tech-*i*

INSIGHT FROM EBU TECHNICAL

Contents

Issue 11 March 2012

WHITE SPACES

№ 0101010

EBU TECHNICAL
EBU·UER MEDIA TECHNOLOGY & INNOVATION

http://tech.ebu.ch

Radio, the quiet evolution

Radio, which was the founding medium for many broadcasting organisations and technology companies, typically receives a lot less attention than it deserves. However it is not – and should not be – a forgotten medium.

Many important technology developments had their origins in radio, partly because audio is easier to manage and process than video. I'm thinking here about early compression schemes (MPEG, MP3), COFDM, multiplexing and digital broadcast, internet streaming and P2P networks for music sharing, hybrid services... and there are probably other examples. It's clear that radio can be seen as a trendsetter for potential future evolution in other media.

But what about the future of radio itself as a medium? What do we see (or hear?!) on the horizon? It continues to be hugely popular, reaching more than 90% of the population each week in many European countries (EBU report: Public Radio & New Media Platforms 2011). Radio receivers are present in many devices. Indeed almost everyone has an FM receiver in their pocket in the form of a mobile phone – but it's not always activated. However it is in digital that the real future for radio lies.

The status of digital radio implementation varies quite significantly across Europe. While we can be certain that FM will live on in some European countries even for decades, others are moving towards an all digital market at an impressive rate. In Norway it seems that FM switch-off is not too far away. (See page 11.) A set of conditions has been defined under which, if met, the FM network would be switched off in January 2017 and the country would rely on DAB+ only. These conditions, which are seen as realistically attainable in Norway at least, include 99% coverage for the NRK network, 90% for the commercial channels, and a daily reach of 50% for digital platforms. The checkpoint for these conditions to be met is at January 2015.

But beyond coverage and reach, there are issues related to the receiver market. The car is seen as the key listening location. The Norwegian government also requires that adaptors for the 1-2 million cars that will not have DAB radios should be available, should work well and should be reasonably priced.

> "...radio can be seen as a trendsetter for potential future evolution in other media..."

It could be argued that the car will be the driver (!) for digital radio rollout – if digital radios become standard in all new cars, it will be much easier for listeners to experience for themselves the leap in quality and convenience that digital brings. At CES 2012 one vendor unveiled a new chipset incorporating FM, AM, DAB/DAB+ and DRM. This is an important milestone in making digital radios in cars ubiquitous.

Turning to radio on broadband and internet, other than streaming radio platforms we see interesting new developments like Spotify. Spotify is more than a huge music library: it is a music service platform. It opens opportunities for radio brands to extend their media offer by creating their branded weekly playlist in Spotify and to interact in a social way with their fans. Their growing success and the way these platforms are starting to be used by radio organisations can be seen as an early signal for what will follow in the television world in the coming years.

At the EBU's Digital Radio Summit during February, delegates got an insight into some of the exciting developments to emerge from the radio community. Radio developers are a resourceful bunch as was clear from the RadioHack workshops. Technologies such as software-based radio, RadioDNS and hybrid radio make it possible to leverage broadband networks to bring new tools and services to listeners. For the smartphone generation the soundtrack is all important – and digital radio, complemented by internet platforms, is well placed to provide that soundtrack.

Lieven Vermaele
EBU Director of Technology & Development

Cover: With acknowledgement to Richard Hamilton's 1968 record sleeve for the eponymously titled album by The Beatles. Commonly known as "The White Album" it was completely blank other than the band's name and a stamped serial number to give it the feel of being a limited edition. Learn more about how White Spaces can be used on page 8.

Visit http://tech.ebu.ch to subscribe to tech-*i* free of charge

Published by EBU Technical
European Broadcasting Union
17a, L'Ancienne-Route,
CH-1218 Le Grand-Saconnex, Switzerland.
Editor-in-Chief: Lieven Vermaele
E-mail: tech@ebu.ch
Tel: +41 22 717 2111

Editors: William Daly, Harold Bergin
Production: WHD PR
For editorial & advertising enquiries contact:
Eoghan O'Sullivan
E-mail: osullivan@ebu.ch
Tel:+41 22 717 2745
Printing: New Goff n.v.

LED Studio Lighting for Film & TV

The challenges and a possible solution

The EBU FTV-LED Group reports on the research being undertaken to produce an EBU Recommendation for Lighting Measurement.

All around us we see the world by light reflected from objects, and then we judge those objects by what we see. Would we normally question the lighting source if we thought that a person looked ill when their skin tone looked pale? When a television or film camera captures the wrong colour it is firmly embedded in the signal, and no colourist can correct all the problems created by this.

The physical effect that is responsible for this is called Metamerism, and it remained a scientific colour vision curiosity until the public started to purchase clothes in shops that used fluorescent lighting. They soon looked at the colours of their purchases under daylight and saw the differences. In fact, daylight and that other staple source of light the tungsten filament lamp have continuous spectra, whereas the high efficiency flourescent lights feature a 'spiky' spectrum. This can be best illustrated by colour photographs that featured a green cast caused by these light sources.

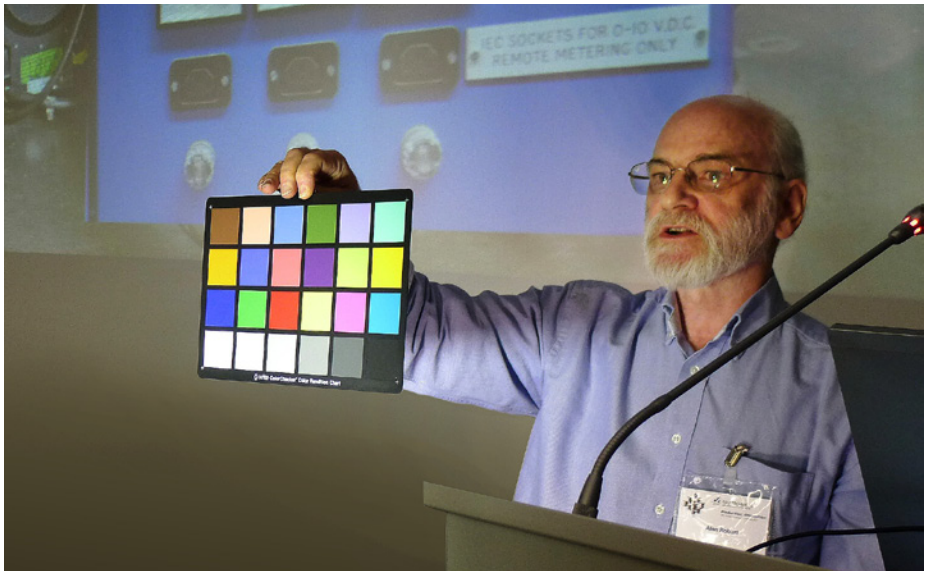
Modern white LED sources are even worse than fluorescents in some respects, as LEDs usually consist of a visible blue emitter with an amber phosphor. Apart from a lack of the important blue-green spectrum there is no ultra violet content at all in these sources, unlike daylight or even tungsten filaments. Although neither humans nor cameras can directly see UV light, the whiteness of paper and shirts or the vivid colours of the 1980s depend on it for their colour appearance.

Consequences for Production

The inevitable introduction of high efficiency lighting (such as LED) is leading to a number of unintended and possibly expensive consequences of colour reproduction for both television and film production. However, LEDs offer several advantages in terms of efficiency (reduced power consumption), lighter weight and less need for power hungry air conditioning systems. For those reasons LED light sources are economically very attractive for the broadcasting and film industries.

Studies show that the lighting industry's Colour Rendering Index (CRI) is inappropriate for television because of the floating white point, the use of an outdated colour space, and because it is aimed at human vision rather than the reproduction of a scene viewed by a TV camera. The aim of the work within the EBU FTV-LED group is to develop guidelines to adapt the new lighting environment to the existing

> The Colour Rendering Index is currently the only standardised metrology available for quantifying lighting quality for colour rendering.



Alan Roberts demonstrates the impact of different LED lights during his presentation at the recent EBU Technical Production Technology Seminar.

Figure 1:
An illustration of the differences on camera between daylight and basic white LED lighting of the same colour temperature. Note the first two patches on the test chart represent skin tones.

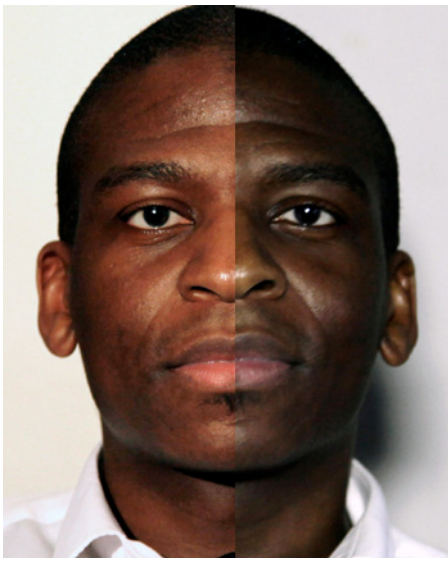


Figure 2:
The picture illustrates the impact on skin tones while using LED lighting.
Skin tones should appear natural, otherwise the subject could look ill.

camera model. The next step would ideally show how these studies could lead to the design of a 'Standard Camera' model, much along the lines of the human CIE (International Commission on Illumination) 'Standard Observer'. Based on this work a 'Television/Film Lighting Consistency Index' (TLCI) will be proposed with the aim of further standardisation by the CIE.

Colour Rendering Index

The Colour Rendering Index is currently the only standardised metrology available (from the CIE) for quantifying lighting quality for colour rendering. Unfortunately, it is far from ideal for a TV environment because:

- Three of the more saturated test colours lie outside the TV colour gamut
- CRI is only defined for light sources that are approximately white
- CRI has a discontinuity in the measurement technique for light sources with a correlated colour temperature below and above 5000K
- CRI does not always correlate well with subjective colour rendering, particularly for light sources with spiky emission spectra such as fluorescent lamps or white LEDs
- It relies on the outdated, perceptually nonuniform, CIE 1964 colour space
- We do not know yet how (or even whether) the numbers it produces correspond to the accuracy of colour reproduction in a TV system, since it is designed for human rather than camera vision

Nonetheless, with the current immature state of the market in low-energy TV lighting products, CRI gives a first indication of which lights are most likely to produce reliable results on TV.

Other activities

In the US, the National Institute of Standards and Technology (NIST) has developed the 'Color Quality Scale' (CQS) in an attempt to improve the behaviour of the CRI as LED light sources become more widely used. In addition, PLASA (a diverse organisation operating within the entertainment technology industry), in their Technical Standards Program have referred to the CQS ('Recommendations for Measuring and Reporting Photometric Performance Data for Entertainment Luminaires Utilizing Solid State Light Sources'). It is a step forward, compared to CRI for visual appearance using LED lighting, but still does not address TV lighting requirements. The important point for the broadcast and film industry is that the scene will be viewed by a TV/film camera and not the human eye as presumed in the CRI/CQS.

Television Lighting Consistency Index

The BBC pioneered some research with the development and proposal of a Television Lighting Consistency Index (TLCI) in the 1970s and 80s, which now needs to be updated for modern camera channels.

This research is now being taken forward by the EBU FTV-LED group. The aim is to produce an EBU Recommendation on lighting measurement, as many EBU Members already have LED lighting in use for their daily production, and submit this for international standardisation through the CIE.

The TLCI specifically quantifies the quality of colour reproduction of a series of standard test colours through a standardised TV camera and TV system. It considers the differences in reproduced colour, which would be observed for each of the test colours by comparing the light source under test with reproduction under standard lighting conditions. It does this through the measurement of the spectral characteristics of the light source. It is proposed to use the test colours of the 'Macbeth ColorChecker' chart for this work. Figure 1, the 'Macbeth ColorChecker', shows the different appearance of a set of colours under different lighting conditions. Figure 2 shows how a particular skin tone is affected when two different LED light sources are used simultaneously.

Until such a TV-specific measurement method is available, it is highly advisable that proposed light sources should be tested in a studio environment using the cameras with which they will operate. By observing the variety of colours in the set, costumes/clothes and skin tones, users can form an opinion on what type of LED lighting sources will best fit their requirements regarding colour rendition. In particular, there is a special need for care and testing where different types of light sources are to be mixed.

As shown in Figure 1, it becomes obvious that even with the best possible settings/matching of cameras there will be a need for advanced colour correction to rectify the observed errors. Without going into detail, it will take experienced colourists considerable time in post-production to make these corrections (scene by scene) using advanced multi-vector colour correctors. The cost of this can quickly outweigh the argued economical savings indicated by using LED light sources with their higher efficiency, lower power consumption and very little need for air conditioning.

Colouring the Future

Alan Roberts gives a personal view of colourimetry for the television of tomorrow and the quest for a future-proof solution.

With luck, UHDTV (Ultra High Definition TV) could be the last ever new television standard, so we should try to get it right. And that means understanding why the earlier standards aren't perfect. Conventionally, the gamut of displayable colours depends on the system primaries alone, but the colour accuracy depends on the coding system. Until now, the display primaries have always defined the system primaries, but that need not be so for UHDTV, since complex signal processing of a type impossible 40 years ago is now routinely simple.

Imagine a system in which the system primaries are not defined by the display primaries. The system primaries could be wide enough to encompass all visible colours, but the display primaries could be anything achievable at the time, and could be different in different displays. All that's needed is a look-up table to convert the transmitted signals in the display; a ROM (although a big one). That way, all displays could be accurate within their own colour gamut, they would all look the same, and we would finally get away from the restrictions of 1950's manufacturing technology.

The simple way to do this is to use very wide gamut system primaries, such as CIE XYZ. Any professional camera can be made to do this fairly easily (at the design stage), so the transmitted signals are then XYZ rather than RGB and all visible colours could be coded without problem. The X and Z signals can be regarded as colour, because the Y signal is defined to be luminance[1], so some form of bandwidth reduction coding and filtering can be done as usual. In the display, the XYZ signals would be decoded from the transmitted signal, then converted by matrix or look-up table into the RGB signals needed to drive the actual display. The only fly in the ointment is the nonlinearity of human vision.

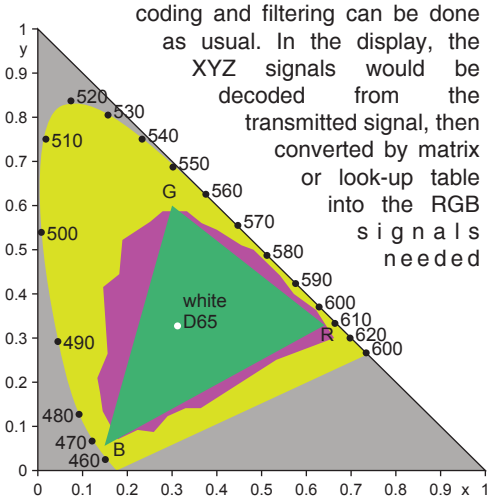


Figure 1. Colour Gamuts

Figure 1 shows the colour gamut of ITU R.709 primaries (green area), Pointer's Gamut of Real Surface Colours from 1980 (magenta, the limit of reflective colours at that time), the gamut of all visible colours (yellow) and that of a system using XYZ primaries (grey). Clearly, XYZ copes with everything.

Human eyes do not respond linearly to changes in light intensity, the response more closely resembles a logarithmic curve, which can be approximated with a power law. The CIE has an equation for this, the L* curve, which produces values from 0 to 100:

$$L^* = 116(Y/Y_w)^{1/3} - 16 \text{ for } Y/Y_w < 0.008856$$

$$L^* = 903.29(Y/Y_w) \text{ for } Y/Y_w > 0.008856$$

… where Y_w is the luminance of peak-white. The curve of a conventional high grade monitor is a power law of 2.3 to 2.5 (the ITU is settling on 2.4) which is a decent match to the L* curve, fortunately. This means that our conventional displays are a good match to our eyes. Let's keep that feature, for it means that small perturbations to the signal have equal visual significance irrespective of the signal level at which they occur (noise, compression effects, etc.).

So, we should keep gamma-correction, and apply it to the XYZ signals. This makes the display a little more complex, since the matrix conversion from XYZ to the display RGB must be done on linear signals. And that means removing the nominal gamma-correction in the display (i.e., applying a power law of 2.4), and reapplying it after the matrix (i.e., applying a power law of 1/2.4). But it's still only a single operation, a look-up table. Figure 2 shows the processing, in which it is obvious that the two nonlinear operations and the conversion matrix can all be done together in one, numbers-in to numbers-out.

There are two snags to this method - compatibility and coding efficiency. The signals generated in the camera will not be compatible with those of any other system, but the conversion is simple, as it is the same as in the display. And the camera signals will fully use the coding range, since the XYZ gamut is much larger than the gamut of visible colours, so this coding would need, probably one extra bit per channel compared with standard coding.

Adopting this technique makes the system fully future-proof, and applicable to any display, which, surely, has to be a good thing.

Alan Roberts joined the BBC's R&D Department in 1968 as a Research Engineer. He was part of the team that worked on the Eureka95 HDTV project and represented the BBC on EBU and Eureka committees as a colour scientist. From this HDTV work in the 1980s and 90s he developed the 'film-look' favoured by drama and wildlife programme-makers, devising ways to use the new technology to lower production costs without compromising quality. Now in retirement, he continues as a consultant on colour science and HDTV matters, advising manufacturers and programme makers on HDTV developments. (Please note that Matilda the wombat, while friendly, is not available for consultation.)

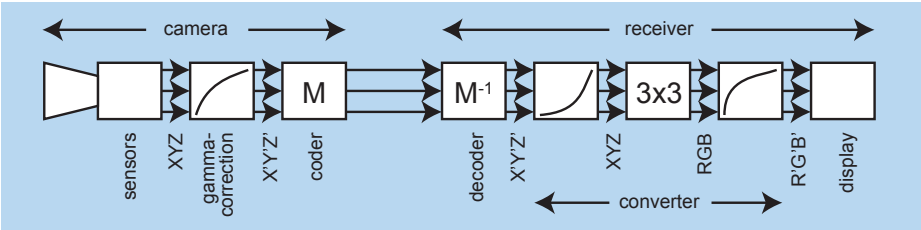


Figure 2. Block Diagram

[1]In this maths, the Y signal really is luminance, rather than the luma signal Y' generated in normal standard coding from gamma-corrected R'G'B' signals. So there is total separation of luminance and colour information, unlike for standard coding today.

Media Storage

Enterprise storage and the Cloud

The BBC's Chris Chambers and EBU Technical's Félix Poulin explain the work of the Future Media Storage Systems project group and its mission to provide reliable information on how storage systems can achieve their specific business needs.

Introduction

Media content storage is a fundamental technology in broadcast operations. Traditionally, recording audio and video has always demanded very specific facilities in order to deliver the bandwidth and service quality requirements necessary for production demands. Ignoring some very early solutions, this was normally achieved with magnetic recording tape on purpose built equipment, often at some considerable expense for both the analogue and digital domains. These solutions delivered the requirements of the business with drawbacks in sharing and copying content to meet workflow and delivery demands.

With the advent of Information Technology and the tantalising promise of ubiquitous data storage taking advantage of extremely low production costs and high availability, many assumed that it would be a simple matter to embrace this technology within the media business workflows as an extremely attractive solution. The problem was that many IT suppliers would make such claims without really understanding the actual business requirements of the traditional media world as it was often assumed that IT applications, as used widely in general business PCs, would suffice.

Conversely, many from the traditional broadcast and production world did not grasp the difficulties of applying their business requirements to the IT mass market and this has led to several years of confusion on both sides and many implementation problems.

Delivering media storage

Today, much of the past confusion has gone, as many from both the IT and media production areas have a much deeper understanding of the demands of IT based media. However, in their transition to fully file-based workflows and the fast growing number and size of media files to manipulate, EBU Members need reliable information about how storage systems can achieve their specific business needs. It is this that the EBU Future Media Storage Systems (FSS) project group will be addressing.

Prior to starting the FSS group the EBU hosted a two day workshop to bring together EBU Members and industry. They listened to presentations and took part in sessions that developed the key issues and set the priorities for the work of the FSS group. This workshop was held on the 21st and 22nd of November 2011. During those two days, experts discussed the need for:

- User requirements for storage throughout the life cycle of media data
- The requirements for digital preservation storage
- The particular requirements of media applications for networked storage infrastructure
- The development of a common approach to testing the performance of media storage and its surrounding structure
- The issues surrounding performance and scalability using generic IT infrastructure
- The exploration of cloud services in broadcast applications.

The participants were divided in two groups for interactive sessions, one group consisting of users and the other being industry suppliers and manufacturers. The users worked to identify and prioritise key issues within their organisations that they would like the EBU to address. The participants from the industry were asked to discuss how the EBU can help them to provide suitable solutions to our Members.

The output from the two groups was discussed, with common issues collated from the interactive session and then prioritised in the final plenary session. The workshop proved most valuable and will ensure that the FSS group's work will address the Members' most important issues.

The group started its work in December by producing its terms of reference that were approved by the Technical Committee in February.

It is proposed that the first part of the group's work focuses on analysing the current operational practices of our Members in order to identify the user requirements for media storage systems. Systems for short term preservation and high-performance systems (e.g., production, post-production, playout) as well as long term preservation (archives) are to be investigated.

The second part of the work will include addressing the measurement of the performance of those systems against the requirements identified. This work will lead to guidelines on making the appropriate technology choices taking into account the performance vs. costs trade-off during the whole life cycle of the media content.

Both EBU Members and non-members interested in contributing to this project group can find information on how to join at: http://tech.ebu.ch/groups/fss.

Participants brainstorming during the EBU Media Storage Workshop

In the Zone

Broadcasters trial 'White Spaces' in Europe

With the growing demand for spectrum, Jim Beveridge of Microsoft reports on how some broadcasters are assessing the potential use of White Spaces in the UHF Band to ease the scarcity.

The year 2012 will be a landmark for TV White Spaces (TVWS) in Europe. The hi-tech cities of Cambridge and Munich are exploring the potential afforded by the use of White Spaces in the UHF Band. Both cities are covered by White Spaces transmission hotspots as part of the trials, with detailed measurements being undertaken by trial members. This information will be used in ongoing UHF band planning.

EBU Members are actively supporting both trials. In Munich the TVWS trial is supported by IRT as members of the EU funded COGEU consortium[1]. In Cambridge the BBC actively supports the trial as a member of the Cambridge White Spaces Consortium[2].

White Spaces - Using Technology to Avoid Interference

The first recorded regulatory acknowledgement of White Spaces took place in the 1950s. Early UHF tuner designs suffered from poor image frequency and adjacent-channel rejection, resulting in the FCC being forced to mandate that transmitters operating in the same immediate area in Oregon (KPTV, Portland, Oregon) keep a minimum of six channels apart to avoid interference. The term 'White Space' was coined by the FCC to refer to frequencies allocated to a broadcasting service but not used locally.

Phil Kesby from Arqiva at work at the Cambridge Trial (photo courtesy of Arqiva)

These results made it clear to network planners, particularly in Europe, that they needed to plan for a considerable distance between transmitters operating on the same frequency, so that only a subset of the available frequencies was used at each site.

By the time UHF transmission started in Europe, advances in technology, championed by the broadcast community, had solved many of the initial interference problems.

Fast forward 60 years, with the growing number of new applications and uses for the same spectrum, White Spaces are no longer viewed merely as a buffer zone for the TV but a real economic and social opportunity. This time around, advances in silicon and software through cognitive and geolocation database technologies, available today, are being deployed to compliment the broadcasters' traditional array of tools to avoid interference. Smart databases controlling smart devices make for greater spectrum utilisation.

White Spaces - Multiple Platforms, Growing Demand

Demand for wireless connectivity is growing at an exponential pace. Society is more connected than ever, with laptops, smartphones and tablets. Perhaps most important is that expectations have changed. Consumers expect to be connected and now want multi-megabyte pictures and multi-gigabyte video on these devices. In Europe a good proportion of IP video content will be generated by broadcasters.

IRT testing vehicle used in the Munich Trial (photo courtesy of IRT)

Jim Beveridge
Senior Director, International Technology Policy, Microsoft

Jim Beveridge is responsible for driving Microsoft's Technology Policy Initiatives in EMEA, LATAM and Asia Pacific. Prior to joining Microsoft, Jim worked for Pace Micro Technology as General Manager of their Digital Division. He is a member of the DVB Steering Board, and member and Chairman of the Digital Interoperability Forum. For recreation Jim enjoys sailing the sunny Western Isles of Scotland.

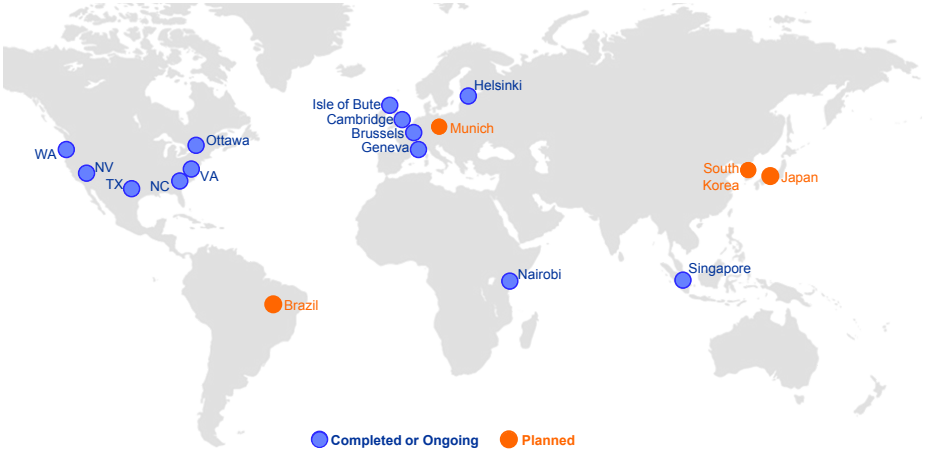
Even fixed, connected TVs raise the requirement for wireless connectivity, as broadband access stretches out to the more sparsely populated rural areas. Within the home too, there are opportunities for wireless networks to allow consumers to reach the content they want from whichever smart glass device is most convenient. Smarter use of the White Spaces can help satisfy these demands to the benefit of the consumers and the broadcaster community alike.

White Spaces – Sharing Spectrum Solutions

Globally, there is a growing understanding that the way spectrum has been allocated is creating scarcity. That is because allocations are based on historic limitations of legacy radio technologies in which wide swathes of spectrum are allocated for a particular use, but not necessarily actually used. These allocations were made with no knowledge of the types of uses of spectrum that we have today or any understanding of the technology and techniques that can be applied to manage the spectrum.

This fixed physical asset coupled with increased demand means we have to start sharing, and to get used to using smart technology to allow sharing of the spectrum between different users and applications. Inherent in this is the idea that the smart devices are licensed on the condition that they report where they are and operate under control from a database. Smarter databases and devices will lead to greater spectral efficiencies and lay the foundation for enhanced consumer services and an

White Spaces trial activities around the world



emerging 'Internet of Things'(IOT) (uniquely identifiable objects or things and their virtual representations in an internet-like structure). Cambridge start-up Neul has developed an IOT, 'Machine to Machine', TVWS sharing solution.

As noted above, mobile network carriers alone cannot keep pace with the growth projections for bandwidth usage. We have to lose the 'tyranny of or' – licensed or license exempt, carrier or consumer driven, open or closed, broadcast or broadband – and move to the 'genius of and'. It goes without saying that this needs to happen globally. The recent workshops in Munich and Cambridge associated with the White Spaces trials were well attended by engineers and regulators from across the globe. All administrations are faced with the same reality, and the techniques being developed in White Spaces, whilst not a panacea, are widely recognised as an important component in the toolbox of solutions. Ultimately, the solution may draw in a wide range of continuously evolving technologies – spectrum sensing, dynamic access and reallocation, smaller cell sizes, variable power, new modulation schemes including cloud-driven, improved interference tolerance in receivers, and software defined radio. With the right regulatory framework, sharing can instil competition between the sharers, providing an incentive for companies to gain efficiencies through innovation.

White Spaces - World

Over the past year there has been a lot of trial activity. Microsoft has been involved in several of these. TVWS trials have been run on the Microsoft Redmond campus for the last couple of years. Last year, three live demonstrations formed part of the broadcast industry's events. At the annual National Association of Broadcasters (NAB) Show in Las Vegas, with hardware supplied by Adaptrum and using the Microsoft database, 1080p HD streaming video was delivered to an Xbox over unused UHF TV channels. This ably demonstrated a coexistence with the broadcast transmissions present.

White Spaces - Cambridge

This trial, supported by the UK regulator Ofcom, represents an unprecedented industry partnership of broadcasters, multiple radio providers, White Spaces databases, cable and telco operators, and handheld device manufacturers. The Cambridge consortium has created a test and measurement programme designed to help inform Ofcom's regulatory proceedings in the UK, and those of others elsewhere. Of particular importance, is to understand what is really needed in interference protection so as to inform and guide the development of technical regulations.

To do that, the consortium has an ongoing programme of field tests in which White Spaces device signals have been fed to DTT receivers to determine their immunity limits. Coexistence with wireless microphones is also being studied. Full reporting of these tests will be available in 2012.

In addition to these tests, the Cambridge trial consortium members are working to assess the potential of White Spaces to deliver cost-efficient broadband access to rural communities, offload wireless data demand in urban centres, and open the way for innovative business models.

White Spaces in Europe - The Way Forward

The topic of White Spaces in the EU received a recent regulatory boost with the publication of the Radio Spectrum Policy Group (RSPG) analysis and recommendations on the way forward for dynamic approaches to spectrum. Annex C of the report provides a summary of the Cambridge trial[3].

RSPG analyses and recommends the way forward for 'dynamic' approaches to spectrum sharing in the general sense and investigates how to implement or further improve the regulatory framework for innovative sharing arrangements in Europe.

Over the last months Microsoft has participated in workshops in Munich and Cambridge organised by the COGEU and the Cambridge White Spaces consortia. One factor both workshops had in common was a sense of excitement amongst the engineers. Of course there are problems to solve and obstacles to overcome, however there is a real willingness from all involved to embrace the challenge and apply new techniques and technologies to benefit society.

TV White Spaces: The EBU's perspective

The EBU's position with regard to the use of TV White Spaces (TVWS) for services other than broadcasting is based on the following three principles:

1 To ensure protection of broadcasting and PMSE (programme making and special event) services. For this, the use of geolocation databases is considered the best way to ensure such protection and therefore should be mandatory. The EBU is actively participating in the CEPT work on the definition of technical and operational requirements for the operation of White Spaces devices in the band 470-790 MHz;

2 To require that other services that might use the TVWS should have a secondary status, i.e., they should not cause interference to or claim protection from the primary services using the concerned frequency band;

3 To investigate the opportunities for broadcast content delivery and for related services to benefit from using the TVWS. If used in a correct manner, they could improve the efficiency and the flexibility of using spectrum.

A multitude of applications are subject to trials in different regions of the world. The work in the CEPT shows however that considerable time and effort are still required before these applications can be commercialised. The agreement on harmonised standards and the implementation of region-wide geolocation databases are on the critical path.

From a broadcaster's point of view, the key to success of any application using TVWS would include the following:

1 It should require simple and effective ways of ensuring mutual compatibility with broadcasting and PMSE, and show acceptable/manageable impact on cable TV services. The ongoing trials and pilot projects may show that some applications are significantly easier to accommodate in TVWS than others;

2 It should show flexible requirements in terms of capacity, as the available White Spaces will be variable with time and with location;

3 It should offer services that can motivate regulators and industry stakeholders in order to jointly progress on all aspects of implementation.

Walid Sami, EBU TECHNICAL

[1]http://www.ict-cogeu.eu/partners.htm
[2]http://www.microsoft.com/presspass/emea/presscentre/pressreleases/June2011/CambridgeTVWhiteSpacesConsortium.mspx
[3]http://rspg.ec.europa.eu/_documents/documents/meeting/rspg26/rspg11_392_report_CUS_other_approaches_final.pdf

Sound Processing

Loudness for digital radio? Follow the FM way?

Since the successful adoption of the EBU R 128 Loudness Recommendation by many television stations, the question is often asked 'Should loudness also be harmonised for radio?'. Mathias Coinchon reports.

Loudness in radio is a very long story that begins from when the first sound processor emerged. In FM, many radio stations are known to attain the highest levels of loudness achievable using expensive complex multiband sound processors. Why are they doing this?

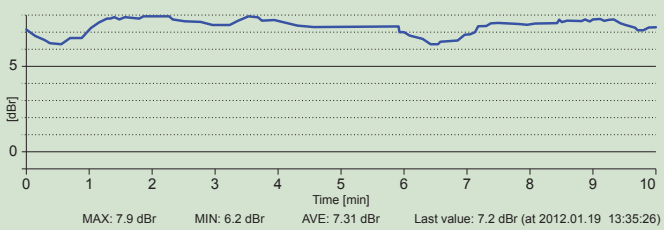
- **The FM coverage argument:** increasing loudness and therefore reducing dynamics, has the effect of increasing the ratio between the wanted audio and reception noise due to a weaker signal. Therefore, by increasing loudness it has the effect of increasing the coverage of an FM station.
- **The commercial argument:** when listening to radio in a noisy environment, when the reception is bad or when the receiver loudspeakers are small, increased loudness makes the sound 'jump out of your radio' and sound 'more clear'. The equation put forward by commercial radio is then very simple: loudness = listeners, and listeners = money.
- **The differentiation argument:** most radio broadcasters spend hours tuning their broadcast sound processors to give their station a specific signature sound to match their brand. This translates generally into maximum loudness for hit radio stations.

These arguments have sometimes led to excessive loudness processing with the consequence of fatigue and excessive distortion. The other consequence is a larger average bandwidth of the FM signal. For this reason, ITU-R has produced an updated version of Recommendation BS.412-7 advising us to constrain the average energy of the modulating signal to prevent excessive spectrum occupation. Putting a constraint on the power of the FM multiplex modulating signal leads to loudness limitation. This was the beginning of problems for many radio stations and their listeners.

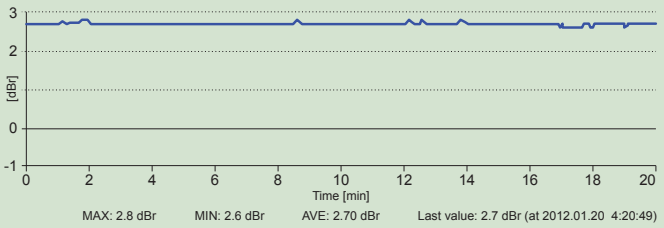
- **Country differences:** the FM multiplex power recommendation of BS-412-7 is not in force in every country. For example in France it is not applied while in Germany and Switzerland it is. Zapping between stations in these two countries in the border regions lead to bigger loudness differences than before the rule was applied. Station directors complain that they cannot reach the loudness of their competitors on the other side of the border and listeners don't understand why some stations sound so weak that they have to adjust the volume.
- **Music production gets louder:** for some years, the music production world has followed the same loudness route, increasing loudness as much as they can. The consequence is that some music recordings already have an excess of power that the broadcast sound processor has to correct in order to respect BS.412-7. This translates into muffled sound or an ugly loudness variation from these recordings on FM.

So what about digital radio? The FM coverage argument does not apply anymore but commercial and differentiation arguments still apply. We can already see with existing digital radio stations that, sometimes, 0dBFS is the limit. The problems for radio are very different than those for television. The programme material has generally far fewer differences in loudness than in TV content (drama, film vs. adverts). The loudness of adverts is not much of a problem in radio. Putting loudness limit regulations in force may not be a good idea. In particular, care would need to be taken to avoid repeating the same errors as with FM and BS.412-7 and thereby creating more differences in loudness at the end of the day.

Should we avoid opening Pandora's Box and instead do nothing? This is not a good idea either. We can see that the effect of excessive loudness and levels is not well known when working with perceptual coding (MPEG). What are the overshoots in receivers? How should they align between DAB+/internet/FM? What is optimal for encoders? Also on the radio production side, loudness normalisation is needed, especially when archiving. Finally, further studies must be undertaken. So the answer to the question 'should loudness be harmonised for radio?' has to be an ambiguous one: "No, but maybe yes".



FM multiplex power over 20 minutes on a French hit radio station with no BS.412-7 multiplex power limiter. This station sounds very loud.



FM multiplex power over 20 minutes on a Swiss hit radio station with a BS.412-7 multiplex power limiter. This station sounds much weaker than the French one above and sometimes sounds poor (example: the vocalist is loud at the start and then muffled when other instruments start to play and the BS.412-7 limiter comes into action).

A Date With Digital

The Norwegian Approach

NRK's Øyvind Vasaasen explains how Norway arrived at the decision to switch off FM and the country's plans for the migration to digital radio.

Øyvind Vasaasen
Head of Distribution, NRK
& Chairman of Digital Radio Norway

NRK, Norway's public service broadcaster, together with the country's two largest commercial radio broadcasters are currently finalising negotiations with the operator of the DAB network to increase coverage to 90% of the country. The digital radio network will be completed in the autumn of 2014, with a coverage of 99.5% for NRK's radio stations.

Digital radio via DAB has been broadcast since the late 90s in Norway through a partnership between NRK and commercial radio stations. On February 4, 2011, the Norwegian government decided that the target date for FM switch-off would be January 2017. However, there were the following three main conditions:

- The coverage of NRK's digital radio services must correspond to that of NRK P1 on FM today (~99.5%).
- The multiplex that carries commercial national services must cover at least 90% of the population.
- Digital radio must represent added value for the listeners.

Two additional conditions must be fulfilled by January 2015 to avoid the FM switch-off being postponed to January 2019:

- Affordable and technically satisfactory solutions for in-car radio reception must be available.
- At least 50% of radio listeners should be using a digital platform for listening at some time during the day. Note that this condition is related to radio listeners (50% of people), not radio listening (50% of time) as is the case in the UK.

When switching from analogue to digital transmissions, limiting the transition period is one of the key factors. This cuts costs, but it also provides a clearer message to all parties involved: listeners, broadcasters, the car industry, receiver manufacturers, telecom operators.

The big question for many countries today is how to migrate to digital without incurring heavy distribution costs. It is essential that public service and commercial broadcasters work together to find satisfactory solutions for all parties. The idea should be to cooperate on technology, while competing on content. This saves costs and may free resources to programming. Limited government involvement with regards to the planning of the practical migration can also work as a catalyst.

The decision to switch-off FM was a very brave one. The government risked bad publicity and the loss of votes from dissatisfied listeners that felt that they were being forced to buy new receivers. But the press was surprisingly positive, and so were the radio audiences. After all, Norway is a very rural country where a lot of people only have access to 1 - 4 radio stations. They will now get 13 - 30. The announced switch-off has also given the parties involved a sense of security. Knowing that FM will cease affects the range of radio receivers on offer as well as buying patterns. No one wants to buy an FM-only radio as it will soon be obsolete. Most cars today come with a DAB receiver or it is offered as an upgrade option.

NRK still use the DAB standard, while some commercial stations have taken up DAB+. There will be a gradual transition to DAB+ and we will cover the entire country with fewer DAB transmitters than we use for FM today. We will need about 600 transmitters in total to cover the whole country, while we have over 2000 FM transmitters.

In Norway, we are building a robust and modern digital radio network that we think will be far better than today's FM network. All transmitting stations covering more than 5,000 inhabitants (total 90% of the population) have implemented the following forms of redundancy:

- Power back-up reserve through emergency electric generators
- Redundant signal delivery to the transmitters
- Duplicated transmitters and equipment
- Redundant clock synchronisation of the transmission signal

All new highway tunnels will come with DAB transmissions. Existing tunnels where only FM is installed will be upgraded to DAB in time for the switch-off in 2017. The government requires the ability to locally break into all broadcasts in a tunnel in case of an emergency. The tunnel operator can then communicate to the motorists in their cars and give them instructions on how to get out or what to do.

We are facing a very busy period, but we are sincerely happy with the political decision to switch off FM and invest in digital radio. It has given the market a clear message on what will happen and it makes the entire process better and much easier.

Karli Jaans from the firm Normast working with DAB equipment on Gamlemsveten, one of the main transmitters for Møre and Romsdal County in northwest Norway. (photo courtesy of Normast)

In the Spotlight

Igor Orlov is the First Deputy Head of the Department of Production and Technology at RTR (Russian TV and Radio Broadcasting Company). In 1986 he graduated from the Moscow Aviation Institute and started his career there as a senior engineer. In 1997 as a post-graduate, he completed a PhD at the Moscow Institute of Civil Aviation Engineers. He has been engaged in the research of the radio frequency range of electromagnetic waves and aviation radiolocation and navigation areas.

His international affiliations extend to full membership of the International Academy of Television and Radio since 2008 and he became a member of the EBU Technical Committee in 2009.

Can you tell us something of your current responsibilities at RTR?

I am the First Deputy Head of the Department of Production and Technology at RTR. My key responsibilities are dealing with technology management. These include the running of the relevant departments in the division, participating in strategic planning for the development of TV production technology, and budget planning. I also control key system projects concerning the modernisation of TV production facilities.

It's always interesting to hear about 'outside interests' - what are yours?

I particularly enjoy travel as it provides new emotions, wonderful impressions and self-development. I have always had a keen interest in history and music. Jazz of the 1930s - 1940s and classical music relaxes me and keeps the spirits up.

What do you consider as your finest achievement so far in your career?

During the period from 2006 to 2009 while working in Sony I was the head of a department that realised a number of systems television projects in Russia and CIS. These included the delivery of 10 HD OB vans that are successfully operational in Kazakhstan, Belarus, Ukraine and Russia. At Sony CIS, a System Integration department was set up, which gave me the opportunity to accomplish many significant technological projects.

Why did you step forward as a candidate for the EBU Technical Committee?

I have been working in the television industry since 1989 and during this time I have made a lot of friends, some of whom have been mentors. Shortly after joining RTR, it was recommended that I should take part in the activities of the EBU Technical Committee.

What are for you the most important challenges facing EBU Members, particularly those with circumstances similar to RTR, today?

I find the area of IT for TV production particularly interesting and especially how it can be used for news production. Needless to say, the implementation of IT is considered to be a rather difficult task, when taking into account not only the technical aspects but the problems of staff training. Almost all broadcasters face this problem and it is always interesting to get our colleagues' experiences to help overcome these problems.

Igor Orlov
RTR

A New Arrival From The Zoo

A new member of staff joined the team at EBU Technical in December. Eoghan O'Sullivan has taken on responsibility for the dissemination of information about the work done by the department, whether through publications, events or the website. His brief is to raise and enhance the profile of the EBU as a reference for technology and innovation. He'll also act as single point of contact for communications-related matters, in particular connecting with the network of Technical Liaison Officers (TLOs) throughout the membership.

Eoghan is no stranger to the EBU having previously spent the five years up to June 2009 coordinating communications for the DVB Project, based in the Technology and Development department. Prior to that his professional experience included three years working for RTE in Ireland, during which time he was awarded a scholarship to attend the International Academy of Broadcasting, a graduate school established in Montreux, Switzerland by former EBU Technical Director George Waters and former Technical Committee Chair Aleksandar Todorovic. His academic background also includes a BA in Communication Studies and an MSc in Science Communication, both from Dublin City University.

Much more recently he has spent two and a half years working at Amsterdam Zoo; or to be more precise, for the European Association of Zoos and Aquaria (EAZA), which is based at the zoo. So he has swapped monkeys for metadata, lemurs for loudness and hyenas for hybrid TV. We welcome him to the team.

Eoghan O'Sullivan
Technical Publications and Communications Manager

To (R&)D or not to (R&)D? That is the question.

The EBU's David Wood asks how much research and development broadcasters need to do.

What do you think? Is technology research and development (R&D) a waste of money for broadcasters? These are tough times financially. A broadcaster's success is determined by the programmes made, n'est-ce pas? We are not making and selling electronics, so why help others who will make money out of the electronics? Of course there are two sides to this.

Over the past 15 years, fewer and fewer broadcasters have maintained sizeable technology research and development departments. In Spain, France, the Czech Republic, and elsewhere, what were once world-leading broadcasters' large R&D groups are no more. What might once have been a discussion about technical standards between eight or nine EBU Member laboratories - and sometimes even three more Eastern and Central European laboratories - have often been reduced to a dialogue facilitated by the EBU between three: the BBC, RAI, and the German-speaking broadcasters' group, the IRT.

The main functions of broadcasters' R&D included making equipment and systems that were not commercially available, providing expertise in the company so decisions about technology strategy would be taken with authority, and contributing to the development of technical standards that would (later) be important for broadcasters. In this way R&D functioned as a kind of 'insurance policy' for the company itself. But such things can be intangible, particularly to accountants in economically difficult times. It may well seem sensible to 'put all the money in front of the camera (or mic)', not behind it.

Large broadcasters' research laboratories have also all but disappeared from the United States, but NHK in Japan maintains a fine department that has a decisive role in NHK company policy and in world standards development.

In industrial terms, a company that relies on technology usually spends 1-4% of its annual turnover on R&D. In their prime, some broadcasters were spending between ¼ and ½% of their annual turnover on R&D. They saw this as the reasonable balance, bearing in mind that while broadcasting sinks or swims on its programmes, it relies on technology to deliver its content. Today, these figures would be utopian.

Sociologists talk about 'technological determinism': technology changes society in the long term, rather than any particular content it carries. For broadcasting it will be the same. Technology will shape whether we are successful in the long term, but for this year and next, the programmes we make will decide. It is good to think about success in the long term, but unless we have success in the short term, there may be no long term to worry about. So, the appropriate level of R&D, if any, is a difficult decision for any broadcaster to take.

What has been the impact of this change in the priorities of EBU Members? In the 1970s, 1980s, and 1990s it was the combined weight of broadcasters that shaped broadcast technology. The technical standards for digital television and audio were set by broadcasters, and the groundwork for satellite broadcasting was done by EBU broadcasters. EBU broadcasters had the advantage that they were not, for the most part, competing with each other, so they had every reason to share their work with fellow broadcasters. We might even call these the golden years of R&D.

Today, the BBC, RAI, and IRT still have labs and do work together with other Members, and the EBU, but there is less collective contribution to technical standards. Are standards today on a worldwide level more fragmented and less designed in the interests of EBU broadcasters? An honest answer is probably: yes, they are. Has the lack of R&D meant less expertise is available for good decision making by broadcasters? An honest answer, here too, is probably: yes, it has.

What is the right balance for broadcasters between their short term need to put money into programmes, and their long term need for a technological insurance policy in the form of R&D? Each broadcaster has to decide for itself. You will have your own opinion. A motto to remember could be: 'Content is king; but don't forget that technology rules the palace he lives in.'

Spectrum Impact

David Wood, EBU Deputy Director of Technology & Development, addresses the working lunch at WRC-12.

Our future digital broadcasting and wireless broadband will be strongly affected by the conclusions of the World Radiocommunication Conference (WRC-12) held in January and February 2012 in Geneva, Switzerland. It brings together the world's administrations to discuss and agree policy for the uses of radio frequency spectrum that have international implications.

One of the issues that conference delegates were discussing, inside and outside the formal meetings, is the extent to which more of what are currently the UHF broadcasting bands, beyond that already agreed, should be given over to wireless broadband in future. This could have a major impact on the way digital terrestrial television evolves. Part of the discussion is the use of 'White Spaces', outlined on pages 8 and 9.

The EBU hosted a debate on radio spectrum involving the world's broadcasting unions, interest groups and leaders of the WRC-12, on day two of the four-week, ITU-led symposium. During a working lunch, a number of key points that broadcasting unions would like taken into account were presented. These are given below. At the beginning of the conference a workshop lunch was held, hosted by the EBU, to allow a number of key points to be presented that broadcasting unions would like to be taken into account. These are given below.

For additional insight, opposite you will find some comments by delegates on what, in their opinion, were the key points to be kept in mind at WRC-12.

David Wood

Main Messages from the WBU-TC

01 Terrestrial broadcasting and wireless broadband (including internet) are both needed by the world's consumers. Each of these services has their own strengths.

02 Both terrestrial broadcast systems and wireless broadband (internet) systems, and the public's expectations for and usage of them, are evolving. This will continue for the foreseeable future.

03 While at the current time spectrum for terrestrial broadcasting is just sufficient, if insufficient spectrum is available for the evolution of terrestrial broadcasting, it will lead to the demise of this service and the associated industry worldwide. This will certainly impact a significant percentage of the world's population employed in broadcasting and affiliated services, as well as the huge broadcasting audiences. Clearly, this is not an option.

04 Repeated incursions on the spectrum available for broadcasting services in the UHF band has already impacted the broadcasters and the broadcasting industry quite adversely, including limiting new investments. This is more so in the case of the re-stacking requirement.

05 Spectrum below the 800 MHz band must be maintained for digital terrestrial broadcasting and its evolution. Given the latter, more spectrum may be required in the near future.

06 New allocations of spectrum that might restrict the access of broadcasting to spectrum below 800 MHz should not be made without thorough studies of the reasons and the consequences of such new allocations.

07 Broadcasters are open to study, and are currently studying, flexible ways of sharing spectrum and distribution means with other services.

WBU Members:

ABU: Asia-Pacific Broadcasting Union

ASBU: Arab States Broadcasting Union

AUB: The African Union of Broadcasting

CBU: Caribbean Broadcasting Union

EBU: European Broadcasting Union

IAB: International Association of Broadcasting

NABA: North American Broadcasters Association

OTI: Organizacion de Telecomunicaciones Iberoamericanas

WRC - 12 Insights

The conference shows that the demand and competition for spectrum is growing further. New radio applications are appearing and the existing ones have increasing requirements.

In order to get their adequate share it is essential for broadcasters, now more than ever to clearly express their demands and visions for the present and the future of broadcasting, and how sufficient spectrum is urgently required for this.

Helwin Lesch
Head of the Department of Program Distribution, Bayerischer Rundfunk

We see from the last WRC and even more from WRC-12 that there is an increasing pressure to release broadcast spectrum. As broadcasters we have to be able to justify our claims for spectrum, based on serious studies of requirements for our future services. This work will be an important part of our preparations for the next WRC.

Lis Grete Møller
Senior Consultant, TM-Distribution, DR

Two of the striking pieces of advice I heard were these. First, that we broadcasters, who want to hold on to the UHF band, should make a plan for how we would use the bands - for SDTV, HDTV, UHDTV, 3DTV, HBB, handhelds, whatever. This would help us to plan the future, and give us stronger arguments. Secondly, that we should take time to explain well to our friends in the countries where the UHF bands are relatively unused today that, in time, our needs for terrestrial broadcasting will be theirs too. The rate new technology arrives varies across the world, but eventually it is everywhere.

Davd Wood
Deputy Director of Technology & Development, EBU

The most important lesson that I had to learn at WRC-12 is that we broadcasters are indeed only observers at this event, which means our influence is very, very limited. Therefore, whether we like it or not, we have to liaise more actively with our administrations, in particular our own national administrations to campaign for us and put forth our objectives. To this end, we will need to make them understand our needs and requirements.

This calls for a strong convincing argument, and therefore we need to clarify our vision of the future of broadcasting in order to unlock undiscovered opportunities.

Dr. Roland Beutler
International Spectrum Management, Südwestrundfunk

diary 2012

BroadThinking 2012
28 - 29 March 2012 / Geneva (CH) / Fee. 'Managing end-to-end'. The EBU's annual seminar where broadcast meets broadband, a key event for anyone interested in hybrid services, interactivity, second screen, CDNs, IP delivery and more.

SMPTE Forum on Emerging Media Technologies
13 - 15 May 2012 / Geneva (CH) / Fee. Organised in collaboration with the EBU, this is a global summit on the media technologies that are likely to emerge in the next three years - and dominate over the next fifteen.

Technical Assembly 2012
07 - 08 June 2012 / Zagreb, Croatia / Members Only. This year's EBU Technical Assembly takes place in Zagreb, hosted by the Croatian national broadcaster, Hrvatska Radiotelevizija (HRT).

Network Technology Seminar 2012
26 - 17 June 2012 / Geneva (CH) / Fee. Organised by the EBU in collaboration with SMPTE, this is an essential annual meeting for anyone interested in media network technology.

Further details and up to date information can be found at http://tech.ebu.ch/events