techniques and encourages monitor manufacturers to do the same.

HLG was developed by the BBC and NHK to offer broadcasters an evolutionary approach to HDR production and distribution. The signal characteristic is similar to that of a traditional standard dynamic range camera with a "knee" and requires no production metadata. This means it is compatible with conventional

standard dynamic range production equipment and infrastructure.

PQ uses a new non-linear transfer function that is finely tuned to match the human visual system. It supports HDR displays up to 10,000 cd/m². In contrast with the HLG system, in PQ the signal is 'display referred', which means it represents the light shown on a reference display. This is also the reason why the maximum brightness of the reference monitor must be sent as metadata, so other monitors can adapt the signal to match their capabilities.

In the spotlight Bruno Tézenas du Montcel

DIRECTEUR DES TECHNOLOGIES ET SYSTÈMES
D'INFORMATION, FRANCE MÉDIAS MONDE

WHAT ARE YOUR CURRENT RESPONSIBILITIES AT FMM?

My job title is rather specific to the French media industry, with responsibilities similar to those of a CTO: hierarchical management of engineering, technical support, production, programming and broadcasting. FMM edits an international television news channel (France 24, in four languages – French, English, Arabic and Spanish) and two international radio channels (RFI, in 15 languages, and MCD in Arabic).

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

The older you get, the more difficult it is to select only one achievement... So I'll choose the most recent one, as if I was still a young professional. The new "visual radio studio" of RFI went on air last September. Several workflows – radio only, radio with automated visuals, "television-like" visual radio and music shows – can be configured automatically through a one-touch selection process. All workflows are manned by multiskilled technicians,

in different numbers depending on the complexity of the show. All visual radio workflows can be aired live, simultaneously on radio and television, or recorded to follow specific schedules.

WHAT ARE YOUR PREDICTIONS FOR MEDIA TECHNOLOGY IN THE FUTURE?

While media technology will be less and less specific in itself, specific media services, running on standard technology, will continue to help creative talents to produce and distribute stories. Massive virtualization of infrastructures, dematerialization of collaborative workflows and disruptive user experiences will bring about a reinvention of the storytelling process as much as the tools that will help to tell and spread stories.

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

Radical changes in audience behaviour, and storytelling and marketing approaches will need to be addressed, while the average cost



of each minute of content produced and delivered will continue to fall. Technology shifts and profound job changes will be tough challenges for individuals and organizations on tight budgets: most of us realize by now that if you know how to shoot but don't know how to tell a story, you'll probably be out of a job pretty soon, if you aren't already! And that if you know how to tell a story, you had better learn quickly how to shoot and edit! These groupings of creative and technical know-how will spread even more along the value chain. Professionals will need to master all services that can be used at some point within their work environment while historical media will lose the relative protection of their capex-heavy business model with the shift to XaaS.

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

My family, food, music... and the game of golf!

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