tech-*i*

Seeking higher value

Plus
- **ACCESS SERVICES**
- **IF INTERNET SUPERSEDES BROADCASTING...?**
- **DELIVERING 4K/UHD-1 AT FIFA WCUP'14**
- **BEYOND HD**

and more...

tech-i
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Cover Story: We're focusing on higher value in this issue of tech-i, including an update from Spain, where they tested 4K content via DTT. See page 7.

As we approach my second IBC at the EBU, it is going to be interesting to evaluate the latest trends in our industry at this year's gathering. I encourage you to visit the EBU Stand in Hall 10F20 where you will see a variety of demonstrations from cross-platform authentication to ultra-high definition. We are also showcasing our work on the FIMS standard, showing off the networked studio work of our members from the BBC and a virtual microphone system from RAI. Members of the team will be there to meet with you and talk you through the latest news and show you some of our recent areas of engagement. There will be a live 4K transmission of the Moto GP across the Eurovision network from Friday, 12th September until Sunday, 14th September. There will also be the chance to see some of the FIFA World Cup 4K footage that we helped make available to a set of broadcasters worldwide during the semi-finals and final championship match. Don't forget to join us on Monday evening as the show closes for drinks on the stand..

TThe FIFA World Cup was a major event for the Eurovision team at the EBU and fantastic coverage was fed back to members across Europe. The encoding of 4K matches for experimental transmissions from some members was a challenge and a member of the EBU Technology and Innovation team, Adi Kouadio, was on hand at the event to manage and control the 4K encoding. Synchronising the 4x3G-SDI quadrants (each encoded at 21 Mbps) and re-assembling them in Europe was a challenge in itself. This was continued by some of our members, such as BBC, who delivered the first HEVC DVB-T2 4K transmissions derived from the feed. In other cases, IP delivery to Connected 4K TV was favoured. Besides the 4K commercial trial, our colleagues from NHK recorded sixteen games in 8K

60P, already preparing for the RIO 2016 Olympics.

Our Technical Assembly was held in June in Prague this year, kindly hosted by Czech TV, and the main topics on the agenda were on the policy front: spectrum, of course, and net neutrality. On the technology front, network (IP) production was of particular interest, as well as, updates from members about new developments in their counties such as the popularity of DTT in Poland and the Czech Republic since launch. There was a thought-provoking keynote from the BBC's Andy Quested titled "Will technology make broadcasters obsolete?" pointing out new ways in which audiences can access content and essentially bypass traditional gatekeepers, also encouraging us all to support graduate entry into our industry through such schemes as the Broadcast Apprenticeship that the BBC is engaged in, an interesting example for us all to emulate.

This year we said goodbye to some of our long standing Technical Committee members during the bi-annual elections. In particular, I would like to express my and the EBU's gratitude to Arild Hellgren from NRK who has been involved in the Technical Committee for 12 years, 4 years as the Vice-Chair and 2 years as the Chairman. His vast amount of knowledge and sage advice has steered the EBU technology strategy in directions to benefit the industry.

We welcome our newly elected Chairman Egon Verharen, Manager of R&D for NPO in The Netherlands. Egon will bring his varied experiences to bear on our work as we adopt the new Workplan for 2015 which has been published on tech.ebu.ch. Egon is joined by new and re-elected members of Technical Committee from CyBC Cyprus, RTR Russia, TVP Poland, RTP Portugal and France Télévision.

Finally it was encouraging to see the work we have done on Hybrid Radio come to life over the last two weeks with the 'Visual Radio' live data slideshow with sports results and pictures from the European Athletics Championships in Zürich. Partnering with Getty Images and Swiss Timing using a new content processing and production system that the EBU developed. I hope that you will come and say hello during IBC and stay in touch.

Simon Fell, Director, EBU Technology and Innovation

A NEW ARRIVAL

A new member of staff joined the EBU Technology and Innovation Department in July 2014. Shannon Frame has taken on the responsibility of Technical Editions Manager for the Department. Whether it's through publications, events, or the website, Shannon's brief is to enhance the profile of the EBU as a reference for technology and innovation. She'll also act as a single point of contact for communications-related matters, in particular, connecting with the network of Technical Liaison Officers (TLOs) throughout the EBU membership and with external partners.

Shannon is no stranger to technology and innovation. In her last role at the International Organization for Standardization (ISO) she helped lead an organizational change process to facilitate the move from PDF-publishing to XML. She also managed a number of technical committees, developed new products and specified and prototyped new tools to improve processes. Prior to this, her professional experience included working at the International Federation for the Red Cross and Red Crescent Societies where she oversaw the production of publications, communications and large-scale conferences and events for the health department.

Her academic background includes a BA with Honours in Political Studies and History of Art. She was also awarded an International Studies Certificate from Queen's University (Canada) on graduation. She spent two years of her degree studying abroad in the United Kingdom, Italy and Switzerland.

With such a varied background, Shannon brings with her a wide range of experience and is ready for action. We welcome her to the team.

You're invited...

...for drinks, snacks and conversation on the EBU booth at IBC 2014. Join us on Monday, 15th September @ 17:00.
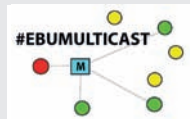
IBC '14
12-16 SEPTEMBER, AMSTERDAM

As usual, the EBU will be present at Europe's premier broadcast media convention, IBC. Our stand will showcase a number of technology demos with half-hourly presentations on a range of topics.
https://tech.ebu.ch/events/ibc2014

Multicast workshop
24-25 SEPTEMBER, GENEVA

Many believe that multicast solves a lot of problems related to the online delivery of live content. However, it is not widely used. Find out more at the Multicast workshop.
https://tech.ebu.ch/events/multicast14

DevCon '14
30 SEPTEMBER–1 OCTOBER, GENEVA

The second EBU Developer Conference will provide an opportunity to learn about best practices in software engineering and get 'hands-on' with current development and deployment tools. Participants will pick up new ideas to run software-driven broadcast infrastructures to improve their engineering workflows.
**https://tech.ebu.ch/events /decvon14**

Archives workshop
28-29 OCTOBER, GENEVA

This workshop will provide insight into how to organize file-based audio-visual archives as part of a media production facility. The first day provides the overview and focuses on integration, while the second is centred on quality control. Special attention will be paid to creating efficient workflows.
https://tech.ebu.ch/events/archives14
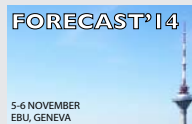
Forecast 2014
5–6 NOVEMBER, GENEVA

5-6 NOVEMBER
EBU, GENEVA

FORECAST is the EBU's annual conference dealing with broadcast technologies, spectrum management and related topics. It attracts more than 100 delegates each year, bringing together broadcasters, network operators, regulators, policymakers, industry stakeholders and researchers.
https://tech.ebu.ch/events/forecast14

Looking ahead…

Production technology seminar 2015
27-29 JAN 2015
Digital radio summit 2015
11 FEB 2015

BroadThinking 2015
25-26 MARCH 2015
MDN workshop 2015
JUNE 2015

HDR - AN IMPORTANT CANDIDATE FOR UHDTV: 17 June 2014, Munich, Germany

Dynamic range can be described as the ratio of the lightest to the darkest part of the TV image. For the second time, the Digital Video Broadcasting (DVB) and EBU organized a joint workshop on UHDTV; this time bringing together over 90 experts in the field of Higher Dynamic Range (HDR).

Hosted by EBU member IRT (Insitut für Rundfunktechnik), industry, service providers and broadcasters discussed the value, timescale, and HDR features in Munich on 17 June 2014. The workshop set out to prepare guidance for a proposal for UHDTV 'Phase 2' requirements that should be finalized by DVB the beginning of 2015.

Participants had the opportunity to learn more about the subject through the various perspectives represented at the meeting. For example, Jenny Read, neuroscientist at the University of Newcastle, provided a very interesting insight into how the Human Visual System (HVS) reacts to HDR screens. Through her presentation it became clear that encoding schemes must be defined by taking into account human contrast sensitivity.

Prof Norbert Frühauf from Stuttgart University gave further insights on current and future display technologies, calling for a dynamic range much higher than the 100 to 1 possible today. He also advocated for a wider colour gamut in order to make the best use out of HDR.

After learning about the creative HDR process, representatives from Technicolor, BBC, Dolby and Philips or TPV explained their proposals for a new Electro-optical Transfer Function (EOTF) and Opto-electrical Transfer Function (OETF) so that participants could better understand the differences between the proposals which are partly under discussion at the ITU-R and SMPTE. All proposals were made available to participants as demos running throughout the day.

A session on broadcast and production infrastructure rounded up the fact finding at the workshop before participants went into discussions led by David Wood, EBU and chair of DVB CM-UHDTV, and Tim Sheppard, Cisco and chair of DVB CM-AVC.

Overall, the conclusion of the workshop was that HDR is one of the most essential UHDTV features (possible with HD as well) to create a brilliant, real picture.

A workshop report is currently being prepared and will be of use to DVB and EBU to establish liaisons with other standardization and industry bodies on the HDR topic.

SHAPING THE UHDTV ROADMAP FOR EUROPE
5-6 June 2014, Lucca, Italy

The Forum of Advanced Media in Europe (FAME), which is co-chaired by the Digital Interoperability Forum (DIF) and the EBU, met for a first FAME UHDTV Roadmap workshop in Lucca, Italy from 5-6 June 2014. Over 65 attendees participated in the event, representing professional and consumer industries, network operators, and private and public broadcasters.

Forum for Advanced Media in Europe

The objective of the workshop was to define concrete steps towards what is termed "Phase 2" of UHD-1 (2160p). UHD-1 Phase 2 discussions should include features such as: higher dynamic range and higher frame rates, as well as extended colours, in addition to the 4-times resolution of 1080p HD. The overall conclusion was that the time to influence industry is short, and that the broadcasting industry only has around 12 months left to come up with technical requirements and implementation guidelines.

UHD-1 Phase 2 is regarded as a major step beyond the HDTV services that the majority of European broadcasters are currently transitioning to and is an advance on the 4k display technology that is already being sold in shops but which concentrates 'only' on an increase in resolution. The Digital Video Broadcasting (DVB) project has already started gathering commercial requirements for UHD-1 Phase 2.

The workshop also looked outside the European domain with presentations from NHK, Japan (focusing on the 2020 Olympics in Tokyo) and Kobeta, South Korea. Both presentations highlighted the possibility that Europe could fall behind in introducing UHDTV if significant progress is not made soon.

Based on the work in the three breakout sessions (production, distribution and consumer) concrete actions were defined and each of them are being followed up by the FAME team. Actions range from closer collaboration with, and support from, the European Commission to sharing experiences for UHDTV workflows (concrete production examples like FIFA and the Commonwealth Games), training, and interoperability for technology infrastructures. FAME will also engage more closely in the next meetings with new players from the streaming and OTT community, since there is a significant momentum to deliver UHD over IP to the home.

FAME meets again on the 12 November 2014 at the EBU in Geneva. Interested parties should contact Dr. Hans Hoffmann (EBU) at hoffman@ebu.ch.

At IBC 2014, we can be found in our usual spot in the corner of Hall 10 (Stand 10.F20). Our focus this year is to meet with our Members, promoting the activities we foster on their behalf, and acting as a guide and reference to the latest technology trends. Presentations will take place on the booth every 30 minutes, covering a wide range of topics. Demonstrations will include: FIMS tests and EBU-core metadata; cross-platform authentication; EBU.IO; the networked studio; high dynamic range; and HEVC over DVB-DASH. There will also be a demonstration of their RAI new virtual microphone.

On Monday evening at IBC, all EBU Members and group participants are invited to join us at the booth for drinks and snacks. There won't be a formal programme for this event – just an opportunity to meet with your fellow broadcasters and discuss all you've seen and heard at the show.

The EBU has a strong presence at the IBC Conference this year. On Saturday afternoon we are producing a session titled "Broadcast meets Broadband". This session will address the crucial question of how broadband networks (Internet and private IP distribution) will be able to complement traditional broadcast distribution technologies. On Monday morning, the EBU will present the Loudness Breakfast, a free session providing the latest updates on R 128 implementation. Simon Fell will speak at the great spectrum debate and Chair the EBU session "Broadcast meets broadband".

IBC Demos

EBU.IO Discover the new EBU.IO platform which facilitates the application of best practice in software development.

Network Studio Live production can be done using today's commodity off the shelf infrastructure. Stop by and see for yourself!

High Dynamic Range High Dynamic Range is one of the most important factors of UHDTV. We will show a comparison of SDR and HDR content produced during the Zurich Athletic Championships 2014 and in Turin 2012.
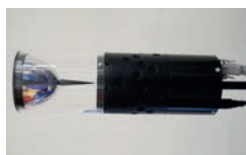
RAI 3D Virtual Microphone Come and see the RAI 3D Virtual Microphone! It is capable of capturing any acoustic signal coming from any direction in space without the use of any mobile device.

FIMS Tests & EBU Core Different test platforms addressing FIMS 1.1 specifications will be shown alongside tools for the management of metadata for file and commercial exchange.

HEVC OVER DVB-DASH Delivering high quality UHD content with your online services is now reality! This demo shows live and on demand playout using DVB DASH HEVC on both a Connected TV and Tablet.

My Media, Any Device... Powered by CPA Find out more about cross-platform authentication. Come see the BBC "Playlister" using CPA.

4K Ready! Come see a Live 4K feed from the Misano Moto GP Races and recent 4K content from the FIFA World Cup'14 at our EUROVISION demo.

NETWORK TECHNOLOGY SEMINAR

ON OUR WAY TO THE NEXT GENERATION OF STUDIOS
24-25 June 2014, Geneva, Switzerland

When discussing the next generation of studio technology last year, people said "It would be nice if…" But at this year's Network Technology Seminar (NTS), it became clear that "It is going to happen": It is simply a matter of time and of technology selection.

The transition will be from special purpose broadcast media infrastructure to an application-based production environment running on commodity IT. In other words, the replacement of Serial Digital Interface (SDI) and AES/EBU interconnections by IP networks in the live production studio.

Day 1 of the NTS was spent developing this hot topic. Starting with a vision of a future "IT studio," its promises, and the steps needed to achieve this vision by 2020. A number of new studio use cases were described, such as radio station virtualisation at the BBC, and an automated control room redesign at CBC. Key standard technologies that will shape this future infrastructure were explained; for example, the IEEE precision time protocol, the AES multichannel audio over IP, what Software-defined Networking (SDN) means for media production, and the Time-sensitive Networking (TSN) for the extension of Ethernet networks.

Good news of the day was "we are not alone using those technologies." One of the major benefits of relying on commodity equipment is that we can benefit from the lessons learned and the development of a huge market place. The bad news is that the broadcasters can no longer influence the standards as before, that we need to learn how to use this kind of equipment at its best, and to hire IT expertise and teach them what the specifics of our domain are.

Between the sessions, attendees could see prototypes and real products at work from Axon, BBC, Cisco, Nine Tiles, SDNsquare and Sony. In a panel discussion, the representatives of those demo systems were challenged with the ultimate requirement of the broadcasters being that products should be integrated into one system. Delegates concluded the competition between different approaches will continue for a while, as harmonization will take some years to happen.

On Day 2, many use cases were presented, such as, the brand new ITV-X contribution network, the VRT new multimedia vans, and their Mini-Cooper version of an autonomous journalist car. The use of IP over Ka-Band satellite, and the aggregation of different transmission techniques for optimal file-transfer, were also covered. It was interesting to see how the industry tries to reproduce the "switched circuit and low latency feel" while using the packet-switched technologies from the IT industry such as IP and Multiprotocol Label Switching (MPLS). Another example was the Belgium broadcaster VRT who came to an agreement with a national internet provider for QoS over VDSL. This enables the replacement of ISDN audio codec that are falling out of use, by audio-over-IP with the same level of service. The only problem with this promising approach is that it is not standardized and would have to be agreed provider by provider. This may be an area where EBU could help to harmonize.

The media storage session discussed an approach proposed by the Swedish Radio on how to classify media storage demands in order to find good enough media storage at a reasonable cost. This led to the recent publication of EBU Tech 3359. RAI also presented their T3 project set up for an asset repository architecture.

A final thought provoking presentation came from a famous neighbour of the EBU in Geneva. Like broadcasting, a huge amount of data is being produced, stored and transferred for physics computing at CERN. Therefore we can learn from their experiences. But although they are data hungry users, the size of the media files is a characteristic that makes us "a bit" different.

This year's programme concerned mostly IT technologies, thereby confirming that this is not just hype, but a clear trend. In practice, we have to look to around 2020 when broadcasters may get the full benefits from this transition and the issues of interoperability will be reduced. But broadcasters need to adapt quickly and the EBU is there to help. This NTS was a way to quickly build knowledge and share experiences within an audience of 100 participants and EBU Members (who have access to the presentation and videos).

For more information, see: https://tech.ebu.ch/events/nts2014

RTVE pioneer of transmission and reception of 4K Ultra HD content using HEVC/50p and DVB-T2

PERE VILA, DR. DE TECNOLOGÍA, INNOVACIÓN Y SISTEMAS RTVE, GIVES US THE INSIDE SCOOP

The Corporation has tested the benefits of the latest technology for encoding and broadcasting 4K content via DTT. UPM (Polytechnic University of Madrid), Abertis, Sapec, Hispasat, Sony, LG, Panasonic and Samsung collaborated in this project, involved in the full chain: capture, editing and postproduction, compression, transmission and reception.

RTVE has carried out a production of ultra-high definition television, using 3,840 x 2,160 images (UHD-1), for broadcasting over a DTT mux. The result has been a 55 minutes documentary ('The passion of the Prado') about the Prado Museum, the most important museum in Spain. The original recording of the UHD film was at 50 frames per second and it was maintained across all the processes.

The eight million pixel video was compressed to a 35 Mbps archive using High Efficiency Video Coding (HEVC), the most efficient and latest technology in compression, previous to emission in DTT over a limited coverage in a metropolitan area in Madrid.

The emission in DVB-T2 was carried out from the Polytechnic University of Madrid on channel 56 UHF (754 MHz). 8 MHz bandwidth, 32K extended FFT mode, 5/6 FEC, 1/128 guard interval, 64QAM modulation and 125W power transmitter were selected. The emission was carried out with a final bit rate around 37 Mbps, less than the maximum allowed limit.

The DTT signal was received on a standard TV aerial placed on the roof of RTVE Institute, and distributed to a set of four compatible consumer UHD TV sets which then decompressed the video. Realism and superb pictures could be shown.

With the mind in the future of television, RTVE maintain the idea to continue with 4K trials on a DVBw-T2 multiplex, testing new developments in UHD, compression, mobility and radio.

In this way, the public service broadcaster has demonstrated in this pilot in Madrid the potential of new coding and transmission technologies for applying in conjunction with 4K pictures. It is possible to record, coding and broadcast at 50 fps using less bit rate than allowed in one multiplex, if the DVB-T2 standard is used.

This pilot is the continuation of a research project started in 2013 with the European Broadcasting Union. In this first test, the signal was compressed in MPEG-4/AVC at 25fps. Now, for the second test, the signal was encoded in H-265 at 50 fps. The Spanish broadcaster has demonstrated that High Frame Rates in 4K signal are possible if High Efficiency Video Coding is used.

In order to publicize the project set up for understanding UHD technology, RTVE Institute organized a presentation day. The Corporation welcomed a presentation of the pilot. It explained all the processes and final conclusions and was held on June 24th 2014. Viewing in real time of the documentary via four different manufacturer's TV receivers was possible, located at RTVE Institute hall.

The Migration from DVB-T to DVB-T2 in Germany

HOW DECISIONS ON SPECTRUM INFLUENCE THE FUTURE OF TELEVISION DELIVERY AND FREE-TO-AIR TV ITSELF BY **ECHARD MATZEL**

Objectives and general requirements of the migration from DVB-T to DVB-T2. Since the analogue switch-off in 2008, terrestrial broadcasting in Germany has been quite successful. The terrestrial distribution option for watching linear TV content is very popular in densely populated areas, due to the fact that one only needs a low-cost indoor antenna and a DVB-T receiver to get up to 30 free-to-air programs from public and commercial broadcasters. As a result, up to 25 percent of the TV viewers are using terrestrial reception in urban areas, while the average throughout Germany is around 11 percent. The overall DVB-T coverage in Germany is more than 90% of the population and, of that, 30% is portable indoor. Unfortunately, commercial broadcasters are only available in urban areas and not in rural areas, which makes DVB-T less attractive in these regions.

As terrestrial technology has evolved, the time has come to make terrestrial transmission even more competitive compared to cable and satellite reception. By using new state-of-the-art coding technology HEVC (H.265) and the latest digital terrestrial television system DVB-T2 for transmission, Germany will be able to broadcast more programs, using HDTV instead of SD, accompanied by further improvements in audio and data services. Moreover, we will enhance broadcast-broadband convergence by incorporating HbbTV offering video-on-demand services and live streaming. Such a migration from DVB-T to DVB-T2 will also bring cost reductions through more efficient source and channel coding and spectrum efficiency. In addition to upgrading the technology, the plan is to optimize the network by reducing the power of a small number of transmitters.

To be able to launch a HEVC/DVB-T2 service requires the availability of consumer devices in all price ranges. These should come on stream as the services start. And thus be available in 2017. First contact with consumer manufacturers has been very promising as they intend to implement HEVC in their upcoming UHD products soon. This same HEVC decoder can be used with the DVB-T2 tuner.
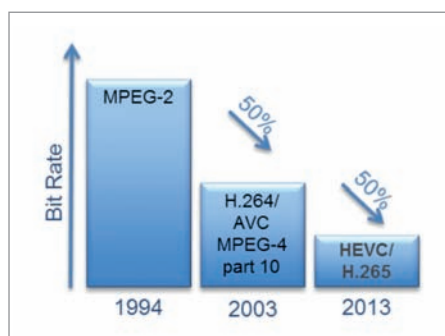
Regarding the reception conditions, the broadcasters will retain the same quality as today: stationary, portable and mobile reception. Although not yet fixed, the DVB-T2 parameters could look like the following:
• 16k FFT, GI 19/128, 64 QAM, CR 3/5 (or CR ½)
• Signal-to-noise ratio: 16.4 dB (13.4 dB)
• Data rate: 22 Mbps (18 Mbps)
The estimated video data rates, by using HEVC will be 0.8 – 1.8 Mbps for SD programs and 2.8 – 7.0 Mbps for HD programs.

SOME SPECTRUM ISSUES:
As we know, the Digital Dividend I (DDI) generated by the digital television transition is already history. At the World Radio Conference (WRC) in 2007 the 800 MHz band was already allocated co-primary to mobile services. In Germany the Federal Network Agency (BNetzA) auctioned this spectrum in 2010 to the mobile network operators who now provide first LTE800 services within this band. Unfortunately, the DDI was only the first step of the story: the second Digital Dividend (DDII) concerning the 700 MHz frequencies is already a done deal. WRC 2015 will decide finally what will happen to the 700 MHz band. Meanwhile there

seems to be no doubt, that this part of the spectrum will split off to co-primary use for mobile services too, ostensibly to bring broadband access to everyone in Germany even in rural areas. Thus these frequencies are lost for broadcast services.

The broadcasters in Germany now need a strong commitment from the regulator and from politicians concerning the rest of the UHF spectrum (470 MHz - 694MHz). For the migration from DVB-T to DVB-T2 broadcasters temporarily need the 700 MHz frequencies because a simulcast is planned at least in urban areas for several months. A possible clearance of the 700 MHz band from broadcast services presupposes that:
• Frequencies have to be found from the remaining spectrum for those transmitters which are operating in the 700 MHz band today (replacing of frequency allocations);
• A cross boarder coordination without the 700 MHz-band needs to be done, and the technical coexistence of broadcast and mobile services should be approved, and;
• The migration to DVB-T2 should be finalized.
Concerning the duration of the DVB-T2 migration it is foreseen to start at the beginning of 2017 or even earlier in 2016. The migration itself should be completed by 2020 at the latest, if not before.

For more information:

EBU Spectrum & Management & Regulation Group
https://tech.ebu.ch/groups/sm

Spectrum fact sheet:
https://tech.ebu.ch/docs/factsheets/ ebu_fs_spectrumdebate.pdf

Technical Assembly update

HOSTED BY CZECH TELEVISION, THIS YEAR'S TECHNICAL ASSEMBLY TOOK PLACE IN PRAGUE, CZECH REPUBLIC FROM 12-13 JUNE 2014.

The Technical Assembly (TA) is a unique opportunity for technology leaders and EBU Members to meet their peers and share information of common interest. Although circumstances for broadcasters differ from country to country, the challenges are similar and much can be gained from learning how others plan to address them.

This year's TA addressed a difficult but very relevant question for broadcasters to consider: Will consumer technology make broadcasters obsolete? Using the BBC as a case study, Andy Quested – Head of Technology, HD & UHD, BBC – posed this question, and described how audiences' expectations and actions have changed over the last years. In conclusion, Members agreed on the importance of the issue and that in order to take on this challenge, change was needed.

We also heard from Petr Viteck – Manager of International and Technical Projects, Czech Television – about digital television and its future development. An interactive discussion was led by Simon Fell – Director of Technology and Innovation, EBU – to discuss these topics in more detail.

Several presentations from Members were made throughout the TA during the "Proud to present" sessions. These included: VRT, RTVE, CR, YLE, RTE, and NHK.

In addition, three sessions with a strategic focus took place. The first looked to solve the biggest challenges in production. For example, file interoperability, new architectures in news rooms, gaps in the UHD chain, FIMS and SOA. The second targeted strategies that will shape the future for broadcasting. This session included discussions on how to make DTT services more attractive, how worried we should be about losing spectrum, net neutrality and broadcast radio distribution versus LTE. The third session took participants through the conclusions of the EBU Vision 2020 project.

2014 was a special year for the TA as it marked the year for the next TC election. Members participated in several rounds of voting to elect a new TC. The new TC elected included Egon Verharen, NPO, who was elected the new Chair and Klaus-Illgner-Fehns, ARD/ZDF-IRT, and Andy Bower, BBC, who were elected as Vice-Chairmen.

Committee members now include: Gino Alberico, RAI; Per Bjorkman, SVT; Dieter Boen, VRT; Alain Danré, FT; Galina Fedorova, RTR; Calrlos Gomes, RTP; Wieslaw Lodzikowski, TVP; Grigoris Malitos, CyBC; Thomas Saner, SSR SRG; and Petr Vitek, CT.

The second day ended with a report from Simon Fell, Director of Technology & Innovation at EBU and the outgoing Technical Committee Chair, Arild Helgren. It was a chance to take stock of the work done in EBU groups throughout the previous year and to agree the workplan for the year ahead.

A new Technical Committee and new challenges ahead

EGON VERHAREN, THE NEWLY ELECTED CHAIR OF THE NEW TECHNICAL COMMITTEE, GIVES US AN INSIGHT INTO THE CHALLENGES FACING THEM IN THE FUTURE.

During this year's Technical Assembly in Prague, Czech Republic, a new Technical Committee (TC) was elected (see the box on page 11 for a list of members). The TC represents its members on strategic technical issues and, oversees the activities as defined in the Workplan 2014-2015 as approved by the Technical Assembly. The most pressing issue that the TC is concerned with at the moment is probably the protection of broadcast spectrum. The good work that is done in the Strategic Programmes on Spectrum Management & Regulation and Future Distribution Systems (previously CTN) and Project Groups have resulted in a number of published documents. They concern sometimes politically sensitive viewpoints, and are brought to the attention of the appropriate stakeholders, often at the EU level.

The development of future broadcast production systems and future public service media services are also important topics. They may concern integrated media production systems seeking more efficient production methods and quick ways of publishing stories, or new standards on networked studios, the specification of parameters for UHDTV Phase 2, or the development of broadband services and distribution platforms. Making sure our requirements are heard by manufacturers, sharing knowledge and experience of early implementations, or helping standardize the best solutions, are all tasks that the TC takes on.

When looking at the future of Public Service Media (PSM), we are not only looking at technological developments but also internally to our own organisations and how they should prepare for the future. The EBU Vision2020 recommendations, both the general ones, as well as, the more detailed ones on distribution, technology and audiences (found in Annex 8) provide good guidelines. The implementation of them (if already possible) or the policy and strategic steps to take towards a future realising them should have our full attention. Not only have they already steered parts of the EBU Workplan, but they will also play an important role in developing the future workplan and organisation of the EBU itself - Phase 3 of Vision 2020. TC members will play an important role in this.

A particular challenge is to make sure that the rest of the EBU community and steering bodies up to the Executive Board are aware of the work that is already done in the technical community and the consequences it has, or can have, for the work of other Departments. Policy and regulatory affairs and marketing can benefit from the technical expertise brought together in the TC and Strategic Programmes and Project Groups.

Introducing the new Technical Committee Chair

Every two years, the EBU Technical Assembly (TA) elects 13 members to make up the new EBU Technical Committee (TC). The TC oversees the technical activities and policies of the technical department and submits regular reports of its activities to the TA and the EBU General Assembly.

Since March 2010, the EBU's technical activity has been divided into two main areas of work, which the TC manages on behalf of EBU Members. A series of 'Expert Communities' brings together specialists in specific fields associated with media technology and another series of 'Strategic Programme Groups' allow an interdisciplinary approach to major strategic issues facing EBU Members.

In June 2014, at this year's TA in Prague, Czech Republic, Egon Verharen was elected the new Chair of the TC.

Egon Verharen is manager R&D at Nederlandse Publieke Omroep (Netherlands Public Broadcasting) overseeing projects on new or improved broadcast- and distribution technologies and the development of new media services.

He also directs the audio- and video streaming platform for live and on demand services. He co-led the introduction of HDTV broadcasting in the Netherlands and he advises the Board and the Director of Distribution, Technology and Broadcast on technical issues.

Before joining the NPO Egon was innovation manager at the Dutch higher education and research network, and an assistant professor at Tilburg University.

He received his MSC (computer science) at University of Twente and his PhD at Tilburg University and has been a member of the EBU Technical Committee since 2010.

When asked about why he stepped forward as a candidate for the EBU Technical Committee, he told us "because I believe in sharing knowledge and I can bring to the table my knowledge and experience on both innovation and broadband networks which I believe are important for the future of public service media services."

The TA welcomed Egon as the new Chair and looks forward to his leadership over the next two years.

An insight into EBU's BeyondHD group

YVONNE THOMAS, PROJECT MANAGER AT EBU AND COORDINATOR OF THE STRATEGIC PROGRAM, BEYOND HD, WALKS US THROUGH THE GROUP'S MAIN GOALS, STRUCTURES, MEMBERSHIP AND EVENTS.

While many broadcasters remain focused on rolling out their HDTV services, the industry is looking to an even more immersive future. The BeyondHD group was created to look at the formats that lie beyond HD.

In particular, the group engages in strong liaisons with industry and standardization bodies to better understand the impact of UHDTV parameters on the image quality and viewing experience, especially, in comparison to HD formats (mainly 1080p50) along the whole chain. The group also investigates the use of new production and distribution codec technologies in HDTV and UHDTV applications.

MANAGEMENT

The group is managed by Giorgio Dimino (above, left), Research Unit Manager at RAI CRIT and the Chairman of the Strategic Programme Beyond HD (SP BHD); Dagmar Driesnack (above, centre), Engineer Production Systems at IRT Munich and vice-chair of SP BHD; and Yvonne Thomas (above, right), Project Manager at EBU and coordinator of SP BHD.

MEMBERSHIP

There are a total of 160 group members (of which 43 are EBU Members and the rest industry). Active EBU members include: IRT, RAI, BBC, VRT, ZDF, TF1, SVT, NHK and WDR. Other stakeholders include: ITU-R, SMPTE,

EVENTS
The BeyondHD group has been involved in a number of events over the last few years, including:
- **3D & UHD Test sequences production, June 2012**
- **Joint DVB-EBU UHDTV fact finding workshop, May 2013**
- **Eurovision Young Dancer production in 3D UHD p50, June 2013**
- **UHDTV "voices & choices" workshop, November 2013**
- **Joint DVB-EBU HDR workshop, June 2014**
- **Visit of BBC R&D New Broadcasting System Showcase during the Commonwealth Games, July 2014**

DVB, VQEG, DIGITAL EUROPE, MPEG, FAME, ATSC, HDMI, and BTF.

TESTING

Various tests, together with industry partners, have been undertaken over the last 2 ½ years, such as: UHD-1 versus HD on UHD screens, codec tests of Sony's XAVC and Panasonic´s AVC-ULTRA with HDTV test sequences or tests to define an appropriate HDR test methodology.

These tests always require a good selection of test material which was created, for example, in Turin, Italy in 2012 together with EBU member RAI and industry partners Sony, ARRI, DVS, Technicolor, Kamerawerk and TVLogic. Another example of test material was for the production in 3D (2 times 2160p50) of the Eurovision Young Dancer production in June 2013.

FUTURE PLANS AND DOCUMENTS

Looking to the future, the SP BHD plans to focus on more codec tests, drive the inclusion of 100Hz in BT.2020, and define requirements for UHDTV Phase 2. More test productions will be made during the Zurich European Athletics Championships' Production in HDR/HFR in August 2014. The aim is to have more test material available.

For more information on our work, the following Technical Reports are useful: *What follows HDTV? A status report on 1080p/50 and '4k'* and *the EBU Policy statement on ultra-high definition television*. The reports can be found at the following addresses: https://tech.ebu.ch/docs/techreports/tr014.pdf and https://tech.ebu.ch/docs/techreports/tr028.pdf.

NEWLY ELECTED TECHNICAL COMMITTEE (2014-2016)
Egon Verharen, NPO, The Netherlands (Chairman)
Klaus Illgner-Fehns, ARD/ZDF-IRT, Germany (1st Vice-Chairman)
Andy Bower, BBC, UK (2nd Vice-Chairman)
Gino Alberico, RAI, Italy
Per Bjorkman, SVT, Sweden
Dieter Boen, VRT, Belgium
Alain Danré, FT, France
Galina Fedorova, RTR, Russia
Carlos Gomes, RTP, Portugal
Wieslaw Lodzikowski, TVP, Poland
Grigoris Maliotis, CyBC, Cyprus
Thomas Saner, SSR SRG, Switzerland
Petr Vitek, CT, Czech Republic

# Delivering the first 4K/UHD-1 worldwide feed at FIFA WCUP'14

EMERSED IN THE ACTION, **ADI KOUADIO**, EBU, WALKS US THROUGH HIS EXPERIENCES HELPING TO DELIVER THE 1ST 4K/UHD-1 WORLDWIDE FEED AT FIFA WCUP'14.

T he FIFA World Cup has always been an event where technology prototypes and concepts meet the real world. In 2006 in Germany, the event signed the start of HDTV broadcast, whilst in 2010 in South Africa it skimmed quickly through the 3DTV hype. This year's world cup signalled the start of a commercial journey for UHDTV together with the increasing demand of contextual data (for second screen apps and social media).

Indeed, besides the NHK SHV (8K) production trials, three games hosted in the Epic Maracana Stadium were officially produced and distributed worldwide in 4K. The 4K production used up to 16 4K cameras; sometimes co-sited with the HDTV camera as can be seen in the picture below. All signals were processed in the Globosat 4K/60p OB Truck to generate the final 4K signal. The latter feed was then delivered to the EBU's (Casablanca Online) SNG over a (4x) Quad-3GSDI interface. The EBU by means of its operational branch (EUROVISION) ensured the worldwide delivery of 3 Games over its secured satellite and fibre network (see the figure contained in the world feed satellite distribution photo).
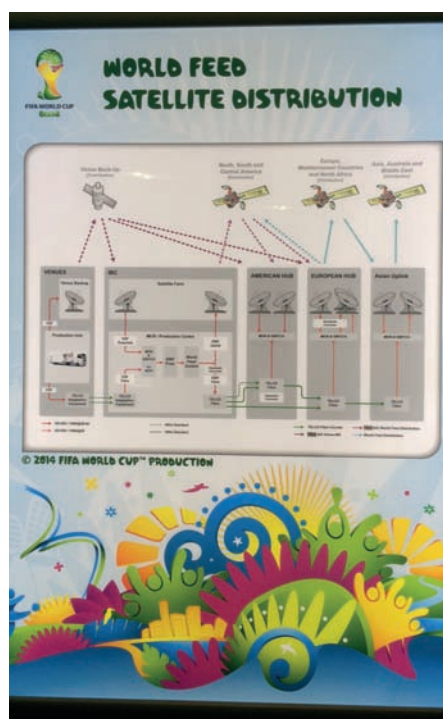
CHALLENGES QUALITY VS BIT-RATE...
The bottleneck in such transmissions is the satellite capacity which constrains the overall signal bandwidth. The 4K world feed featured a 94Mbps H.264/AVC 4:2:2 MPTS, with an audio combination of MPEG I layer II for international and commentaries, with Dolby E for customers interested in surround sound.

The resulting high quality source allowed all takers to repurpose the signal according to their use cases for example: live event cinema delivery, 4K live streaming using DASH /HEVC, 4K over DTT UK and Korea.

UHDTV-HEVC FOR DELIVERY = YES! ...BUT NOT YET FOR CONTRIBUTION
While HEVC is foreseen as the enabler of UHDTV distribution to the home thanks to its promiseof 50% gain over H.264/AVC, it is still at its early stage and we will need 1-2 years before the advent of a mature 4:2:2 single unit 4K/60p encoder and an affordable decoder. In the meantime, the established H.264/AVC systems fulfill the needs of UHDTV contribution applications.

(SCALABLE) SINGLE INTERFACE FOR UHDTV URGENTLY NEEDED
As it is well known today, UHDTV does not (yet) possess a practical, single link professional interface as its predecessor's formats (3G/HD-SDI & SD-SDI for HDTV and SDTV respectively). The

"HEVC is maturing for UHDTV distribution but still needs 1-2 years for contribution applications" ADI KOUADIO - FIFA 4K WORLD FEED PROJECT LEAD -SENIOR PROJECT MANAGER EBU T&I.

UHDTV signal is therefore divided into as many quadrants as can fit a 3G-SDI interface. The cable length and quality between each output need to be arranged to ensure perfect synchronicity between quadrants and to not affect the encoding process. Therefore, the SNG truck needs to be situated next to the 4K production truck to minimize cable length.

POTENTIAL 3G-SDI LEVEL CONVERSION
As it can be read in EBU TR 002, the 3G-SDI standard has 3 Levels (level A, Level B-DS, Level B-DL) which are not always fully supported by professional equipment. In this operation, the truck output (level B-DS) had to be converted to level A for compatibility. Knowing the potential induced delay of such conversion should be deterministic, and constant between all quadrants to ensure synchronicity.

QUADRANT SYNCHRONIZATION AT THE RECEPTION END
In the contribution domain especially in a multilateral transmission, interoperability is important due to the variety of receiver sets. Several solutions for 4K Quad HD transmission exist but mandate special communication between the encoder and decoders to ensure perfect synchronicity. The encoding solution used (based on ATEME Encoders) allowed the EBU to define a manufacturer-agnostic and cost effective 4K reception set up for the MRLs.

FRAME RATE CONVERSION
For this particular quick start of 4K/UHDTV transmissions, standard conversion was not required by the takers i.e. the signal remained at 59.94 frames per second throughout the contribution chain. It is an area of investigation that should be urgently considered in the short term for QUAD interface transmissions, and the near future single interface 4K transmissions. Especially with the introduction of (new) higher frame rates, together with higher dynamic range considered to play an important role in the added value of UHDTV.

WHAT'S NEXT?
It is expected that more major events will embrace 4K content production and delivery, waiting for the UHDTV phase 2 to become production friendly. The EBU/Eurovision will be there, ready to provide its expertise in content delivery.

Public broadcasters and access services

GION LINDER, HEAD OF SUBTITLING AT SWISS TXT AND CHAIRMAN OF THE EUROVISION ACCESS SERVICES EXPERTS GROUP, PROVIDES INSIGHT ON PUBLIC BROADCASTERS AND ACCESS SERVICES.

Access services such as subtitling, signed programs, audio description and audio subtitling are part of the identity of a public broadcaster. Their aim is to include sensorially handicapped people and to allow them to participate in public discourse.

Most public broadcasters are confronted with similar problems when it comes to access services. It is important that the processes are handled efficiently since the target groups demand more access services - but budgets remain tight. That's why the Eurovision access services experts groups meets once a year and discusses the most important issues. This year's topics are:

• Access services on all devices: More and more, the contents of all broadcasters can be received on all kinds of devices, such as connected television, tablets or mobile phones. What's the impact for a public broadcaster?

• Automatic subtitling: Speech recognition is getting better and better and therefore can speed up the production process. Some broadcasters already have implemented this technology while others are on the verge of using this technology.

• Quality of live subtitling: Most complaints about subtitling concern live subtitling, since errors may occur more often and they are never exactly in sync with the image. That's why the UK Ofcom has launched a quality initiative. What has come out of it? The results of a Pan European survey will also be presented.
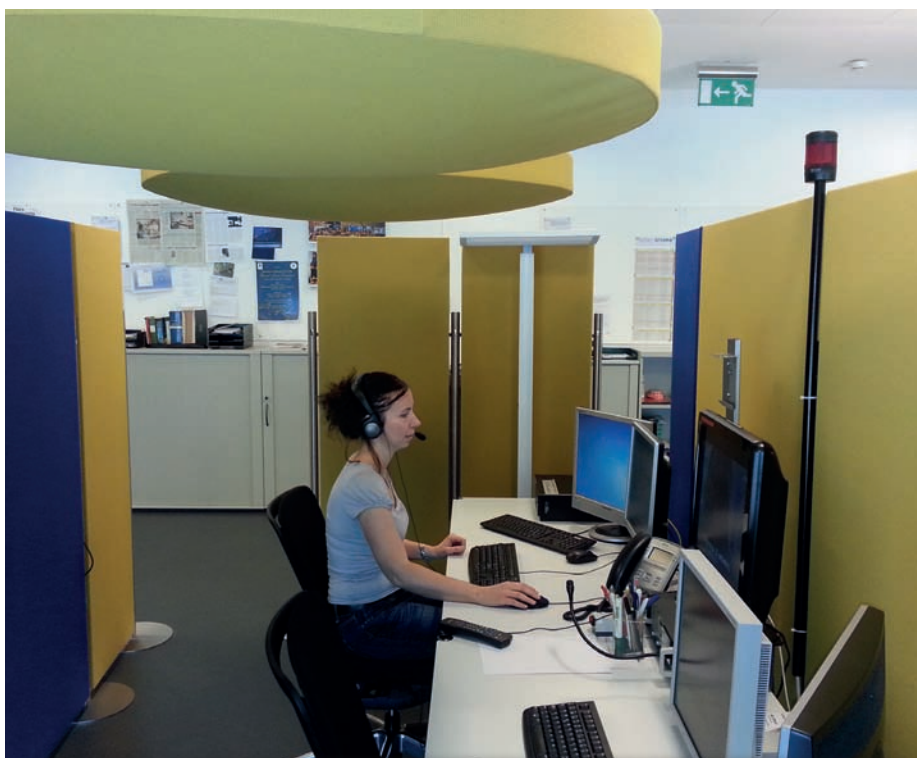
> **The Access Services Experts Group is open to all EBU Members. It's a place where decision makers can:**
> • **Discuss the future development of Access services**
> • **Present showcases**
> • **Stimulate and support the exchange of technologies, products and services**
> • **Achieve standardization in order to develop common formats, guidelines, processes and legislation for authorities and stakeholders.**

If internet supersedes broadcasting...?

THE IDEA THAT BROADCASTING WILL BE REPLACED BY INTERNET HAS MANY DIMENSIONS. **DAVID WOOD** EXAMINES A FUTURE WHERE INTERNET COULD SUPERSEDE BROADCASTING.

"All it all, it is a very complex matter with many twists and turns, and implications and knock on effects"

During the May 2014 meeting of the World Broadcasting Union's International Satellite Operations Group, a ripple ran through the room. The discussion centered on a future in which broadcasting, as we know it today, is superseded by Internet delivery of programmes. Some delegates were stopped in their tracks by the proposition that this would mean moving from a world where "we are watching TV programmes" to one where "the TV programmes are watching us". Could the demise of normal broadcasting unleash a Big Brother society?

The idea that broadcasting will be replaced by Internet has many dimensions. The advantages could include the convenience of being able to watch programmes at any time and on any device, and the prospect of governmental income from selling the hitherto broadcast spectrum. The disadvantages could include lower technical quality, lower reliability for the users, higher costs for the user, and a greater cost to the environment because of the higher energy consumption.

There may be some parallels with transport. Even though private cars cost more per usage than public transport, are more damaging the environment, and congestion stifles the roads, for better or worse, they are still something that most people want. Convenience, even if only available sometimes, is worth a great deal to us. We are prepared to pay, and put up with a lot, for it.

But the WBU meeting brought home to delegates that there may be another aspect to consider. Watching a free to air broadcast is done by the viewer in complete anonymity. No one knows what, when, and how you watch. A broadcast is like rain from the sky. Your privacy is complete.

If our TV diet were served only by Internet it would be different. Internet programmes would be seen by the viewer because a conscious request has been made to the programme provider. What he delivers is a package that has your 'address' on the front. All the details of what happened are recorded by a combination of the ISP and the content provider. Even the specific terminal (the MAC address) used to view it is recorded. The ISP may assign you an address which, as an intermediary, it sends to the programme provider, but the programme provider still knows generally where you are, because it knows the ISP's coverage area. If an authority cares to use the ISP data, if can find out exactly who and where you are.

The addressing information can also be used for 'traffic analyses'. The content provider will know, at any time, how many are watching, and generally where they are. This may be an advertiser's dream, but some argue that it may also mean more incentive for less challenging programme content. Knowing the ISP's coverage can also be used to stop content from being provided in certain areas ('geolocation') for copyright reasons.

Is it possible to arrange Internet delivery of programmes so that they are viewed 'anonymously', in a broadcast-like way, if you or society in general, concludes that this is needed? The answer is a 'maybe'. For some years the 'Tor' project has been devising a system which can be arranged, not to stop the Internet addressing system from working, by rather to confuse anyone who wants to know who is watching or consuming what. If you use a Tor browser, the path that the request takes is not direct but chosen to confuse. It is like going on a car journey but via a random erratic route, and where you keep changing cars too. There are reports that it is effective, but equally reports of its weaknesses. There are also views that it can be used for ill as well as good to hide criminal activities. The debate seems likely to take quite some years.

However, defeating geolocation is becoming more and more common place.

All it all, it is a very complex matter with many twists and turns, and implications and knock on effects. Such is human nature that having a system like Tor invites people to try and try again until they break it. Could it be said that, on balance, maintaining broadcast services would be a much simpler way of providing anonymity, and of course have the other technical advantages of broadcasting? What do you think? If you will excuse me, I am just going to catch a train.

Higher dynamic range

ANDY QUESTED, WHO CHAIRS ITU-R AND BTF GROUPS ON HIGH DYNAMIC RANGE, TAKES US FURTHER INTO THE OPTIONS FOR A HIGHER DYNAMIC RANGE FOR TELEVISION. READ PART ONE IN THE LAST ISSUE OF TECH-/ FIRST.

As explained in Part 1 of this article, using an alternative OETF (Opto Electronic Transfer Function) and more bits/sample compared to that used today may increase the image quality of the video signal. Bear in mind that the gamma curve (the specific OETF used today) specified in ITU-R BT.709 was designed to approximate the subjective 'lightness' curve of the human visual system. But in quantising a video signal, the objective is to avoid contouring, not to provide uniform perception of noise. So, in quantising a video signal, the important characteristic is the human visual system's ability to distinguish similar values of brightness.

It seems that visual lightness is an example of Steven's law, which is that the perceived relative intensity is a power law of the physical relative intensity. The best estimate of the exponent for lightness is CIE 1976's value of 0.42. So an 18% reflectance grey card, often used in the film industry, has a lightness of 50% (0.18**0.42≈0.5) and appears midway between black and white.

The 'just noticeable difference' in brightness is governed by Weber's law (modified to the De Vries-Rose law at low luminance). Weber's law is that detectable difference between brightnesses is proportional to the brightness level. For brightness, the Weber fraction of cone cells in the eye is between 2% and 3% [Davson], which means that subjects can reliably detect a change of between 2% and 3% in brightness.

Weber's law suggests that a logarithmic OETF (signal ∝ log (relative luminance)) would provide the maximum dynamic range whilst rendering quantisation steps imperceptible. A Weber fraction of 2% means we could quantise a 100:1 dynamic range, without perceptible contouring, using 233 quantisation levels, i.e. 8-bits/s.

To produce a video signal with higher dynamic range, and because of the limitations of the Rec 709 OETF (even with a knee), many electronic camera manufacturers have designed their own OETF which are mostly 10-bit/sample. These include: Filestream [Thomson] (Thomson), S-Log [Sony] (Sony), Panalog [Galt][Panavision] (Panavision), Log C [Brendel] (Arri), Canon Log [Thorpe] (Canon, only 8 bit). Not surprisingly these
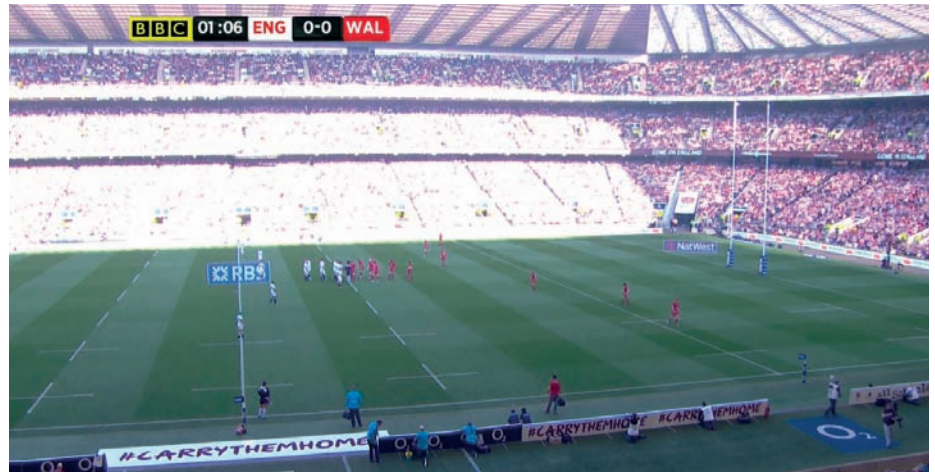
are all quasi-log curves. Other logarithmic OETF have been proposed in different contexts [Thiele][ITU H264][ITU H265] . With a Weber fraction of less than 1%, a 10-bit log transfer characteristic can achieve a dynamic range of greater than 10 000:1.

Given the benefits in terms of dynamic range you could ask why a logarithmic transfer characteristic has not been adopted for video production and distribution. The reason seems to be that the dynamic range of TV sets has been limited to 100:1, which does not require a logarithmic curve, and that a logarithmic curve would be incompatible with the installed television infrastructure. For video production, either a knee characteristic was introduced to extend the dynamic range of video cameras, or non-standard OETFs have been used for capture and then converted to a Rec 709 gamma characteristic after post-production. Now, however, if a higher dynamic range for the end viewer is required in new Ultra High Definition (UHD) television standards a conventional gamma curve, even extended to 12-bits, is no longer adequate.

THE MATHEMATICS OF THE OETF/EOTF

A new OETF has been proposed to provide a higher dynamic range for video and movie production and distribution [Miller et al]. This OETF is based on the human contrast sensitivity model developed by Barten. The OETF is modelled in the equations below. Here V is the signal value

and Y is the brightness.

$$V = \left(\frac{c_1 + c_2 Y^n}{1 + c_3 Y^n} \right)^m$$

v[1]

$$n = \frac{2610}{4096} \times \frac{1}{4} \approx 0.15930176$$

$$m = \frac{2523}{4096} \times 128 = 78.84375$$

$$c_1 = c_3 - c_2 + 1 = \frac{3424}{4096} = 0.8359375$$

$$c_2 = \frac{2413}{4096} \times 32 = 18.8515625$$

Extending the dynamic range to encompass Y=0.0001, a dynamic range of 10 000:1, the Weber fraction increases only slightly to 2%. However the proposal extends the dynamic range to 107:1, from 0.001 cd/m2 to 104 cd/m2. This is achieved by increasing the Weber fraction to 4% at Y=10-5, 9% at Y=10-6, and a huge 29% at Y=10-7 (full details in [Miller]). This can be justified by equating the value of Y=1 to be 104 cd/m2, because then the tiny values of Y (<10-4) correspond to very low light level to which the eye is much less sensitive. At these low light levels the threshold for just noticeable differences is a much higher than at more typical levels of illumination.

Whilst the objective of achieving a wider dynamic range is admirable, the practicality

[1] ITU H264/MPEG AVC & H265/MPEG HEVC both define two logarithmic transfer characteristics in Table E4, options 8 &9.

of such a change has yet to be established. It is not clear that such a large dynamic range is needed for image display, since the simultaneous dynamic range of the eye is probably less than 104. Furthermore the dynamic range of film and the best electronic cameras is also about 104. And a dynamic range of 104 (100 times more than conventional television) may be achieved with a simple 10-bit log OETF with a Weber fraction of less than 1%.

Ideally though, it is better to keep an HDR programme in that format right through to the transmission encoder so how can you show it on current dynamic range TV? After the experience of dual versions of programmes for 3DTV, no one really wants to repeat the process by having to make two versions of a programme with different dynamic ranges. Real time conversion (tone-mapping) is essential.

Tone mapping could be said to be a re-quantisation of the image pixels. But how can this be achieved? One possible way might be to use a process that effectively converts the HDR signal to a linear gamma-space representation, and then emulate the processing used in broadcast cameras conforming to ITU-R BT.709 with a fixed 'knee'. Receiver manufacturers might like this idea as it is relatively simple to implement, and requires no metadata.

JOIN THE DEBATE
Modern displays have the potential to support higher dynamic range images, but remain limited to 100:1 dynamic range by existing infrastructure and standards, particularly for interfaces because from the beginning of television almost until the demise of the CRT display the same image formats were used for production, exchange, distribution and display.

There are some who say that given a dynamic range of say 1 000 000:1 (about 20 stops), it would not be 'appropriate' to define a display that could handle this in a single image as it would not be possible to see detail in the black due to the glare in the human visual system from the highlights!

Individual scenes should take advantage of different sub-ranges within the displays 'dynamic range'. Dark scenes with lots of shadow detail should be rendered at lower levels while brighter scenes with very bright highlights should be rendered at much higher levels.

Over the next few months there will be much work on different OETF/EOTFs and the debate on what Image Dynamic Range actually means, so if you would like to see an end to images like this;
Join the EBU Beyond HD group (https://tech.ebu.ch/groups/beyondhd).

Roadmap for the evolution of Digital Terrestrial Television – A bright future for DTT

DigiTAG is aware that the TV industry is going through rapid changes to meet consumer demand and expectations through the adoption of new technologies and services. In a new report written by DigiTAG, in collaboration with Analsys Mason, DigiTAG provides reference materials on the evolution of DTT technologies and development in different countries around Europe, from adoption to migration, to improve the DTT offering to consumers.

The report is structured into four main sections. First, it develops an overview of DTT technology availability in Europe and a roadmap up to 2030. Second, it characterises the current DTT situation across the European Union (EU) using selected reference EU countries as examples of possible types of market development. In order to describe potential DTT technology future adoption roadmaps, the report also includes three simple progressive evolutionary DigiTAG profiles. It finally provides some conclusions related to today's DTT platform role and its potential evolution over the coming 10 – 20 years. DigiTAG expects this report to provide a reference for the TV industry when discussing the future of DTT.

The evolution of the DTT technologies mentioned in this report, the associated DigiTAG profiles and the efforts of the TV industry together suggest DTT is ready to continue playing an essential role as the TV distribution platform in Europe. Therefore regulators and policy makers must provide the right long term framework for DTT. The DTT industry is well prepared, with the support of consumers, to ensure the DTT platform remains a strong TV distribution platform and it has a bright future!

The report will be available at this year's IBC 2014 event and a further in-depth PowerPoint presentation will be available to DigiTAG members. If you would like a copy of this report please visit the DigiTAG stand at IBC, Hall 10 Stand F29.

This report has been prepared by DigiTAG with the support of Analysys Mason.
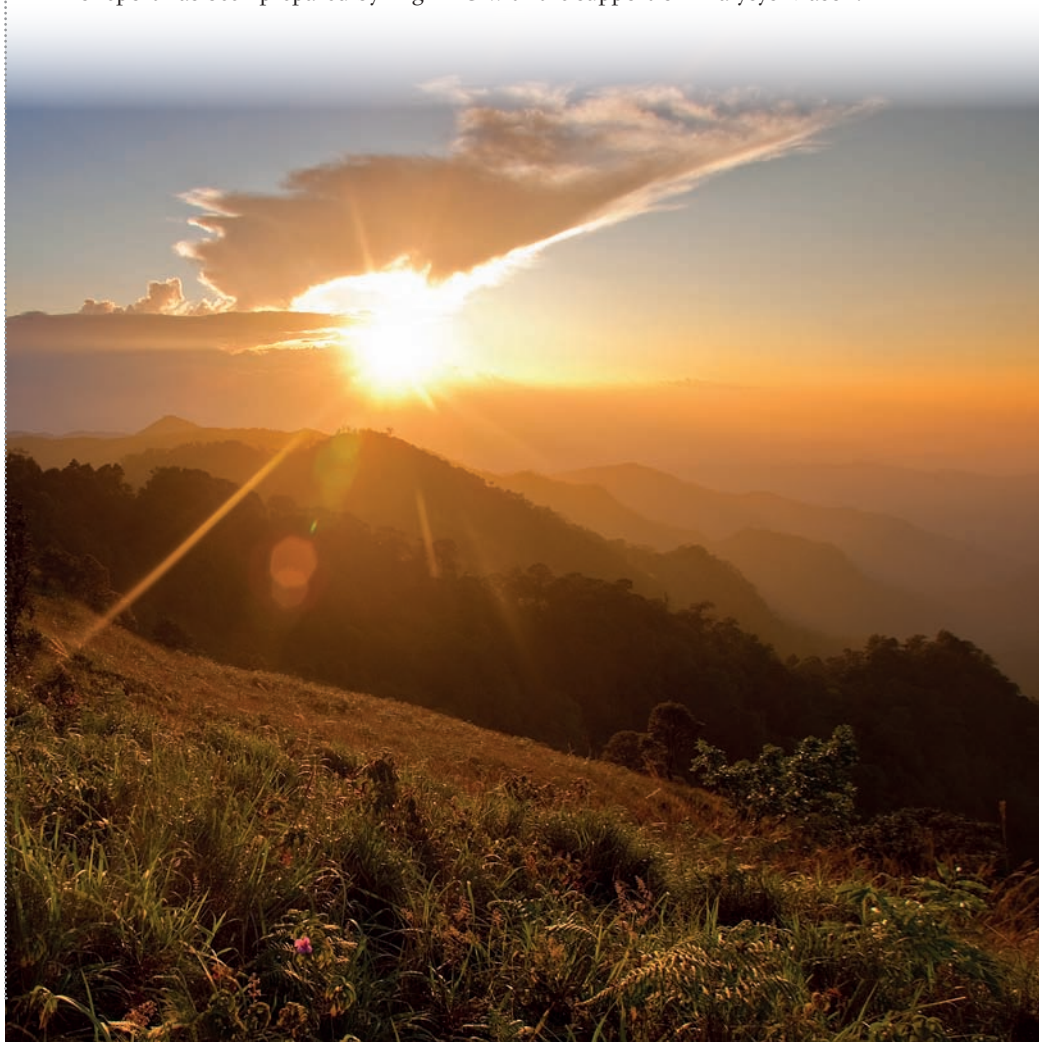
Getting your teeth into digital

DAVID WOOD LOOKS BACK AT THE BIRTH OF DIGITAL TV.

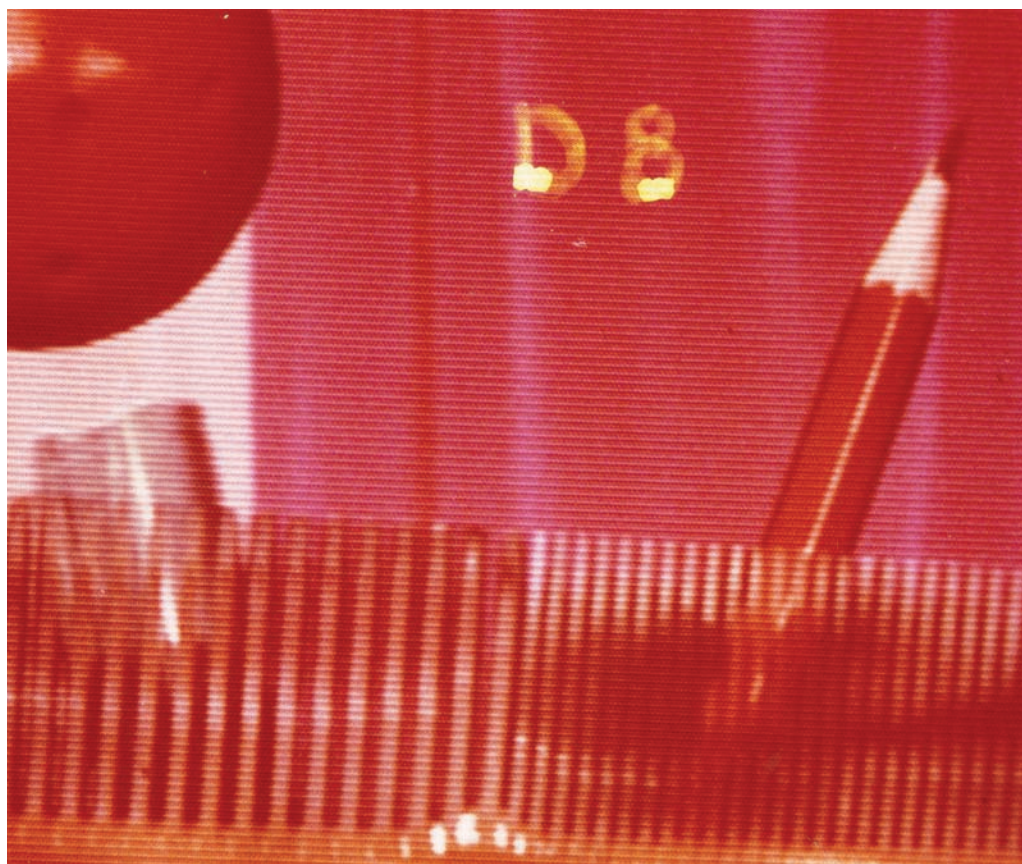DETAIL FROM THE COLOUR MATTE WITH COLOUR COMPONENT OF ONE THIRD LUMINANCE

A humble comb is the father of the TV systems that we have today. Don't believe me? Read on.

Thirty five years ago, in the late 1970s, the broadcasting world knew that the future of television would be digital, and the first step would be a digital standard for making programmes. By 1981 there was much agreement about what it should be... but one element remained. The answer came with a comb.

The back-story is that in the 1960s analogue colour TV in Europe had many patriotic flavours - PAL and SECAM plus the variants. In the 1970s, everyone recognized that Europe needed a single digital television production system. But it couldn't be a digital version of either PAL or SECAM - the losing systems would find that unfair.

In summer 1979, Europe agreed that it would turn to a new approach, choosing neither PAL nor SECAM - but digital 'Component Coding' - three individual digital bit streams. One stream was 'Luminance' - essentially the black and white image (or Y). The other two streams were 'Colour Difference' signals (or U and V). The Y, U, and V streams are mixed together in the TV set to create the colour picture.

The second step was to identify what level of luminance and colour difference signals were needed. A law of diminishing returns applies to detail in the picture. The amount of detail is related to the 'bandwidth', and the corresponding digital 'sampling frequency' creates digital numbers out of the bandwidth. No one wanted more than could be discerned by the viewer - that would be just wasting money.

1980 showed that picture quality improved as the bandwidths and sampling frequencies increased, but it did flatten off. Tests were made with the viewers sitting at given distances from the screen - some at four and some at six times the height of the screen. If you increased the luminance' sampling frequency beyond 12 MHz and the colour difference components' sampling frequency beyond 4 MHz, you were wasting your money, because it could not be seen. The magic ratio of luminance to colour difference was three to one. Our eyes are much less sensitive to colour detail than to black and white detail, so this sounded logical.

But digital television is by nature very easy to manipulate, so we guessed that with digital, programme production staff would want to use all the new toys available in the digital world for processes like special effects. We needed not only fine picture quality out of the camera, but also fine quality 'post production'.

A series of tests were done of all the processes likely to be needed in post-production including: expanding and compressing image size; applying digital compression for a 140Mbit/s transmission line; recording the images on film; going back and forth from digital to analogue. In all cases, the numbers 12MHz and 4MHz, the three to one ratio, held up well.

The final test was for a process then well used in the movie world, 'colour matte' or 'chromakey'. This is a way of combining two images so that they appear to be a part of a single image. Image elements are shot against a pure blue or green background. When the electronics finds blue it switches in a second image - and hey presto, a combined image.

A whole series of colour matte foregrounds and backgrounds were used for the tests. The three to one ratio held up well. That is, until we found the 'combs' test image, which is shown on

DETAIL FROM THE COLOUR MATTE WITH COLOUR COMPONENTS WITH COLOUR COMPONENTS OF ONE HALF LUMINANCE

THE REFERENCE COLOUR MATTE WITH FULL BANDWIDTH RGB

the right. The reference image here is a colour matte composite image of how the combined foreground and background should look.

But now, for the first time, the three to one ratio did not look good - as the detail shot from the screen below shows. You cannot see the light background curtain through the comb teeth. To see the curtain you have to increase the ratio from 'three-to-one' to 'two to one', as shown in the detail screen shot below the last.

Because of this, the ratio of luminance to colour difference components was chosen to be two to one. This is cited as '4:2:2.' This ratio is what we continue to find in television production systems today, for standard definition, high definition television, and ultra-high definition television.

In the final ITU system, the 12MHz sampling frequency was increased to 13.5MHz, not for quality reasons, but because this meant the same sampling frequency could be also used in North America and Japan.

But the 4:2:2 remained: I wonder whose comb it was?

Gino Alberico

IN EACH ISSUE OF TECH-I WE ASK A MEMBER OF THE EBU TECHNICAL COMMITTEE TO STEP INTO THE SPOTLIGHT. THIS TIME IT'S **GINO ALBERICO**'S TURN. HEAD OF STUDY AND RESEARCH AT RAI IN ITALY.

WHAT ARE YOUR CURRENT RESPONSIBILITIES AT RAI?
As Head of Study and Research at RAI R&D my role is to coordinate research activities in the domain of services and delivery platforms and to evaluate the strategic impact of new technologies and support their deployment into the company's operational processes.

WHAT DO YOU CONSIDER AS YOUR FINEST ACHIEVEMENT SO FAR IN YOUR CAREER?
In my 25 years at RAI I've been involved in many interesting activities. Among others I like to recall all the introductory activities in the late 1990s which led to the launch of RAI digital services both on the terrestrial and satellite platforms. In more recent times, the development of services on new platforms such as catch-up TV and VoD services on connected TVs as well as Digital and Hybrid Radio.

WHY DID YOU STEP FORWARD AS A CANDIDATE FOR THE EBU TC?
Because the Technical Committee is the place where common EBU positions on subjects such as spectrum, technical and industry standards are elaborated, allowing EBU to speak with authoritativeness in the various international bodies, organizations and institutions. For these reasons I'm glad to contribute to the TC work sharing my personal experience and also learning from other members.

WHAT, FOR YOU, ARE THE MOST IMPORTANT CHALLENGES FACING EBU MEMBERS TODAY?
Challenges are coming from actors and companies in many different business sectors, all competing to gain control of content and how they are accessed by the final users. In this context the most important challenges for broadcasters are evolving their infrastructures with the migration to IT-based production, improving technical quality of picture and sound to state-of-the-art HD/UHDTV, and being relevant with their presence on all media platforms.

TELL US ABOUT SOME OF YOUR INTERESTS AWAY FROM THE WORKPLACE.
During the warm season I enjoy hiking and cycling on the mountains surrounding Turin and in winter I have fun snowshoeing on the same mountains. I am also passionate about photography, in particular, exploiting the possibilities offered by searching or creating unusual lighting conditions.
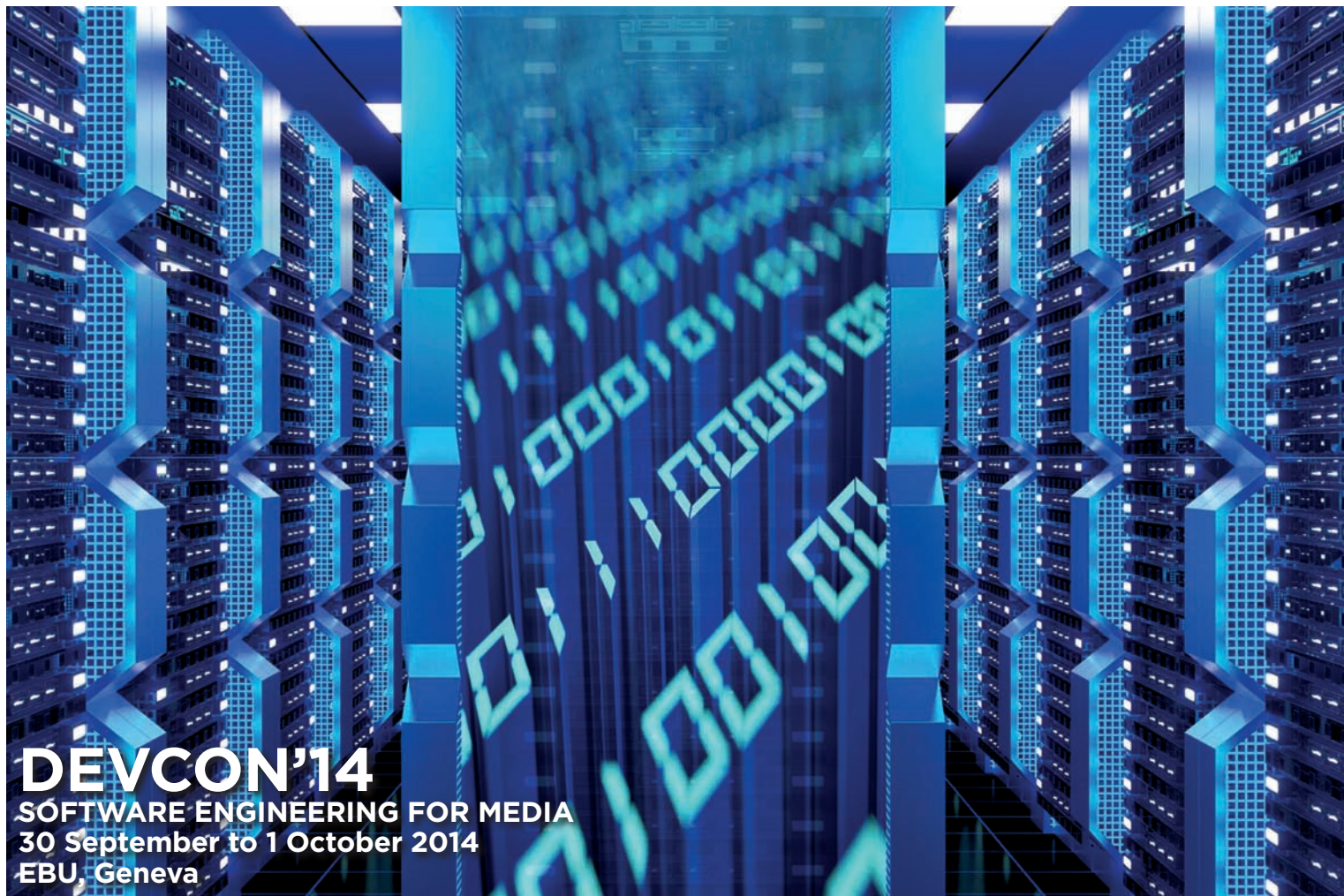
DEVCON'14
SOFTWARE ENGINEERING FOR MEDIA
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