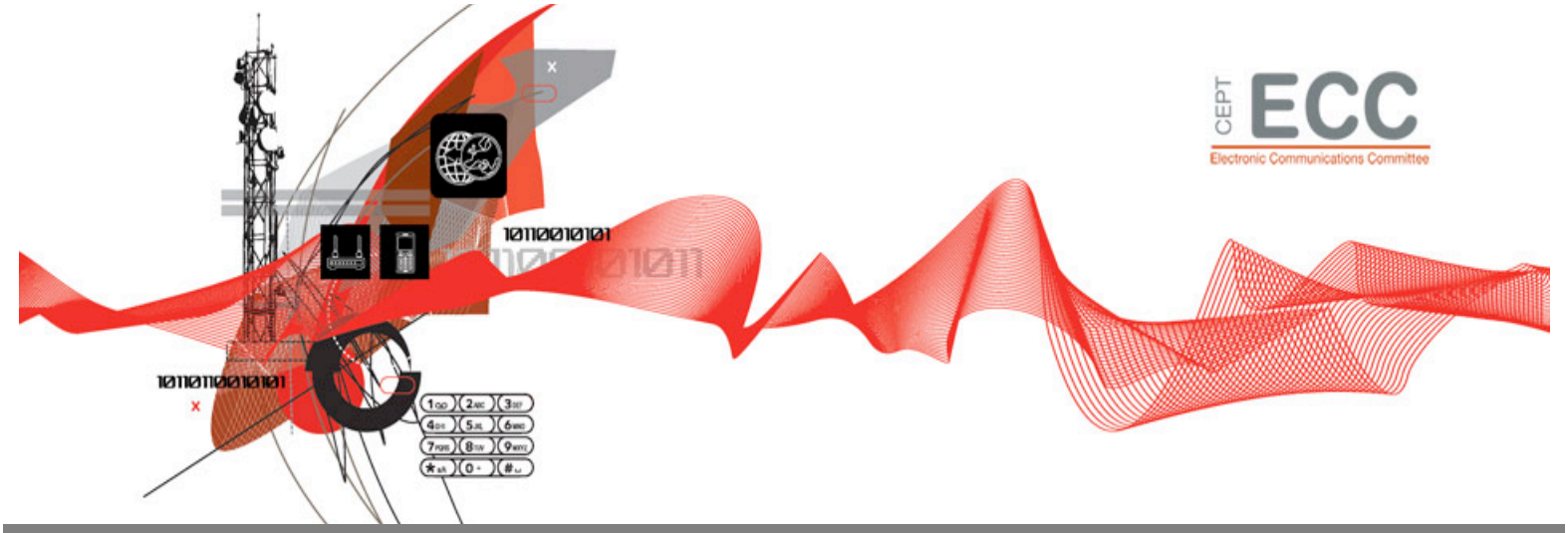

ECC NEWSLETTER **April 2014**

Looking at more space for broadband use on Wi-Fi

The highest profile issue for a number of years now in the world of spectrum politics has been mobile wireless broadband. This is not surprising: the players in the drama are big, well-organised and well-known. The concepts and services are familiar to the public: TVs and mobile devices, and the bills paid by users are part of almost everyone's life. And the drama of big money auctions adds an interesting twist.

But among all of this, the greater growth is now in data traffic over RLAN networks (Wi-Fi). Smartphone and tablet users who pay their own bills understand this well. The appeal of licence-exempt short range spectrum, using an efficient global technical standard is obvious, especially given the relative ubiquity of good fixed broadband connections in most population centres. But a good and appropriate environment is as important for licence-exempt as for any other spectrum.

Broadband everywhere

In the European Union, the aspirations for digital connectivity are expressed through the 'Digital Agenda for Europe'. The European Commission shares the view that Wireless Access Systems/Radio Local Area Network (WAS/RLAN) bands for wireless broadband are emerging as an essential spectrum resource for the provision and uptake of internet-based services. It is therefore necessary to ensure that sufficient spectrum resources are available on a harmonised basis to support a long-term future for new generations of WAS/RLAN technologies, that will provide increasing data capacity and speed.

In September 2013, the European Commission issued a Mandate to us in CEPT to study and identify harmonised compatibility and sharing conditions for Wireless Access Systems including Radio Local Area Networks in the bands 5350-5470 MHz and 5725-5925 MHz ('WAS/RLAN extension bands') for the provision of wireless broadband services.

But there are no empty spaces in these or other frequency ranges; in fact there are a number of existing systems, many of them having recognised primary status and a right to protection. Furthermore, there are other EU policy priority applications used or designated in these ranges, such as the European Earth monitoring programme GMES (Global Monitoring for Environment and Security), now known as Copernicus, and ITS (Intelligent Transport Systems). Therefore the mandate requires that coexistence of WAS/RLANs with other systems in these and in adjacent frequency bands is safeguarded.

The aim is, after the finalisation of the relevant technical and regulatory studies, to extend the spectrum designation for WAS/RLANs as currently provided by EC Decision 2005/513/EC (amended by EC Decision 2007/90/EC), and to enable a future usage of the whole range from 5150-5925 MHz without the requirement for individual authorisations.

The expected development of WAS/RLAN technology and of the relevant standards until 2020, in particular the use of larger channel bandwidths, should also be taken into account.

The spectrum under consideration within the scope of the Mandate is also under discussion in the context of preparations for the World Radiocommunication Conference 2015 (WRC-15) Agenda Item 1.1.

Interest from industry / requirements for additional spectrum

From the RLAN industry point of view, the growing proliferation of Wi-Fi hot spots in private homes as well as the increased importance of publicly accessible Wi-Fi access points in Europe for public institutions (libraries, tourist bodies, etc.) and businesses underlines the value of the WAS/RLAN bands.

In addition to the private use of Wi-Fi, wireless broadband access provided via publicly accessible Wi-Fi access points has to be recognised as an increasingly important internet connectivity infrastructure that is largely complementary to mobile internet services. Given the inherent limitation of coverage, mainly related to power limits and backhaul needs, such WAS/RLAN-based infrastructures can be considered as an essential competitive element in wireless broadband markets to the extent that such services are used in either nomadic or static situations. Therefore, from an industry perspective, there is a demand for higher data rates / higher bandwidths for RLANs.

The majority of RLAN devices in use today are still operated in the 2.4 GHz band (83.5 MHz wide) because the vast majority of commercially available access points in Europe have until recently only been capable of operating there.

While there is already 455 MHz of the 5 GHz band harmonised for WAS/RLANs, the industry sees evidence of an increasing number of consumer devices, including smart phones and tablets, that now have dual-band capability and that large-scale public Wi-Fi networks are a significant driver of 5 GHz use today. In this regard, providing an additional spectrum resource on a shared basis without impacting existing usage could provide additional benefits.

In addition, a new generation of RLAN systems (known as IEEE 802.11ac) will be able to achieve throughput rates sufficient enough to extend high-speed fixed broadband infrastructures wirelessly (of 30 or 100 Mbps or more) to a broad range of consumer devices without reductions in speeds if operating in 80 MHz and/or 160 MHz channels. Today, RLANs with 20 MHz or 40 MHz channels are typically in use.

Incumbent users

Various radio applications are already planned or in use in the proposed bands, 5350-5470 MHz and 5725-5925 MHz. Comprehensive compatibility and sharing studies are required between WAS/RLANs and the following incumbent or planned radio services/applications, and it is a very long list!

- GMES/Copernicus within 5350-5470 MHz;
- Radars within 5350-5470 MHz and 5725-5850 MHz;
- Aeronautical radionavigation services within 5350-5470 MHz;
- Safety-related ITS (Intelligent Transport Systems) in the band 5875-5905 MHz;

- Transportation systems, i.e. non-safety ITS in the bands 5855-5875 MHz and 5905-5925 MHz, road toll systems in the bands 5795-5805 MHz and 5805-5815 MHz and other transportation systems used within CEPT for public transport automation (like subways) in the band 5915-5925 MHz;

- Fixed-Satellite Service (Earth-to-space) in the band 5725-5925 MHz;

- Broadband Fixed Wireless Access in the band 5725-5875 MHz;

- Short Range Devices in the band 5725-5875 MHz;

- Amateur Service within 5725-5850 MHz and Amateur-Satellite Service (space-to-Earth) within 5830-5850 MHz;

- Broadband Direct-Air-to-Ground Communications (DA2GC) in the band 5855-5875 MHz; and

- Wireless Industrial Applications (WIA) in the band 5725-5875 MHz.

The possible impact on radio services/applications in the adjacent bands should also be considered.

EU framework, tasks

According to the Mandate, CEPT/ECC should study and identify harmonised compatibility and sharing scenarios for WAS/RLANs in the bands 5350-5470 MHz and 5725-5925 MHz based on the latest generation of WAS/RLAN equipment and define relevant protection parameters and conditions in close cooperation with all concerned stakeholders. The aim is to provide an uninterrupted band from 5150-5925 MHz for WAS/RLANs (775 MHz) on a shared basis and based on a general authorisation.

The relevant developments since the completion of the original studies carried out prior to the World Radiocommunication Conference 2003 for the bands 5150-5350 MHz and 5470-5725 MHz also need to be taken into account.

It should also be assessed whether and how coexistence can be ensured between the future WAS/RLAN usage, as an essential element of the wireless broadband EU priority, and other uses of the 5 GHz band that are currently considered on a shared basis, taking into account studies already on-going in CEPT.

CEPT's Final Report A, which will take into account the results from its public consultation, is expected by March 2015. Final Report B, assessing the need to review and/or reconfirm the compatibility and sharing conditions as provided in CEPT Report A based on the results of WRC-15, is expected by July 2016.

Studies within CEPT/ECC

Based on the working assumption that WAS/RLANs would operate on a co-primary basis under an appropriate mobile allocation in the whole 5150 MHz to 5925 MHz band, and in the light of experience already made on the 5 GHz bands in use, the compatibility and sharing conditions should in particular identify the technical parameters that would be needed to ensure consistent harmonised conditions and requirements for WAS/RLANs operating on a shared basis.

These requirements should also take into account the regulatory and enforcement context of a general authorisation and the protection requirements of the primary radio services to which the proposed WAS/RLAN extension bands have already been allocated. In this context also the bands adjacent to them are relevant, as we have learnt from experience.

The parts of the 5 GHz range that are currently used in the EU for WAS/RLAN systems are subject to a variety of usage conditions which reflect the results of previous coexistence studies. The experiences, made during the last few years with regard to coexistence between WAS/RLANs and other radio applications in the bands 5150-5350 MHz and 5470-5725 MHz will be taken into account, such as: problems with some specialist RLAN users not complying with the required technical conditions. ECC Report 192 on 'The current status of DFS (Dynamic Frequency Selection) in the 5 GHz frequency range' has recently been adopted and published. This Report was intended to keep the collected information, and study further in detail the issue of WAS/RLANs 5 GHz interference to meteorological radars.

The ECC is carrying out compatibility and sharing studies between WAS/RLANs and the incumbent radio applications as shown in the list above. Furthermore, we are also considering regulatory aspects by taking into account the working assumption that WAS/RLANs would operate on a co-primary basis under an appropriate mobile allocation in the whole 5150 MHz to 5925 MHz band and based on a general authorisation. As far as Agenda Item 1.1 of WRC-15 is concerned, the studies are carried out in close cooperation with the preparatory work for this Conference.

We have just delivered an Interim Report to the European Commission, providing a description of work undertaken and interim results under tasks (1) and (2) of the Mandate. However, much work is still to be done as the story of broadband on Wi-Fi unfolds and the scene is set for a broadening broadband narrative.

Thomas Weilacher,
Chairman of ECC Working Group Frequency Management

ECC completes regulatory framework aimed at maximising the efficiency of future mobile broadband deployments in the 3400-3800 MHz range

In its February 2012 Newsletter, the ECC described how the first set of technical and regulatory arrangements would be implemented in order to open up the largest frequency band (3400-3800 MHz, which is partly harmonised) for International Mobile Telecommunications (IMT) and, possibly, for other mobile broadband applications. In this issue of our Newsletter, we'll have a look at the ECC's final steps towards making this large amount of still partly under-used spectrum open for future, truly broadband, mobile applications.

It took the ECC slightly over two years to complete[i] its regulatory update and relevant technical work for the 3400-3800 MHz 'mobile' band since the adoption at its plenary in December 2011 of a Decision on harmonised frequency arrangements for mobile/fixed communications networks (MFCN) for this band (ECC/DEC/(11)06).

As explained in our earlier issue, really high-speed mobile broadband applications (such as HD-video streaming and high-quality video calls) require significantly larger frequency channels and a greater overall amount of spectrum, and this demand can only be satisfied in relatively high (compared to those currently used) frequency ranges offering the needed bandwidth. However, this still brings challenges; first of all, ensuring compatibility with other incumbent users of spectrum.

This important requirement triggered the revision of the (then) existing ECC regulatory framework for the 3400-3800 MHz band which resulted, as a first step, in the development of a harmonised frequency arrangement for MFCN, including IMT, utilising larger channel bandwidths. Now, the ECC has largely completed its work on the second essential element of the modern regulatory framework for MFCN, namely the Block Edge Mask (BEM). In order to increase the efficiency of spectrum use, it has also developed a new technical Report dealing with the 'Time Division Duplex-Time Division Duplex' (TDD-TDD) co-existence scenario.

However, the harmonised frequency arrangement (i.e. the band plan) agreed by the ECC in December 2011 was earmarked for review in 2013 in order to identify a preferred harmonised frequency arrangement (either Time Division Duplex (TDD) or Frequency Division Duplex (FDD)) in the lower part of the band (3400-3600 MHz), and the ECC has now completed this task.

After several rounds of 'hot' debates within its specialist project team (ECC PT1 responsible for IMT matters) and an extensive questionnaire carried out by the European Communications Office, the ECC decided not to create a single "harmonised" arrangement. Instead, it favoured following an earlier approach used in ECC Decision (09)03 on 800 MHz, where "preferred" and "alternative" frequency arrangements were defined. From one side, this approach provides guidance to regulators and to the market, but on the other hand it keeps some degree of national flexibility necessary to maintain the competition at a high level. Thus, the ECC decided that TDD was the "preferred" frequency arrangement with FDD declared as an "alternative" for the 3400-3600 MHz sub-band and ECC Decision (11)06 was amended accordingly (the upper sub-band 3600-3800 MHz was initially unanimously supported for exclusive TDD use and was already "harmonised" for TDD in the original Decision).

The final frequency arrangement for the whole band now looks as shown in figures 1 to 3 below:

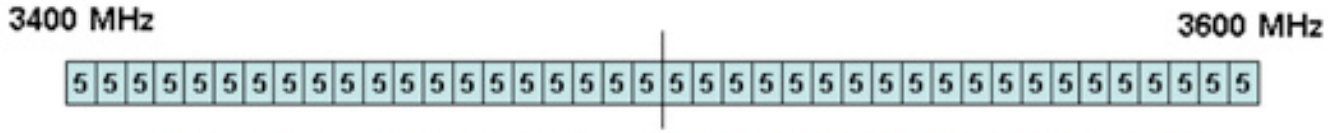

Fig. 1 Preferred frequency arrangement of the 3600-3800 MHz band based on TDD

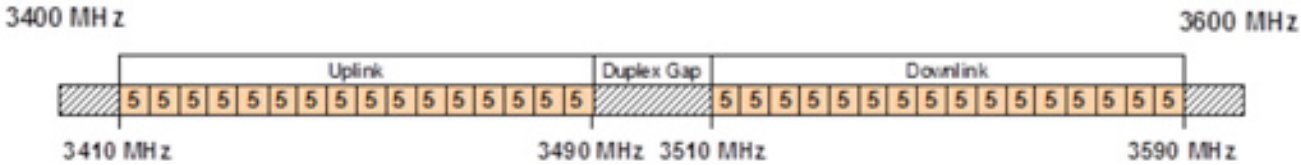

Fig. 2 Alternative frequency arrangement for the 3400-3600 MHz band based on FDD

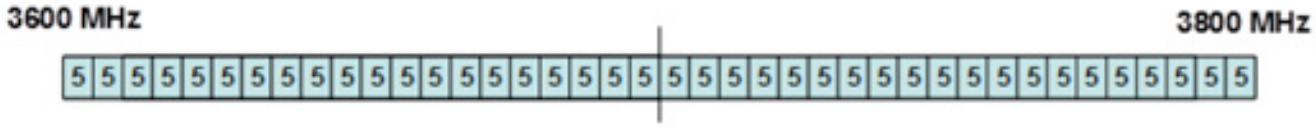

Fig.3 Harmonised frequency arrangement for the 3400-3600 MHz band based on TDD

The other milestone in improving the regulatory framework for the 3400-3800 MHz band was the adoption by the ECC Plenary in March 2014 (as a new element within the updated Decision) of a Block Edge Mask (BEM) out of the pre-defined BEM elements, namely: in-block, baseline, transitional region, guard bands and additional baseline (for protection of military radiolocation systems below the 3400 MHz boundary).

The developed BEM is applicable to MFCN base stations with different power levels (i.e. macro, micro, pico and femto BS) and is assumed to allow co-existence between MFCN applications in the whole 3400-3800 MHz band (the actual BEMs for TDD and FDD modes will be combined out of the pre-defined emission levels for each of the BEM elements carefully described in the appropriate tables provided in an annex to the updated Decision).

Within the TDD arrangement, different emission levels are applicable for the same BEM elements depending on whether the adjacent in frequency TDD networks are synchronized ("synchronized operation" means that no simultaneous uplink and downlink occur between any pairs of cells which may interfere with each other in the same band). Examples of combined BEM elements for adjacent synchronized and non-synchronized TDD blocks are shown on figures 4 and 5 respectively. Figure 6 provides an example of such a combination of BEM elements for an FDD block in the lower part of the FDD downlink spectrum.

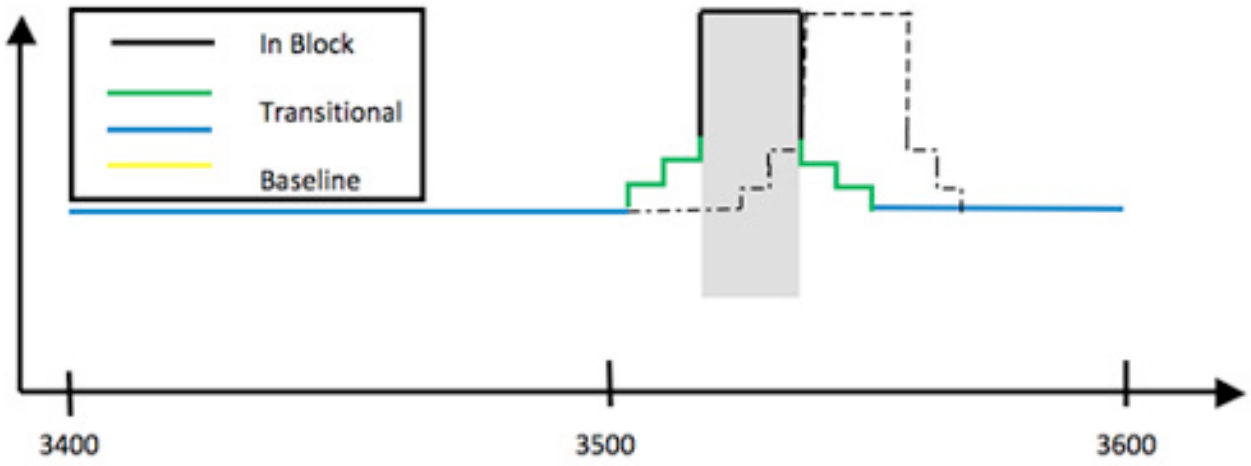

Fig.4 Combined BEM elements for adjacent synchronized TDD blocks

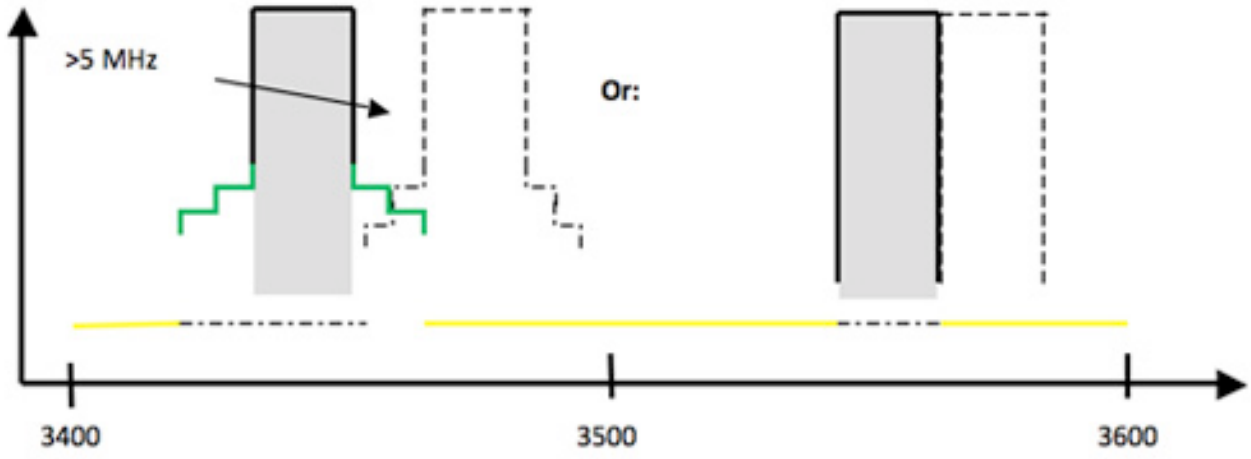

Fig.5 Combined BEM elements for adjacent non-synchronized TDD blocks

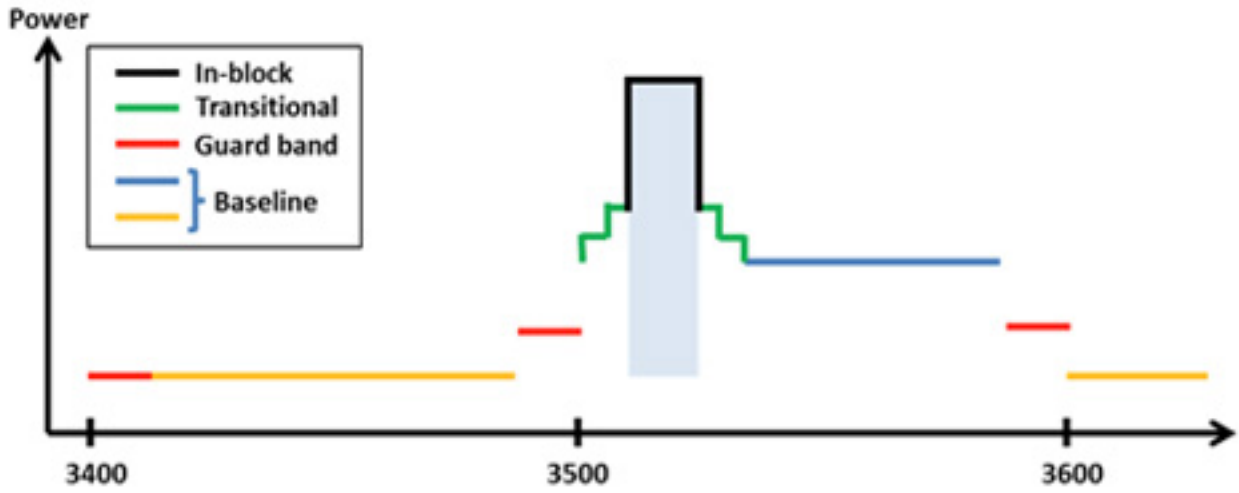

Fig.6 Combined BEM elements for an FDD block starting at 3510 MHz

As regards the ways to increase the spectral efficiency by synchronizing adjacent TDD networks, the provisions of the updated ECC Decision (11)06 are further developed in the draft ECC Report 216 'Practical guidance for TDD networks synchronization' which was subject to public consultation at the time of writing. The draft Report in particular states that a *common reference phase clock* (e.g. for the start of frame) and *configuring compatible frame structures* (e.g. length of frame, TDD ratio etc.) are the two conditions which need to be followed on all base stations that may interfere with each other in a given geographical area in order to achieve a synchronized operation.

Further, the 'TDD-synchronization' Report provides a description of the currently available techniques for transmitting a reference phase clock which includes: global navigation satellite systems (GNSS), packet based networks, over-the-air synchronization, and “LORAN” (reference signal transmitters mounted on high towers and based on either Loran-C or eLoran format, depending on the country). It also suggests that when multiple operators deploy TDD networks in adjacent frequency bands inter-network synchronization conditions can be discussed and agreed at a national level.

In addition, the updated regulatory framework for the 3400-3800 MHz band includes guidelines (as a separate annex to ECC/DEC/(11)06) on how to ensure co-existence between MFCN and other services, such as: with Earth stations of the FSS (Fixed Satellite Service) and FS (Fixed Service) stations.

This updated ECC Decision (11)06 provides a much more advanced and tailored regulatory framework for the 3400-3800 MHz band which will be better able to meet the requirements of upcoming mobile broadband applications. It is based on a huge number of technical studies which have been carried out by ECC PT1 within the last two years.

This work has resulted in: ECC Report 203 on Block Edge Mask in the 3400-3600 MHz and the 3600-3800 MHz bands; CEPT Report 049 in response to the EC Mandate on the 3.5 GHz band; and the provision of a technical basis for the update of the relevant EC Decision 2008/411/EC. The updated EC Decision will contain the identical technical elements to the just modified ECC Decision (11)06 and as a result of its binding effect on all the EU Member States will further strengthen the new regulatory framework developed by the ECC.

Taken together, these completed European regulations for the 3400-3800 MHz band pave the way for consumers and other end users to exploit the full potential of new mobile broadband applications while ensuring effective co-existence with incumbent spectrum users.

Didier Chauveau,
Chairman of ECC PT1 - responsible for IMT matters

Alexander Gulyaev,
Spectrum Expert, ECO

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i Draft ECC Report 216, on TDD Network Synchronization is currently under public consultation, but as an ECC Report it is advisory in nature.

The show must go on – securing a future for PMSE

It is a well-documented preoccupation of spectrum managers to seek ever more spectrum to support the established and projected growth in demand for wireless connections to smart phones and tablets. This brings big challenges and big consequences. We have written about this in several previous editions of the newsletter (in January 2011, February 2012, August 2013 Special Edition). Of course much of our attention focuses on changes to broadcasting as a source of new spectrum: it has offered major improvements in spectrum efficiency over the last 10 years – through digitisation and improved coding efficiency - and this is still ongoing, complemented by evolution in the consumption of media. It also occupies a large part of the so-called 'sweet spot' of frequencies with good propagation and other characteristics. But the need for frequencies that support the making of programmes, as well as a much wider range of cultural, social and economic activity, are also a major element in this subject.

Two years ago, this Newsletter set out the background and described some of the challenges facing the programme making and special events (PMSE) sector. This centres on the developing use of the key UHF band, firstly with transition from analogue TV to digital, and more particularly with the transfer of part of that band in Europe now to mobile broadband. This transfer is already decided and underway for 800 MHz, and the current discussion about whether also to tackle the greater challenge to do a similar thing in the 700 MHz band on a harmonised basis is top of the agenda of many. In this previous article, we described three elements to be looked at. The outcomes of this are clear, but indicative of a dynamic rather than a static environment.

1. The ECC would review the usability of the mobile broadband centre gaps at 1800 MHz. This has proved a very interesting exercise, with analysis now also made for the 800 MHz centre gaps.

2. The ECC's project team FM 50 looked at the 1452 to 1492 MHz range, including as a potential new space for PMSE. However this is now allocated by ECC Decision (13)03 to mobile supplemental downlink – a potentially important element in the support of the mobile data requirement, focusing particularly on traffic asymmetry. This may appear to be at the expense of PMSE, but there may be more to this story yet (see below).

3. We also looked at the role of cognitive approaches; more as a means of protecting PMSE from cognitive 'white space devices' than as a vehicle for PMSE itself. Interest in white space remains but is somewhat stagnant for now with the uncertain environment now created in the UHF TV band.

Looking at centre gaps

Lately, most attention has focused on the opportunities in centre gaps at 1800 and 800 MHz. Apart from any other consideration, these are opportunities which are unlikely to be caught up in the changing dynamics of the UHF band, having only recently been established in the new wireless broadband band plans. The first step of the work was to evaluate the constraints which would be needed on wireless microphones to limit interference to mobile devices. But although the wireless microphones are in international frequency law the 'secondary service', the public doesn't care about that. For example, what is more important at the concert: that a member of the audience receives or can send an SMS, or that a singer's big moment – and the audience's enjoyment - is not blighted by the receipt of that unwanted call?

So the next part of the work was to make some evaluation of what use could be made of these centre gaps in the presence of interference from the public mobile service – either from, say, pico cell base stations in a theatre, or from mobile devices inside it. These studies highlighted the need for an appropriate setup procedure to ensure the required Quality of Service for PMSE. They are documented in ECC Report 191 and an addendum to CEPT Report 50 developed in response to a European Commission mandate which will serve as a technical basis for the Commission's next steps in policy-making towards PMSE.

Challenges and opportunities

Although the centre gaps are useful for PMSE as a whole, they certainly do not provide enough capacity for the complete solution, nor enough security against the adjacent channel interference. Even if you take the 700 MHz range away from PMSE there is still a significant potential in interleaved spectrum in the remaining TV bands, although this may well be insufficient for some larger events. But long term confidence in that resource depends on long-term stability in the whole 470-790 MHz band, and that is some way off.

A further factor less often considered is how more widespread pressures on spectrum reduce the opportunity for borrowing spectrum on a short-term basis for large scale events; these are typically too much of a 'one-off' to be subject to European harmonisation, but it adds to the pressure on the PMSE sector.

One strategic problem PMSE faces is that it has secondary status in international frequency regulations. However at a national level, and also if there are sufficiently strong binding agreements between neighbouring countries, PMSE can have whatever status the regulators may determine. In addition, the rather short range required for PMSE communications makes it quite efficient to plan as a secondary service, namely plan the long-running services like broadcasting and mobile first, and then planners establish the framework for PMSE on a compatible basis. So an order of planning which is (rightly) based on technical efficiency doesn't always reflect the social and economic importance of the service itself.

The ECC's Project Team FM 51 has now produced a key ECC deliverable, ECC Report 204, which reveals important technical studies and recommended ways forward, to try and establish some greater stability, innovation and opportunity in this key sector. It covers a wide range of PMSE issues, including the wireless microphones which are at the heart of nearly all TV and theatre productions, and which are facing the biggest challenges with diminishing availability of UHF spectrum.

A major area of possibility for wireless microphones is in the L-Band. The band 1492-1518 MHz has recently been identified by CEPT for indoor operation of wireless microphones and the band 1518-1525 MHz is currently under study. This frequency range had already been investigated for professional microphones wireless systems back in 2006-2007 (see ETSI SRDoc ETSI TR 102 546) but the latest developments make it now more attractive.

The conclusion of these ECC deliverables marks a big step forward, but as with all of our work, it doesn't stop there. There are other developments which could play a big part in giving PMSE the secure future which we want for it. The ECC is always trying to optimise the efficiency of use of the spectrum, and sharing possibilities are at the heart of our policies, to maximise opportunities for all spectrum users. So it is with PMSE.

Share spectrum with mobile downlinks?

One very interesting avenue to explore is the possibility for spectrum sharing between PMSE and the downlink frequency ranges of mobile systems. In principle, this is not so different an idea from sharing with TV bands, TV transmissions being, of course, all 'downlinks'.

CEPT's review of the potential uses of the 1452 to 1492 MHz band opted to use it for mobile supplemental down links (SDL); PMSE had been one of several competing applications in the ECC's review. At the strategic level this brought with it a prioritisation and what was assumed to be a mutually exclusive decision not to include PMSE. However, with the right conditions to deconflict the services – given a channelling plan and specific base station siting – the potential for wireless microphones to share these frequencies without compromising their utility is very appealing.

This is particularly so given that the spatial environment of downlink frequencies is much more predictable than for uplinks with their mobile terminals eventually being placed anywhere… even in the back pocket of the young singer who has just won the 2013 Eurovision Song contest, has messaged her friends to share her delight, and is now back on stage for a reprise!

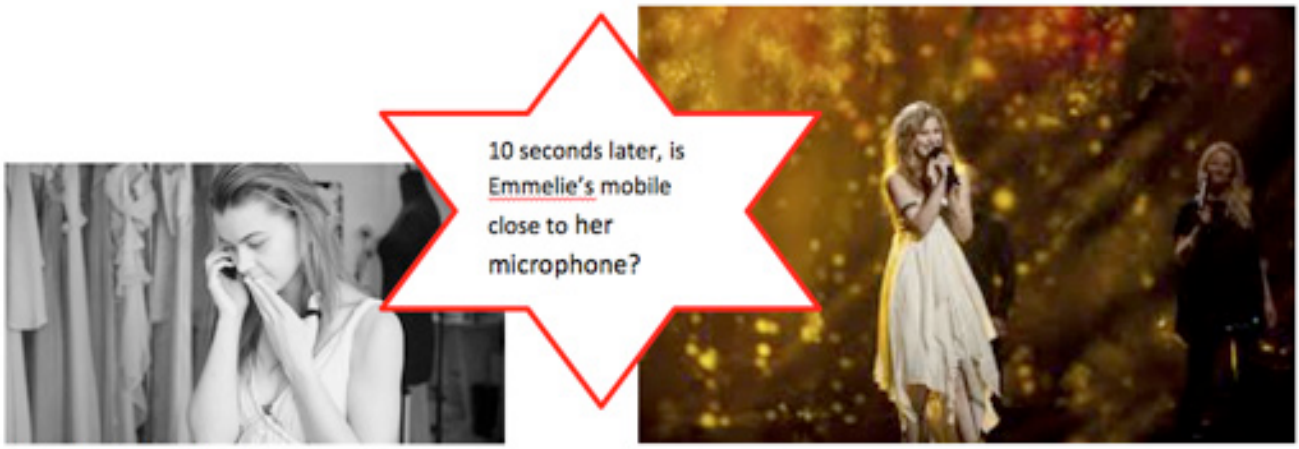

Photo: Line Anhoff, Pressfoto

Emmelie de Forest from Denmark, the 2013 Eurovision Song Contest winner
Photo: kristelig dagblad

New technologies for wireless microphones – and around them

Looking ahead, technical development for PMSE is crucially important. ECC Report 204 identified that a range of new technologies have been or are currently being developed that may increase spectrum efficiency. However, the Report anticipates that these are for long term rather than short term relevance. We look at these possibilities below.

In the short and medium term wireless microphones will remain largely analogue devices. However, the move to digitisation could provide for greater security of quality in environments of light to moderate interference; on the other hand it also brings with it a similarly demanding requirement for spacial availability: in other words the performer's microphone may not get an irritating buzzing sound from interference as (s)he moves around the stage, but interference could lead to on-stage hotspots where the voice disappears altogether!

Whilst being currently under study, the use of cognitive techniques for individual microphones is rather to be considered as a long-term option. On the other hand a local theatre/outside broadcast system managed by a cognitive or semi-cognitive local controller/management system, sensing the RF environment, may provide some ability to squeeze more services into a shrinking space.

Mark Thomas, Director of the ECO
Bruno Espinosa, Deputy Director of the ECO