Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

INTRODUCING GREATER FLEXIBILITY IN THE CURRENT REGULATORY STRUCTURE WITH A VIEW TO TAKING FORWARD CONVERGENCE AND HARMONISATION IN THE ECC

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0 EXECUTIVE SUMMARY

This ECC Report 137 was developed by Working Group Regulatory Affairs (WG RA) of CEPT/ECC as part of the follow on work recommended in ECC Report 080. ECC Report 080 looked at "Enhancing Harmonisation and introducing Flexibility in the Spectrum Regulatory Framework". This Report investigates issues associated with actually applying more flexible Spectrum allocation models in the current Regulatory Framework.

General Conclusions

- This report shows that different considerations need to be taken into account when looking to provide flexibility both in individually licensed bands and in bands covered by either licence exemption or light licensing regimes.
- The most suitable model for representing the least restrictive technical conditions that provide optimum flexibility will depend on the licensing framework (i.e. General or Individual Authorisations).
- In theory the R&TTE Directive (1999/5/EC) is already compatible with all of the models (1-10) that can be used for representing least restrictive technical conditions.
- For some models (e.g. model 3) solutions on how National regulators should notify the least restrictive technical conditions in the national Interface Specifications (and hence notified under Directive 98/34/EC) would have to be discussed further.
- Impact Assessments could be a useful tool to assess the relevant evidence in order to provide the justification for the degree of flexibility chosen.
- By introducing more flexibility into the technical conditions associated with the national licence conditions, it appears some evolution in the way that corresponding Harmonised Standards are developed may need to be further considered within ETSI:
    - ETSI may continue to produce Harmonised standards which could cover either technology neutral generic applications or be for a specific technology or application.
    - Harmonised Standards will have to show how the equipment under test would be able to meet the least restrictive technical conditions.
- The 'Flexible bands' concept has now evolved to include both licensed and licence-exempt regimes under its umbrella.
- The objective of the two concepts, Flexible Bands and WAPECS, must be considered similar, even though the identified frequency bands and services covered under their respective remits may differ.
- The Flexible Bands concept can cover a more diverse range of radio applications and services than WAPECS.
- It is important to remember that the least restrictive technical conditions derived in models 1 to 10 can sometimes provide the limits for out-of-block/band interference management which may have previously been considered to be covered under the requirements of the R&TTE Directive.

Recommendations

- ECC entities in charge of developing new regulations or reviewing existing regulations are encouraged to take due account of the analysis provided in this Report when introducing greater flexibility in least restrictive technical conditions where appropriate.

- It is recommended that work should be initiated to develop guidance on how the least restrictive technical conditions for flexible bands should be specified in the RIS template and should be notified under EC Directive 98/34/EC in the related National Interface Requirements.

- ECC should continue to review the implementation of the new models and monitor the evolution towards more flexible allocations.

- ECC entities in charge of developing new regulations or reviewing existing regulations should consider using an IA to present the arguments and detailed analysis associated with justifying the degree of flexibility chosen,

The Report analyses 10 (ten) models that could be used to represent Technical Licensing Conditions. These models were identified previously within ECC as possible ways to provide the least restrictive technical conditions and they have been analysed within WG SE (CEPT Report 019 on 'least restrictive technical

conditions for WAPECS frequency bands') and WG RA (ECC Report 132 on 'light licensing, licence-exempt and commons'). In order to fully understand the content of this Report it is recommended that the reader becomes familiar with these ten models by both reading Annex 2 to this Report or by reading CEPT Report 019 and ECC Report 132 which are available for download from the ECO Documentation Database at www.erodocdb.dk

This Report concludes that different considerations need to be taken into account when looking to provide flexibility in individually licensed bands and bands covered by either licence exemption or light licensing regimes. It is also noted that it will be the regime chosen, together with final minimum technical conditions as well as how these are reflected either in the individual licence conditions or exemption regulations which will determine how flexible the spectrum "rights of use" are.

In the presentation of the Report we assume that the way in which the technical and regulatory conditions that can be applied to Flexible bands will be dependent upon the licence regime that is planned to be implemented.

Therefore the following models that represent the least restrictive technical restrictions have been considered:

1. Traditional compatibility and sharing analysis method (e.g. using ACLR and ACS).
2. The Block Edge Mask (BEM) model that can be divided into two sub-classes, the transmit power BEM (model 2A) and the EIRP BEM (model 2B).
3. The Power Flux Density (PFD) mask model based on determination of aggregate Power Flux Density.
4. The Power Spectral Density (PSD) based on the determination of aggregate PSD within a specified area.
5. A Hybrid model based on a combination of models 2 (or 4) and 3.
6. The Space-centric model.
7. Licence-exempt (commons) – non specific applications.
8. Licence-exempt (commons) – specific applications.
9. Underlay.
10. Overlay.

Although in this Report we are assuming that models 1-6 are more likely to be used in an individual licence regime and 7 – 10 are more likely under a licence exemption regime they may not be exclusively used in these regimes. As shown in ECC Report 132 a light-licence regime may be managed in a similar way to either an individual licence or licence exemption regime.

From the point of view of implementation under the current regulatory framework, enforcement and spectrum management we analysed each of the proposed models for compatibility with the regulatory environments used currently within CEPT countries to manage interference and regulatory compliance.

Specific Conclusions on the use of the above models

- **For Licence Exemption:**
  - Models 7 to 10 are more likely to be used.
  - The extent of flexibility or liberalisation for users of spectrum will be defined in the initial usage and technical constraints placed on equipment as part of the exemption (i.e. how technology and service neutral the exemption rules are).
  - In line with the recommendations contained within CEPT Report 014 and in order to enable maximum flexibility with regard to change of use, usage constraints should be placed on the use of equipment only when justified.
  - Interference management is predominantly controlled by technical constraints placed on the equipment, with possible additional usage restrictions. These constraints are justified as a result of sharing analysis carried out by CEPT. In the EU the technical constraints placed on the equipment is managed under the R&TTE Directive.
  - No change to the current regulatory framework and the way it is managed is needed in order to implement models 7 to 10.

- **For Individual Authorisations:**
  - Models 1- 6 are more likely to be used.
  - It is desirable that the Technical Licence Conditions (TLC) associated with the authorised use of the spectrum are granted with a minimum set of technical parameters and if possible without designating the nature of the service.
  - Models 1, 2 and 4 can be implemented today and could use the similar regulatory tools to those currently used to manage interference.

- Models 3 and 5 will need an agreement on a certain theoretical model before looking at a suitable regulatory regime for managing potential interference between adjacent operators and accordingly whether current regulatory tools are sufficient for such a regime.
- Model 6 is likely to be difficult to set up and achieve in a harmonised European way, because of the establishment and maintenance of a complex database as well as setting up a suitable certification process for engineers.
- Introducing greater flexibility in theory should enable minimal or no involvement by the regulator when a change of use occurs.

- **For Light licensing:**
  - Light licensing regimes may fit under both General and Individual authorisation regimes.
  - The least restrictive technical conditions (Models 1 – 10) that would be applicable would depend upon if the light licensing regime being considered fell under the "individual" or "general" authorisation category.

By introducing more flexibility into the technical conditions associated with the national licence conditions and/or authorisation framework, it appears some evolution in the way corresponding Harmonised Standards are developed may need to be further considered within ETSI. In particular, in the field of individual rights of use, it remains that the degree of flexibility that is offered in spectrum usage is precisely driven by the TLC given to the licensee.

With regard to "change" of use the Report considers the implications of enabling a change of use of licences with the minimum or no involvement by the regulator. For this purpose it is desirable that the Technical Licence Conditions (being part of spectrum rights of use) associated with the use of the radio frequencies are granted with a minimum set of technical parameters and if possible without designating the nature of the service. It must be underlined that competition issues related to the modification of the terms of existing licences are not addressed in this Report. CEPT should give further consideration to the practical implementation of the new models and the way the evolution towards a more flexible regulation is managed based on current and future experience.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
BEM	Block Edge Mask
CDMA	Code Division Multiple Access
CEPT	European Conference of Postal and Telecommunications Administrations
CT2	Cordless Telephone
EC	European Commission
ECC	Electronic Communications Committee
EESS	Earth Exploration Satellite Service
EIRP	Equivalent isotropically radiated power
ETSI	European Telecommunications Standards Institute
FWS	Fixed Wireless Systems
GSM	Global System for Mobile communication
OoB	Out Of Band
PFD	Power Flux Density
P-P	Point to Point
PSD	Power Spectral Density
RFID	Radio Frequency IDentification
RSPG	Radio Spectrum Policy Group
RTTE	Radio and Telecommunications Terminal Equipment
SEM	Spectrum emission mask
SRD	Short range device
SUR	Spectrum Usage Rights
TLC	Technical Licence Conditions
UMTS	Universal Mobile Telecommunications System
UWB	Ultra Wide Band
WAPECS	Wireless Access Policy for Electronic Communication Services
WG FM	Working Group Frequency Management
WGRA	Working Group Regulatory Affairs
WGSE	Working Group Spectrum Engineering

Introducing greater flexibility in the current regulatory structure with a view to taking forward convergence and harmonisation in the ECC

1 INTRODUCTION

ECC Report 80 on 'enhancing harmonisation and introducing flexibility in the spectrum regulatory framework' contains suggestions and proposals on a number of issues. These are grouped on the one hand on the different levels of frequency management (global, European and national) and are on the other hand referring to technical issues and developments.

This Report is carrying forward some of the suggestions made in ECC Report 80 on flexible usage conditions, convergence and harmonisation. In particular this Report indicates how or if some of these policies could be implemented within the regulatory framework that CEPT members currently operate. For EU Member States this means that we will have to look at how Flexible bands can be implemented under the Authorisation Directive (2002/20/EC), the different licence models that can be adopted nationally as well as how obligations under the R&TTE Directive can be fulfilled. The Report also contain suggestions on how these ideas could be developed and implemented for the bands that have been identified by WG FM for flexible use.

The Report deals with the different levels of flexibility that can be achieved and how this could affect the role of the regulator in any future change of use requests. The effect of the different models for flexibility and their effect on future of convergence and harmonisation efforts are also discussed.

The Flexible bands concept has evolved since ECC Report 80 was written. In ECC Report 80 the flexible bands concept was limited to individual licences that contained minimal technical constraints in order to achieve a maximum degree of flexibility, while avoiding harmful interference. The flexible bands concept has now evolved to include both licensed (including light licensing) and licence-exempt regimes under its umbrella. Therefore to maximise the benefits of using this new flexible approach, licences and exemptions should be as technology and service neutral as possible, whilst avoiding harmful interference.

CEPT members were requested to fill in a questionnaire by 16 April 2007 on three bands identified by WG FM as suitable for flexible use, the 862-870 MHz, 1785-1805 MHz and 57-59 GHz bands. A total of twenty CEPT members responded to the questionnaire, see Annex 1.

The 863-870 MHz band is designated for Short Range Devices according to ERC/REC 70-03. The 862-863 MHz portion of the 862-870 MHz band has been used by government systems and is now under consideration within WG FM for possible SRD designation. The 57-59 GHz band is designated to fixed radio according to ERC/REC 12-09. In the 1785-1805 MHz band there is a designation for Wireless Microphones in accordance with ERC/REC 70-03 which is widely implemented. The results of the questionnaire show that each of the three bands chosen have various and divergent uses among most CEPT states although some of the radio uses within each frequency band are more consistent throughout CEPT than others. Even where we can see some consistency in the use of spectrum the licensing models used for this use differs between some states.

ECC entities in charge of developing new regulations or reviewing existing regulations are encouraged to take due account of the analysis provided in this Report in order for CEPT countries to introduce greater flexibility in Technical Licence Conditions where appropriate.

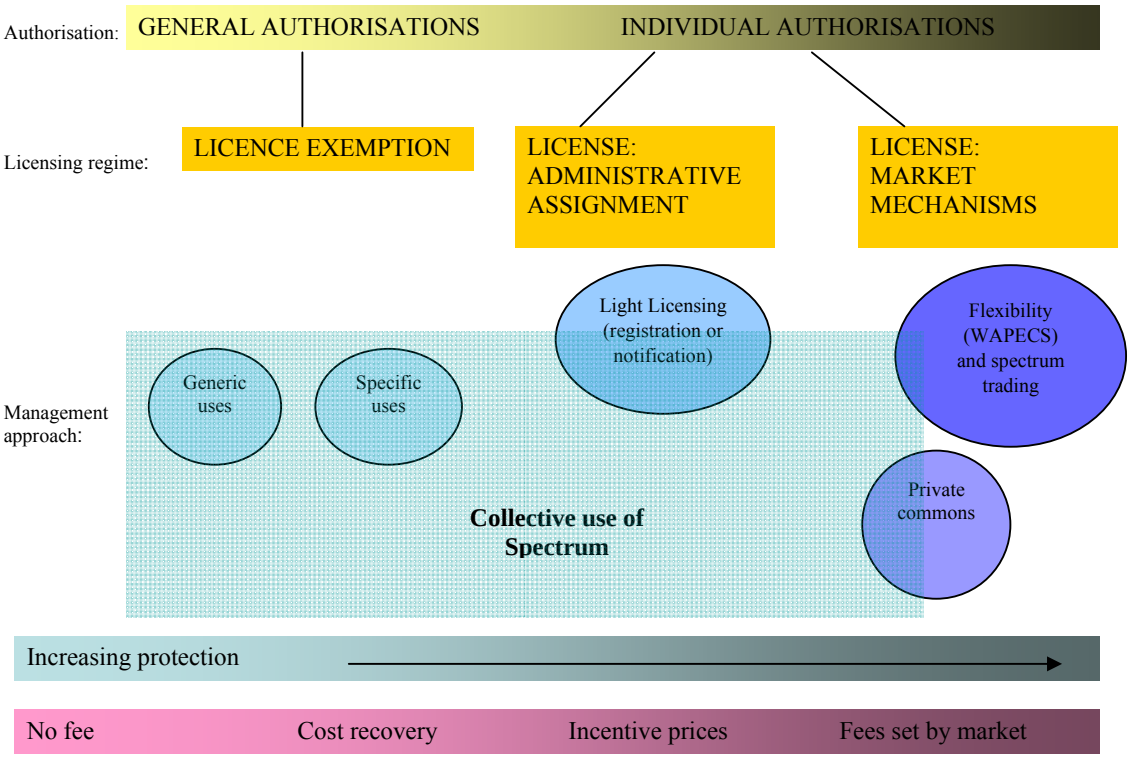
2 RELEVANT OPTIONS ON THE REGULATION OF FLEXIBLE USE

2.1 Licensing regimes

The prime distinction between various regulatory regimes is whether the use of radio frequencies is subject or not to the grant of "individual rights of use". The following is a presentation of these models and a model "in between", so called light licensing.

The diagram below, taken from the RSPG opinion on Collective Use of Spectrum (CUS), shows how each of these licence models fits in within the two authorisation regimes introduced by the EU Authorisation Directive.
Although the authorisation directive is not relevant for all CEPT member countries this diagram could also be seen to provide a representation of the licensing regimes used by CEPT countries that are not EU member states.

Licence Regimes used in spectrum management and the Authorisation Directive



In addition to the RSPG opinion on CUS, ECC Report 132 also gives some direction on the various licence models. As can be seen in ECC Report 132 practices in various European countries reflect a different interpretation of some of the terminologies used to describe the various licence models particularly when looking at the distinction between "licence-exempt" and "light licensing". Table 2 below shows the way proposed in ECC Report 132 to capture some of the fundamental differences between the various regulatory options:

Individual authorisation (Individual rights of use)		**General authorisation** (No individual rights of use)	
Individual licence[1]	**Light-licensing**		**Licence-exempt**
Individual frequency planning / coordination. Traditional procedure for issuing licences.	Individual frequency planning / coordination. Simplified procedure compared to traditional procedure for issuing licences. With limitations in the number of users.	No individual frequency planning / coordination. Registration and/or notification. No limitations in the number of users nor need for coordination.	No individual frequency planning / coordination. No registration nor notification.

Table 1: Key characteristics of different "licensing regimes"

Note: effective regulatory "light-licensing" regimes may actually combine various regulatory features pending for example the definition of geographical area of restricted operation (e.g. "general authorisation" throughout most of a national territory while some coordination zones may be subject to "individual right of use"). It has also been expressed that 'light licensing' should simply be considered as a tool for national authorities to utilize IT systems and the Internet to simplify the licensing process for enterprises and other radio users.

2.1.1 Licensing (individual rights of use)

An individual licence contains obligations for the user which have to be fulfilled before or when transmitting. The licence, apart from being regularly combined with a defined range of spectrum, could be combined with regional limitations etc.

2.1.2 Light licensing

Light licence regimes can be described in many different manners. In all cases light licensing allows typically greater power than licence exempt regimes, combined with less onerous conditions than conventionally individually licensed services. In some cases a similar approach to licence exempt devices may be taken, in that the conditions are based on technical criteria that can be controlled by the equipment.

2.1.3 Licence exempt (general authorisation)

No individual authorisation or co-ordination is required and no fee payable for using the spectrum. Access is regulated solely by adherence to pre-defined regulatory conditions.
Conditions combined with the regime are predominantly of a technical nature for ensuring effective and efficient spectrum use and avoidance of harmful interference.

2.2 Technical Licence Conditions

Technical Licence Conditions (being part of the Spectrum Usage Rights) are normally established under a national regulatory regime or by harmonisation measures within ECC and/or EC. They should be understood here in the general sense of rights and obligations attached to a licensing regime. The regimes range from an obligation to hold a licence to the exemption from a licence requirement.

[1] Sometimes also referred to as "traditional licensing"

When individual rights of use are granted, the strategy for achieving greater flexibility would involve more freedom to market players to decide how spectrum could be used as well as lowering the barriers for access to spectrum. Where possible, in particular where the risk of harmful interference is negligible, the use of radio frequencies should not be subject to the grant of individual rights of use. Only Technical requirements for ensuring effective and efficient use of radio frequencies that are necessary to avoid harmful interference are justified. Any condition imposed should be limited to the minimum necessary and be objectively justified. Transfer, lease, sharing or a similar form of flexibility are issues of interest for a spectrum user. In this context the duration of the period of time for which rights of use for radio frequencies are granted must be appropriate for the service concerned. If the initial Technical conditions are not sufficient then the rights and conditions should only be amended in objectively justified cases and in a proportionate manner.
TLC could involve conditions to prevent harmful interference. In cases of interference, the offending spectrum user should be forced to ensure that the interference ceases, unless the interference is not harmful or permitted.

2.3 The role of standardisation

2.3.1 R&TTE Directive

If radio equipment and telecommunications terminal equipment meets the administrative provisions and the essential requirements of the R&TTE Directive[2], it may be placed on the Community market. The manufacturer who places radio or telecommunications terminal equipment on the market is responsible for demonstrating the equipment's compliance with the essential requirements under the Directive. The technical specifications to be met by radio and telecommunications terminal equipment, which enable compliance with the essential requirements, are laid down in **Harmonised Standards** published in Official Journal of the European Union (OJEC).

Compliance with the harmonised standards is not obligatory. Compliance with the essential requirements under the Directive can also be demonstrated by other means defined in the Directive. The Member States are obliged to apply the presumption that any radio and telecommunications terminal equipment, manufactured in accordance with the Harmonised Standards, does actually meet the essential requirements of the Directive ("presumption of conformity"). Equipment not designed in accordance with a Harmonised Standard does not benefit from this presumption of conformity.

The equipment operating in these flexible bands must comply with the R&TTE Directive and the use of frequencies by this equipment has to be conformity with the conditions and restrictions on frequency use imposed by Member States. These conditions are defined in radio interfaces. The Member States may only impose such conditions and restrictions if this can be justified from the perspective of the effective and appropriate use of the radio spectrum, the avoidance of harmful interference and the protection of public health. The conditions and restrictions imposed on frequency usage in Member States are set out in the **national radio interfaces**. CEPT/ECC can play an important part in determining the parameters for the radio interfaces.

The R&TTE Directive already contains different conformity assessment routes to accommodate all of the equipment that may be used in the above models. However, the alternative methods available under the operation of the Directive have rarely been used in practice, as manufacturers prefer to have the certainty provided by using a Harmonised Standard for their equipment.

Harmonised Standards usually rely on the definition of sharing conditions that are defined within CEPT which has the knowledge of spectrum usage (e.g. for commercial, government or scientific purpose…) and where all relevant stakeholders can be represented. This is particularly true in case of licence-exempt radio equipment. In the field of individual rights of use, relevant equipment not only has to conform to the R&TTE Directive, however, in addition the licence holder is also under the obligation to comply with the technical and usage conditions (which may be minimal) applicable to the licence.

It is also important to remember that the least restrictive technical conditions derived in models (1 to 10) are only looking at providing very basic guidance for interference management covered under the

[2] Under the R&TTE Directive, essential requirements are imposed on radio and telecommunications terminal equipment in the areas of health and safety, electromagnetic compatibility and – as far as radio equipment is concerned – an effective use of the allocated spectrum, without causing any harmful interference (Articles 3.1 and 3.2 of the Directive). Under Article 3.3 of the Directive, the European Commission may impose extra essential requirements, including those in the field of guaranteeing access for emergency services.

Authorisation Directive and do not include other aspects of interference management (e.g. spurious emissions etc) which will be covered under the requirements of the R&TTE Directive.

Harmonised Standards

The latest version of the Harmonised Standard is the "state of the art" concerning technical specifications to be met by radio and telecommunications terminal equipment in order to meet the essential requirements of the R&TTE Directive (equipment requirements). The Harmonised Standards are adopted by **ETSI** (radio aspects, including EMC) and **CENELEC** (safety, health and EMC of wired equipment), in response to a mandate from the European Commission. The Commission publishes and updates regularly the list of Harmonised Standards. As was mentioned before, the use of the applicable Harmonised Standard gives a presumption of conformity with the essential requirements of the R&TTE Directive.

ETSI and CEPT have concluded a Memorandum Of Understanding (MOU) to ensure that regulatory measures taken by CEPT will be given due consideration in standardisation.

Equipment conforming to Harmonised Standards is presumed to fulfil the essential requirements, including avoidance of harmful interference and efficient use of spectrum. This is without prejudice to EU Member States' rights to establish their own radio interfaces and licence conditions. However, with increasing harmonisation of spectrum management and radio interfaces across Europe, it is expected that national legacy regulations will eventually be phased out and equipment that enjoys free market access across the EU may also be put into service with only minimal national adaptations.

Harmonised Standards provide methods for testing a single piece of equipment in laboratory conditions and do not take into account every aspect of equipment that needs to be regulated in order to avoid causing harmful interference. By contrast, spectrum management regulations enable regulators to manage overall interference between different services or frequency boundaries.

Specific issues that may need to be reviewed if national authorities are to implement any of the least restrictive technical conditions described in models 1- 10 contained in this report are shown below

Model 1: Traditional compatibility and sharing analysis method (e.g. using ACLR and ACS);
The current regulatory framework is adequate for this model as the Harmonised Standard and the National Radio Interface Specifications or licensing frameworks are directly linked to Specific technology used.

Model 2: the Block Edge Mask (BEM) model
In order to implement a Block Edge Mask (BEM) in national regulations the technical limits describing the block edge parameters would have to be included in the licence conditions and hence be notified under EC directive 98/34/EC by EU Member States in their interface specifications. BEM is a tool that can manage a number of different equipment spectrum emission masks (SEM) to be defined in proper equipment standard. A Harmonised Standard could help by providing adequate means of fitting different SEM within the BEM included in their licence conditions.

Model 3: the Power Flux Density (PFD) mask
Under this model the onus would be on the operator to ensure that equipment is set up in a way that it does not breach the PFD limits stated in its Technical Licence Conditions (TLC). Similarly to the comments on Model 2 solutions would have to be discussed with the EC on how National Regulators should notify these least restrictive technical conditions in the national Interface Specifications. Again, it appears like in Model 2 that the harmonised standard could help show how the equipment under test would be able to meet the least restrictive technical conditions agreed.

Models 4, 5 and 6: the Power Spectral Density within a specified area; a Hybrid model ; the Space-centric model.
The R&TTE Directive provides a framework for these models to be accommodated but there may be a need for further discussion on how Harmonised Standards and the instruments and assumptions in place for notification (i.e. RIS template) can accommodate these models in practice.

Models 7, 8, 9 and 10 Licence-Exempt (commons) – non-specific applications; Licence-Exempt (commons) –. specific applications; underlay; overlay
In theory the current system works adequately for these models which are normally used to allow usage of licence-exempt equipment as long as there is a harmonised standard available. The current system where a notified body is required to make a judgement without a harmonised standard being available has been in place for a number of years and it has been recognised during the current review process of the R&TTE

Directive that it may be useful to carry out some further investigations to see how successful this route to compliance has been at promoting new and innovative products. In any case, this illustrates the need for sharing conditions to be properly investigated and specified in a CEPT deliverable that can be referred to in a national Radio Interface Specification. This also highlights the need for the standardisation bodies and spectrum regulatory agencies to work in close cooperation and to be ready to take swift action whenever problems appear.

2.3.2 ETSI's role

By introducing more flexibility into the technical conditions associated with the national licence conditions we may have to consider further the role of ETSI and the need for a review of what parameters can be included in a Harmonised Standard under some of the models outlined above. We also have to keep in mind that a Harmonised Standard may cover all of the essential requirements of the R&TTE Directive which is beyond those normally covered under the Authorisation Directive. Therefore ETSI may continue to develop either technology neutral or technology specific standards that give manufactures a guide to declaring their equipment compliant with the flexible technical usage conditions for use in the band (e.g. How to meet a BEM associated with model 2).

In some cases, sharing conditions, as determined by CEPT, do not translate directly into user equipment specifications (for example Block Edge Masks conditions). In such cases user equipment specifications in a Harmonised Standard may appear that they are capable of exceeding the least restrictive technical conditions (for example the Spectrum Emission Mask of equipment might exceed the BEM). If this is the case then the Harmonised Standard should explain by which means the equipment when in service will respect the least restrictive technical conditions. This explanation could include a list of techniques that enable the operation of the equipment to respect the least restrictive technical conditions.

2.4 Impact Assessments

The impact assessment could be an important tool to justify the choices made when deciding upon the appropriate reference systems and/or appropriate models to represent the least restrictive technical conditions chosen when implementing flexible bands policies in future spectrum allocations. Therefore Impact Assessments could be a useful tool to assess the relevant evidence in order to provide the justification for the degree of flexibility chosen.

It must be underlined that competition issues related to the modification of the terms of existing licences are not addressed in this Report. As well, practical implementation of new models and the way the evolution towards a more flexible regulation is managed would require further consideration in the light of current experience.

Such matters could be further investigated when appropriate within the framework of an impact assessment.

2.5 Interference management; Enforcement and Dispute Resolution

This Report provides some consideration on how to manage the risk of harmful interference applied to the licensing models identified in this Report.

Detailed analysis of these matters could be needed on a case by case basis when investigating the applicability of a particular model to a given frequency band.

2.5.1 Enforcement

Enforcement means[3]: "The range of actions and sanctions that can be used to enhance the compliance with national legislation and regulations for the purpose of achieving interference free communications for the legitimate users of the radio frequency spectrum. It includes taking action against occurred and potential sources of interference and unauthorised use and may include appropriate measures. Enforcement can include all types of investigation activities such as market surveillance, inspection of radio equipment, interference investigation and/or spectrum monitoring." Any breach or misuse of a right to use spectrum should be adequately addressed. The resolution of interference issues is first and foremost a responsibility of national administrations.

[3] The definition of enforcement shown here is taken from ECC Report 15.

2.5.2 Dispute resolution

If a dispute arises between those who provide electronic communications networks or services as regards to obligations or licence conditions the parties concerned may refer the dispute for determination by the supervisory authority. The institution of dispute resolution could be engaged in cases of disagreement on the direct cause or extent of interference.
The lawful right of dispute resolution relates only to Member States of the European Union.

3 FLEXIBLE BANDS AND THEIR RELATIONSHIP WITH WAPECS

In November 2005 the Radio Spectrum Policy Group (RSPG) adopted the opinion on Wireless Access Policy for Electronic Communications Services (WAPECS)[4]. RSPG defined WAPECS as follows:

"WAPECS is a framework for the provision of electronic communications services within a set of frequency bands to be identified and agreed between European Union Member States in which a range of Electronic Communications Networks (ECN) and Electronic Communications Services (ECS) may be offered on a technology and service neutral basis, provided that certain technical requirements to avoid interference are met, to ensure the effective and efficient use of the spectrum, and the authorisation conditions do not distort competition."

In 2007 the European Commission adopted a communication[5] on 'rapid access to spectrum for wireless electronic communication services through more flexibility' and identified spectrum of 1350 MHz in total which can be subject to more flexibility; 470-862 MHz, 880-915 MHz/925-960 MHz as well as 1710-1785 MHz/1805-1880 MHz, 1900-1980 MHz/2010-2025MHz/2110-2170 MHz, 2500-2690 MHz and 3.4-3.8 GHz.

Further discussions, on what would constitutes a market based approach with the aim to facilitate a level playing field in an environment of converging services, have taken place within the European Commission.

The objective of the two concepts, Flexible bands and WAPECS, must be considered similar, that is to provide flexibility, even though WAPECS which is limited to ECN/ECS, whereas the Flexible bands concept covers a more diverse range of radio applications and services (e.g. scientific or public use).

As stated earlier CEPT members were requested to fill in a questionnaire by 16 April 2007 on three bands identified by WG FM as suitable for flexible use, the 862-870 MHz, 1785-1805 MHz and 57-59 GHz bands. The results of this questionnaire although valid at the time may have changed in some countries due to some harmonisation initiatives that have taken place since. The band 862-870 MHz is now subject to regular review by the Short Range Devices Maintenance Group (SRD/MG) and PTSE24 with a view to providing a long term evolution of the technical conditions and usage of this band. Without pre-empting any conclusions that may be arrived at following further work by WGRA it does appear that the scope of the work mentioned above is directed by the policies and recommendations put forward in CEPT Report 14 which already promotes (where possible) flexible allocations in SRD bands. In addition, it should be noted that a new allocation in the frequency band 57-66 GHz has recently been incorporated in ERC/REC 70-03 for Wideband Data Transmission systems, which allows a wide range of applications within its scope.

[4] RSPG05-102 final, November 23, 2005.
[5] "Rapid access to spectrum for wireless electronic communications services through more flexibility", COM(2007)50. See also Commission Communications "A market-based approach to spectrum management in the European Union", COM(2005) 400.

4 FLEXIBLE BANDS AND THE DIFFERENT LICENCE MODELS

The way in which flexible bands can be implemented may be dependent upon the licence models that are planned to be implemented nationally or in a harmonised manner throughout CEPT.

4.1 Flexibility in Individually Licensed Bands

Under a regime that allows for change of use and trading in individually licensed bands it is important to reduce the amount of intervention or analysis that is needed to be done by the regulator when or if a licensee wishes to change his use. The amount of flexibility allowed by the initial TLC associated with a licence could be considered to be proportional to the need for the regulator to be involved in any change of use envisaged by the licensee. In addition although flexibility is essential to limit the role of regulator in future changes of use requests, there is also the opportunity for the regulator to facilitate negotiations between licensees for change of use that has not been envisaged under the original least restrictive technical conditions. As part of the response to the WAPECS mandate CEPT Report 019 identified some models that may be applicable to develop technical conditions for the access to spectrum when looking at individually licensed bands[6]. Below we also discuss some of the regulatory issues associated with the implementation of each these models. These sections do not look at the relative merits of each of these models but do look at potential issues that may need to be resolved if CEPT members were to implement these models under the current regulatory environment.

4.1.1 Implementation models for technological neutrality in individually licensed bands

A short description of regulatory issues that may need to be addressed for each of the six different models described in CEPT Report 019 is given below. The models described have different ways of dealing with regulating the power limits for co and adjacent frequency use. Some only look at managing the power limits for the frequency domain whilst others also look at managing the limits for geographical co frequency sharing.

4.1.1.1 Model 1: Traditional compatibility and sharing analysis method (e.g. using ACLR and ACS);

This model is the one that has been used for years for the sharing and compatibility studies and the current regulatory environment has grown around the use of this model. This model assumes that maximum power levels will be complemented by Spectrum Emission Masks, Channel Plans etc.

4.1.1.2 Model 2: the Block Edge Mask (BEM) model that can be divided into two sub-classes, the transmit power BEM (model 2A) and the EIRP BEM (model 2B);

This model was used, for Point-to-Multi Point FWS in the band 3.4-3.8 GHz and for Mobile Services in the 2.6 GHz band addressing situations whereby no decision was taken beforehand by an administration regarding the technology anticipated. It consists in assigning one or more blocks of spectrum to an operator.

Block edge masks control interference between radio systems by defining a power/frequency envelope within which radio transmitter emissions must remain. This is done by specifying a maximum in-block transmission power in addition to out of block or out of band powers.

Concerning the frequency band 2500-2690 MHz, CEPT developed the BEM conditions to cover the different channelling arrangement. EC Decision 2008/477/EC and its CEPT counterpart ECC/DEC/(05)05 stipulates that measures are necessary to ensure a harmonised and efficient use of the frequency band 2500-2690 MHz for IMT-2000/UMTS, but recognises that flexibility should be allowed when implementing the EC Decision, based on market demand and national considerations (e.g. extension of the 50 MHz TDD sub band).

Similarly, concerning future use of the frequency band 790-862 MHz by fixed/mobile communication network, CEPT responses within the frame of the 2nd EC mandate on the Digital Dividend will be twofold. ECC PT1 has developed an ECC Decision stipulating the preferred FDD channelling arrangement within CEPT. WG SE Project Team SE42 has developed technical conditions (BEM) independently of the

[6] See CEPT Report 019 for a comprehensive description of each of these models as well as their relative merits regarding the introduction of flexibility under the technical licence conditions.

channelling arrangement to cover all possibilities (FDD or TDD channelling arrangement and mixed use of the sub band between broadcasting and fixed/mobile networks).

4.1.1.3 Model 3: the Power Flux Density (PFD) mask model based on determination of aggregate Power Flux Density;

The aggregate PFD (Power Flux Density) method aims to offer certainty by specifying directly the levels of interference that a licensee may generate to neighbours. The main difference compared with the BEM approach is that regulation is given on the expected aggregate received power on the victim rather than on the emission power from a single interferer.

4.1.1.4 Model 4: the Power Spectral Density (PSD= transmitter masks based on the determination of aggregate PSD (transmitted power spectral density) within a specified area;

This approach defines the least restrictive technical conditions in terms of aggregate PSD (transmitted power spectral density) within a specified area. This would take into account the aggregation of the emissions on a particular frequency of all of the transmitters within a specified area, considering the density of transmitter deployment. This could be defined at the input to the transmitter antenna.

4.1.1.5 Model 5: an Hybrid model based on a combination of models 2 (or 4) and 3;

This is not a specific model as such, but combines some of the models described in the previous sections. The "hybrid" approach distinguishes between adjacent frequency and co-frequency geographic interference.

4.1.1.6 Model 6: the Space-centric model;

The space-centric model has been used in Australia for over a decade to enable self-management of spectrum licences. This model is used in Australia to assist the management of interference between new devices (not between new and legacy devices), and utilises a set of explicit transmit rights (with implicit receive rights) *i.e.* spectrum rights that define maximum radiated power at each antenna (EIRP).

4.1.2 Management of the risk of undue interference

It is important that we analyse each model for compatibility with the regulatory environments used within CEPT countries to manage interference.

Models 1, 2 and 4

When looking at models 1, 2 and 4 interference management is based on managing the maximum powers output of any transmitter. These models generally fit quite easily under the legal and regulatory environment of EU Member States. Arguably model 1 relies more on the technology specific licence conditions and models 2 and 4 rely more on the stand alone licence conditions (Authorisation Directive) to manage co and adjacent channel interference. With regard to the regulatory environment we work within today, models 1 and 2 would use the same interference management tools we use today although under model 2 the regulator would have to publish the BEM in its national Interface Specifications. Model 4 may involve using a theoretical model to provide appropriate aggregate PSD levels that can be confirmed by performing physical measurements at a given number of transmitters. How the Technical Conditions (aggregate PSD) should be notified under Model 4 in the National Interface Specification will have to be considered further. All of the above models would normally also be complemented by individual co-ordination agreements (MOU) between the appropriate adjacent CEPT countries.

It has to be noted that these models such as BEM are also combined with PFD value to ensure compatibility in co channel but in different geographical areas.

Model 3

In model 3 interference management is based on the amount of interference that an adjacent user can expect to receive and this is controlled by the national technical licence conditions. This method is a similar method to that currently being used in co-ordination agreements (e.g. MOU) between neighbouring countries to manage possible interference between adjacent geographic users. This model may also require the licensees to agree to use a theoretical model for estimating interference when resolving disputes with

adjacent users (both geographic and frequency) rather than using actual measurements due to changes in propagation conditions making consistent measurements difficult to achieve.

In the UK licences have been issued based on the described approach which shows one possible interference evaluation and enforcement mechanism. The feasibility of implementing this approach across Europe would have to be considered if this model was also to be used as a way of defining harmonised approach across Europe. In theory any equipment that can be configured to meet the PFD requirements can be used therefore there would not be any maximum transmitter limits associated with this model. It is also important to remember that this model only looks at providing very basic guidance for interference management and does not include other aspects of interference management (e.g. spurious emissions etc) which will be covered under the requirements of the R&TTE Directive.

Model 5

Model 5 being a hybrid of models 2 and 3 will have the same issues related to interference management as described above for both of these models. It is also important to remember that this model only looks at providing very basic guidance for interference management and does not include other aspects of interference management (e.g. spurious emissions etc) which will be covered under the requirements of the R&TTE Directive.

Model 6

Model 6 relies on the judgement of the engineer who is responsible for signing off the licence conditions (or transmit rights) which sets the boundary conditions for each transmitter. This space centric model limits radiated power at each transmit antenna in order to establish precise levels of guard space isolation at spectrum space boundaries in relation to all interference scenario (device boundary criterion, Out-of-band emission limit and in-band radiated power limit with coordination procedure).This model also relies on having a centralised online database which manages this process. This model also looks to include limits for additional technical parameters (such as spurious emissions etc.) which would normally be covered under the requirements of the R&TTE Directive in the current European regulatory framework.

Conclusions

In conclusion models 1,2 and 4 would use the same or similar methods to those currently used to manage interference today whereas if using either model 3 or 5 licensees may have to agree upon a consistent theoretical model beforehand when looking at the dispute resolution process for potential interference between adjacent operators (both geographic and frequency). In order to implement model 6 there would have to be some thought given as to how this process could be implemented and managed either at a national or European level. The establishment and maintenance of such a complex database and the setting up of a certification process for the individual engineers who would sign off the licence conditions is likely to be difficult to set up and achieve in a harmonised European way. It is also not clear how many of the technical conditions that we would normally cover under the requirements of the R&TTE Directive would have to be included in the licence conditions of a user.

4.1.3 Change of use

The aim of introducing flexibility with regard to change of use is to enable a change of use of licences with the minimum involvement by the regulator. For this purpose it is essential that the Technical Licence Conditions (rights of use) associated with the use of the radio frequencies are granted with a minimum set of technical parameters and without designating the nature of the service.

Restriction on the nature of the service, like any other restriction, must be justified by the need to ensure the efficient use of the radio spectrum and the avoidance of harmful interference or other public interest requirements. This implies that the effect of expanding the service compare with what was originally intended must be carefully analysed beforehand.

Model 1 as it is more technology specific it would appear to need the most involvement by the regulator in order to facilitate a trade or a change of use by new or existing licensee. This may also involve changing an EC/ECC Decision or Directive (e.g.: the change of use from GSM to UMTS in 900 and 1800 MHz bands).

Model 2 would give the user more flexibility than model 1 as long as the new use could fit within the parameters of the licensees BEM and additional licence conditions (if any). This would probably rely on the usage scenarios being similar to the reference WAPECS system that the BEM was based upon.

Model 4 would have similar issues to that mentioned for model 2 although having taken account of possible aggregate interference in this model it should in theory introduce more flexibility than model 2.

Model 3 should involve minimum regulatory input whilst giving maximum flexibility although like model 2 the amount of flexibility may rely upon the choices made when considering the appropriate reference WAPECS systems.

Again model 5 would have similar issues as those described above for models 2 and 3.

Model 6 although in theory is supposed to give maximum flexibility it does require the setting up of an on-line database that can be used by the licensees or their representatives in order to provide that flexibility. Ultimately, the spectrum usage rights granted at a given point in time under this model to a licensee can also create legacy situations and reduce flexibility to future spectrum users.

4.2 Licence Exemption and Flexibility

Change of use in the licensing conditions should have little or no direct relevance to licence exempt services as in theory there is no individual spectrum right or asset to trade or liberalise. In addition it is the equipment which is made exempt from licensing so any future flexibility in the use of the equipment is dependant on the technical parameters that the equipment must meet and any restrictions on the nature of service (if any).

The 'Plan for on the implementation of the "SRD strategy" given in the CEPT Report 014' approved by WG FM at its meeting in May 2008 in Brussels shows among others that various levels of flexibility can be achieved through the way regulatory parameters are specified, without omitting sharing obligations or constraints that have been identified through compatibility studies. Careful consideration is however required on a case by case basis.

The following guidelines have for instance been proposed in support of ensuring that only minimum regulations are specified and are particularly relevant to the review process of the technical annex of the EC Decision on SRDs:

- When there is an obligation to use a spectrum access/mitigation technique whose purpose is to protect a given radiocommunication service, then that purpose should be explicitly stated in the regulation and the detailed technical requirements should be described in the relevant Harmonised Standards only.
- In the case of sharing obligations between SRDs, greater flexibility is certainly desirable. The regulations should not preclude mitigation techniques that achieve the same effect with respect to sharing between the respective SRDs.

Consideration of regulations for specific licence-exempt applications with safety-critical implications, or more generally for applications with higher QoS (quality of service) requirements, suggest that more specific regulatory parameters could better preserve the usefulness of a frequency band.

In current developments under licence-exempt models the regulatory parameters included in the National/ Radio Interface Specification are aimed to be kept to a minimum. Licence-exempt equipment operating in shared bands still relies on detailed specifications in the corresponding Harmonised Standards. This approach can be simply summarised in Table 2 below:

Technical / operational parameters	**ECC deliverable**	**ETSI Harmonised Standards**	**EC Decision**
Protection of radio services	Included (regulatory parameters)	Included	Included
Intra-SRD sharing criteria	Included (informative part)	Included	Not included

Table 2

4.2.1 Implementation models in licence exemption

4.2.1.1 Model 7 - Licence-Exempt (commons) – non-specific applications

No individual authorisation or co-ordination is required and no fee payable for using the spectrum. Access is regulated solely by adherence to pre-defined regulatory conditions (typically specified in the national frequency allocation table (NFAT) and/or national legislation, which may be based on EU or CEPT harmonisation measures). Any application is permitted so long as the regulatory conditions are adhered to. Licence exempt applications are typically low power although higher-powered applications would be possible under the correct conditions.

4.2.1.2 Model 8 - Licence-Exempt (commons) – specific applications

No individual authorisation or co-ordination is required and no fee payable for using the spectrum. Access is regulated solely by adherence to pre-defined regulatory conditions (typically specified in national legislation and/or frequency allocations) which may be based on EU or CEPT harmonisation measures. The conditions specify which application(s) is to be used in the band. The limitation to specific applications may make it possible to share the band with other applications. The equipment must comply with minimum requirements of the R&TTE directive and any usage restrictions in the national interface standards which relate to the specific applications allowed.

4.2.1.3 Model 9 – Underlay

Underlay technologies operate in spectrum that is used for other licensed or licence-exempt use but at very low power levels. This allows the underlay use to share or collectively use the spectrum. Underlay use is not normally licensed. Ultra Wide Band (UWB) is an example of an underlay technology.

4.2.1.4 Model 10 – Overlay

An overlay approach permits higher powers that could cause interference to existing users, but overcomes this risk by only permitting transmissions at times or locations where the spectrum is not currently in use. This can be achieved either using technology (e.g. cognitive radio) or by regulatory means (e.g. only permitting use in certain geographic regions). Here we consider overlay use that is not licensed.

4.2.2 Enforcement and Interference Management

Models 7, 9 and 10 above potentially provides the most flexible models for the use of equipment, where model 8 would be limited to specific usage applications and is the least flexible model. Interference management in Models 7, 9 and 10 is controlled by the equipment parameters, although occasionally there may be an additional general usage restriction (e.g. no fixed outdoor usage). In Model 8 interference management is normally provided by the equipment parameters coupled with a specific usage requirement.

4.2.3 Change of use

Flexibility involves setting rules in a way that allows changes in the use of spectrum without regulatory intervention. For licence-exempt use this will depend on the extent to which the initial usage and/or

technical constraints placed on equipment as part of the exemption rules are technology and service neutral.

In many frequency bands for licence exempt use, "flexible use" is already the norm since there are few specific service restrictions beyond simple technical conditions (e.g. Maximum power, duty cycle etc.). There are various SRD bands (433 MHz, 2.4GHz, etc) that are good examples of this approach. It may also be considered necessary to review existing service restrictions in other bands with a view to making the usage conditions in these bands more generic. However any such review must take into account that once the spectrum has licence exempt use it is usually irreversible in practice.

4.3 Light Licensing and Flexibility

ECC Report 132 gives some direction as to what constitutes a light licensing regime and as can be seen in Table 1 in this Report some light licensing regimes may reflect similar characteristics to "individual authorisations" whilst others may be more suitable to fall under the "general authorisations" category. Therefore when looking at the properties of the light licence regime in relation to the introduction of flexibility we would have to chose the most suitable models described above for both individual licensing and licence-exemption. This would mean that the amount of flexibility that can be introduced will be dependent upon what type of light licence model is being implemented.

4.3.1 Implementation models in light - licensed bands

Therefore from the above paragraph we can deduce that in theory all of the Models 1 – 10 discussed earlier in this Report could be applicable to light – licensed bands. Therefore the model(s) that would be applicable would depend on whether the light licensing regime being considered fell under the "individual" or "general" authorisation category.

This would also imply that there is some scope under certain light licensing regimes that fall under the "individual authorisation" category that trading and liberalisation could be introduced to provide a route for negotiation between users. In this case we would expect that Models 1 – 6 are the more likely models to be used.

In addition we could also deduce that models 7 -10 could apply when the light-licence model being used was considered to fall under the "general authorisation" category.

4.3.2 Enforcement and Interference Management

The enforcement and interference management issues associated with the light licence regime will depend upon which of the models 1-10 is chosen for the Technical Licence Conditions (TLC). The appropriate comments shown in Table 1 will apply.

4.3.3 Change of use

The extent of flexibility will depend upon which of the models 1-10 the light licensing system uses to authorise usage.

5 CONVERGENCE AND HARMONISATION ISSUES

The more flexible the least restrictive technical conditions that are applied to spectrum usage then the easier it will be for operators to provide converged services in the future without further action needed by the regulator.

6 MEASURES TO PURSUE A HARMONIZED APPROACH WITHIN THE CEPT

6.1 Merging of concepts

A flexible approach will involve agreeing on least restrictive technical conditions and a set of proportionate rights and non-technical licensing conditions which should apply in the selected spectrum bands. These objectives unite the two concepts, Flexible bands and WAPECS[4].

It has been foreseen that due to the phenomenon of convergence, further radio frequencies may be included in the list of bands in the forthcoming European Commission Recommendation as appropriate. EU Member States should be considering their position when informing the European Commission about the desirability of adding any further radio frequencies to the list.
Embracing suitable bands within the WAPECS concept provides a predictable and legally binding framework across the EU. In theory if we are taking into account that properties of envisaged applications within *Flexible bands* and *WAPECS bands are identical then* the designated Flexible bands could well be integrated in the WAPECS family or vice versa. As a measure to pursue a harmonised approach to flexibility within many CEPT countries, when it is considered appropriate, an approach to the European Commission could be considered. An EC Spectrum Decision would enable a legally binding harmonisation measure for a critical mass of CEPT countries (i.e. 27 Member States of the European Union).

6.2 ECC Decisions

ECC Decisions are the outcome of any decision making process within the CEPT on matters of significant harmonisation in the electronic communications regulatory field. Such decisions should neither impose nor discriminate in favour of the use of a particular type of technology. Decisions that ”designate” a frequency band for a harmonised application are intended to foster the deployment of an application to meet a market demand in a harmonised manner throughout CEPT.

CEPT members may commit themselves to Decisions at any time. The agreements between CEPT members are voluntary and thus less predictable than an EC harmonisation measure. On the other hand, an ECC Decision might conceive a higher level of consensus and at present **administrations from 48 countries are members of CEPT, compared to 27 Member States within the European Union and 4 members of EFTA.**

6.3 Conclusions on measures to pursue a harmonized approach within the CEPT

We assume that any harmonisation measures will only be adopted where justified in line with the current policies of CEPT. Any measures to harmonise will more than likely be in line with harmonisation through the adoption of similar least restrictive technical conditions in line with but not limited to models 1-10. There may also be opportunity to explore further ways of allowing more than one model to be used under a harmonisation measure.

ANNEX 1: THE FLEXIBLE BANDS QUESTIONNAIRE

Questionnaire and Responses

Questionnaire and summary of responses
on the conditions applicable to current rights of use in frequency bands
envisaged for implementation of the Flexible Bands concept

Introduction

One of the issues identified for further work with regard to the Action Plan developed by ECC PT8 was the "flexible bands concept" and WG FM was tasked with identifying the bands that should be selected as candidates for further work. "Flexible bands" are frequency bands in which licences are technology neutral and can be used to offer any application or electronic communications service, subject to conditions for the protection of services operating in adjacent bands and ensuring safety while omitting any further parameters for the use of the band (ECC Report 80).

In order to verify the applicability of the model to the candidate bands WG FM has tasked WG RA to undertake the necessary regulatory studies taking due account of existing regulations and to convey the results of these studies to WG FM. WG FM intends to develop an ECC report mentioned in the action plan taking into account the results of WG SE and WG RA regarding the technical and regulatory prerequisites.

CEPT members were requested to fill in the information[1] in Table in Annex 2 concerning the conditions attached to the current rights of use in each frequency band listed in Annex 1 as well as the original justifications for those conditions[2].
For the sake of consistency, CEPT members were also asked to list all the conditions, both technical and regulatory, attached to the current rights of use.
The information provided was to be in sufficient detail to reveal any differences in authorisation conditions across frequency bands in your country.
It was also desirable for countries to indicate in the responses any e-communication technologies and services in these bands that are not subject to individual rights of use for radio frequencies, and the usage conditions which have been included in any general authorisation.

The information is to be used to attempt to identify what could potentially be a common and minimal set of conditions for the relevant frequency bands, and subsequently to assess the possible options for voluntary harmonisation measures within the CEPT.

SUMMARY OF RESPONSES

In total 20 CEPT countries responded to the questionnaire:

Austria, Croatia, Czech Republic, Cyprus, Estonia, Finland, France, Germany, Hungary, Ireland, Lithuania, Malta, Moldova, Norway, Poland, Portugal, Romania, Sweden, Switzerland and the United Kingdom.

A quick summary of the responses on a band by band basis can be seen below for a full breakdown of responses please see the table in Appendix 1:

- 862-870 MHz;

Usage of this band varied in different parts of the band. In most countries for most of the services allocated the use was authorised for either by general authorisation or licence exemption. There is however some licensed uses in some countries in parts of the band, notably for CT2 and CDMA 2000 systems. Every country (apart from 1) who responded had an allocation somewhere in the band for non- specific SRD usage but the amount of spectrum available for this use varied across CEPT. Other uses included Wireless Audio applications, Radio Microphones, Alarms, government use and RFIDs.

In 862-863 MHz was either allocated to government use or not allocated. 863-865 MHz seemed to be the favoured band for wireless or radio microphones whilst 865-868 MHz was favoured by the majority for RFIDs.

- 1785-1805 MHz;

Again usage of the band varied in different parts of the band. Most countries allow use of part of the band for wireless microphones in accordance with ERC/REC 70-03 under licence exemption or general authorisation. There are however a number of countries who have licensed fixed, mobile and government uses in parts or all of the band. In Ireland and the UK (Northern Ireland only) there are plans to auction the band on a technology and service neutral basis. Other uses included Wireless Audio applications, Radio Microphones, Alarms, government use (and RFIDs).

- 57-59 GHz;

Most countries have allocated this band for PtP fixed links although there is a divergence in the way the band is managed between countries. Some countries ha a licence exempt regime in place and others have licensed fixed services in the band. It is not apparent whether any of the countries who employ a licensing system have a light licence system but some countries indicate that they have no coordinated frequency planning and no restriction on number of licensees at present. Most other countries have either no allocations in the band or are used for military and EESS (passive).

As can be seen from the above each of the 3 bands identified by WG FM as possible flex bands have various and divergent uses between CEPT countries although some services are consistent in most CEPT countries within each band.
See below and Appendix 1 for more detail on the questions asked with each of the responses received.

Inventory of conditions attached to spectrum usage rights in the frequency bands:

The conditions which may be attached to rights of use are limited to the following exhaustive list:

(1) Designation of **service** or **type of network** or **technology** for which the rights of use for the frequency has been granted, including, where applicable, the exclusive use of a frequency for the transmission of specific content or specific audiovisual services;

(2) **Effective and efficient use of frequencies** including, where appropriate, **coverage** requirements;

(3) **Technical and operational conditions** necessary for the avoidance of harmful interference and for the limitation of exposure of the general public to electromagnetic fields, where such conditions are different from those included in the appropriate ECC Decision or ECC Recommendation;

(4) **Maximum duration** of licence or Usage Rights, subject to any changes in the national frequency plan;

(5) **Transfer of rights** at the initiative of the right holder and conditions for such transfer;

(6) **Usage fees**;

(7) Any **commitments** which the undertaking obtaining the usage right has made in the course of a competitive or comparative selection procedure;

(8) Obligations under relevant **international agreements** relating to the use of frequencies.

APPENDIX 1 TO ANNEX 1

Conditions attached to spectrum usage rights in the relevant	Condition **1** **Service, type of network or technology**	Condition **2** **Effective and efficient use / coverage**	Condition **3** **Technical and operational conditions**	Condition **4** **Maximum duration**	Condition **5** **Transfer of rights**	Condition **6** **Usage fees**	Condition **7** **Commitments in selection procedure**	Condition **8** **Obligations in international agreements**[iii]
862- 870 MHz								
Austria	Mobile Service (Short Range Devices)	Effective and efficient use of spectrum in accordance with relevant sharing studies carried out by WGSE. No coverage requirements.	In accordance with EC-Decision 2006/771/EC and 2006/804/EC and with the actual version of ERC/REC 70-03 as well as EN 300 220 EN 301 357 EN 302 208	Not applicable (general licence)	Not applicable (general licence)	None	Not applicable (general licence)	None
Croatia	SRD ERC/REC 70-03	-	-	-	-	-	-	-
Czech Republic*	No civil use (862-863 MHz)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SRD Wireless Audio Applications and Radio microphones (863-865 MHz)	Operated under General Authorization No. VO-R/10/03.2007-4	Radiated power 10 mW No channel spacing	N/A	N/A	N/A	N/A	N/A
	RFID devices (865-868 MHz)	Operated under General Authorization No. VO-R/10/03.2007-4	Radiated power 100 mW, 500 mW and 2 W in certain parts of the band. Channel spacing 200 kHz, LBT	N/A	N/A	N/A	N/A	N/A
	Non-specific and Alarm SRDs	Operated under General Authorization No. VO-R/10/03.2007-4	Radiated power as well as channel spacing/duty cycle depend on particular type of device	N/A	N/A	N/A	N/A	N/A
Cyprus**	The Radiofrequency Plan of the Republic foresees the following applications: 1. Cordless Telephones (EN 301 792, 1/DEC/(01)02. To be phased out in accordance with ERC/DEC/(01)02) 2. Government Use – **Authorisation procedure in accordance to Article 17(2) of the Radiocommunications Laws (i.e no fees). No application for such authorisation is received so far.** 3. Narrow band analogue voice devices (EN 300 220, ERC/REC 70-03, within the band 864.8-865 MHz) - **General authorisation and registration. No registration for such authorisation is received so far. Terms and conditions will be determined after receiving a registration.** 4. Radio microphones (EN 300 422, EN 301 357, ERC/REC 70-03, within the band 863-865 MHz) - **General authorisation and registration. No registration for such authorisation is**							

	received so far. Terms and conditions will be determined after receiving a registration. 5. Social alarms (EN 300 220, ERC/DEC/(97)06, ERC/REC 70-03, within the band 869.2-869.25 MHz) - **General authorisation and registration. No registration for such authorisation is received so far. Terms and conditions will be determined after receiving a registration.** 6. SRD in 868-870 MHz (EN 300 220, ERC/DEC/(02)05, ERC/REC 70-03) - **Authorisation exempt in accordance to *"The Radiocommunications (Use of Radiofrequencies by Radioequipment that is Exempted from the Obligation to obtain an Authorization) Order of 2005 (P.I. 317/2005, 15.7.2005)"*. Also the radioequipment should comply with Part IV of the Radiocommunications Laws, which adopts the R&TTE Directive.** 7. Wireless Audio (EN 301 357, ERC/DEC/(01)18, ERC/REC 70-03, within the band 863-865 MHz) - **Authorisation exempt in accordance to *"The Radiocommunications (Use of Radiofrequencies by Radioequipment that is Exempted from the Obligation to obtain an Authorization) Order of 2005 (P.I. 317/2005, 15.7.2005)"*. Also the radioequipment should comply with Part IV of the Radiocommunications Laws, which adopts the R&TTE Directive.**							
Estonia	Radio microphones	863.000-865.000 MHz	General authorization based on EC and ECC decisions and recommendations					
	SAP/SAB (Service Ancillary to Programme making and broadcasting)	863.000-865.000 MHz	Frequency authorisation in accordance with CEPT regulation	Temporary or every year prolongation	Not permitted	*State fee in the amount:* 240 EEK with a bandwidth of up to 50 kHz; 600 EEK with a bandwidth 50 kHz to 500 kHz; 1200 EEK with a bandwidth of 500 kHz to 4 MHz; 2400 EEK with a bandwidth higher than 4 MHz up to 14 MHz; 4800 EEK with a bandwidth higher than 14 MHz up to 100 MHz; 12 000 EEK with a bandwidth of 100 MHz and higher; + one-and-a-half times the state fee rate for a transmitter of	First come, first served basis	

						one fixed radio link.		
	Wireless audio applications	863.000-865.000 MHz	General authorization based on EC and ECC decisions and recommendations					
	Non-specific Short Range Devices	863.000-870.000 MHz	General authorization based on EC and ECC decisions and recommendations					
	RFID	865.000-868.000 MHz	General authorization based on EC and ECC decisions and recommendations					
	Alarms	868.600-869.700 MHz	General authorization based on EC and ECC decisions and recommendations					
Finland	862-863 MHz: military use, but could be made available for flex use 863-870 MHz: Short Range Devices (SRD) according to ERC/REC 70-03	available in whole country, no limitations in coverage	according to ERC/REC 70-03	--	--	licence exempt	--	--
France[iv]	Non specific SRD Alarms, social alarms, RFID	Not defined	SRD in the band 868-870 MHz SRD in the band 863-865 MHz RFID in the band 865-868 MHz with some exclusion zones	Not relevant	Not relevant	no	no	No
Germany	CT1 (885-887 MHz)	General frequency assignment	EN 301 796	31.12.2008		Free		Terminated at 31.12.2008; ECC/DEC/(01)01
	CT2 (864.1-868.1 MHz)	General frequency assignment	EN 301 797	31.12.2008		Free		Terminated at 31.12.2008; ECC/DEC/(01)02
	862-863 MHz	No assignment						
	SRD (non specific) (863-870 MHz)	General frequency assignment	EN 301 391 EN 300 220 EN 300 330 EN 300 440	2016, with option to extend		Free		ERC/REC 70-03, Annex 1
	SRD (wireless audio applications) (863-865 MHz)	General frequency assignment	EN 301 357 EN 300 220	2016, with option to extend		Free		ERC/REC 70-03, Annex 13

	RFID (865-868 MHz)	General frequency assignment	EN 302 208 EN 300 440	2014, with option to extend		Free		ERC/REC 70-03, Annex 11
	SRD (alarms/social alarms) (868-870 MHz)	General frequency assignment	EN 300 220	2016, with option to extend		Free		ERC/REC 70-03, Annex 7
	Radio microphones (863-865 MHz)	General frequency assignment	ERC/REC 70-03, Annex 10 and 13	31.12.2013, with option to extend as long as ERC/REC 70-03 Annexes 10 + 13 exist		Free		ERC/REC 70-03
	Wireless audio applications (863- 865 MHz)	General frequency assignment	ERC/REC 70-03, Annex 10 and 13	31.12.2016, with option to extend as long as ERC/REC 70-03 Annexes 10 + 13 exist		Free		ERC/REC 70-03
Hungary	5 applications of SRD	-	ERC/REC 70-03 Annexes	-	-	-	-	-
	Aeronautical Radionavigation[v] (862-864.1 MHz ; 869-873 MHz)	The effective frequency usage depends on the current operatio- nal requirement.	The devices concerned may probably operate until 2012[vi].	-	-	-	-	-
Ireland	Mostly SRDs (Non-specific SRDs, Wireless Audio applications, Radio Microphones, Alarms and RFIDs)	SRD operation is on a non-interference and non-protected basis in Ireland	In accordance with ERC/REC 70-03 and applicable EC Decisions: 2006/771/EC 2006/804/EC	N/A		N/A		
Lithuania	Land mobile, simplex system for identification of equipment Alarms[vii] ; Non-specific Short Range Devices[7]; Radio microphones[7] ; Wireless Audio Applications[7]	Local Unspecified	Max e.r.p. 10W Max Hant 1.5 m. Conformity of R&TTE Directive. In line with ERC/REC 70-03	1 Jun 2013 Unspecified	Not allowed Unspecified	2.20 EUR station/month Free of charge	First come first serve No selection procedure	No No
Malta	-[viii]	-	-	-	-	-	-	-
Moldova	**862-880 MHz** Fixed Mobile except aeronautical mobile Aeronautical Radionavigation	-	Both governmental/ non-governmental usage	-	not applicable	Fees are different for different services	-	-
Norway	**863-865 MHz** Wireless Microphones	Licence exempt.	Maximum radiated power: ≤ 10 mW e.r.p. For analog equipment,	Licence exempt.	Licence exempt.	Licence exempt.	-	-

			maximum occupied bandwidth is 300 kHz.					
	863-865 MHz Wireless Audio Applications	Licence exempt.	Maximum radiated power: ≤ 10 mW e.r.p. For analog equipment, maximum occupied bandwidth is 300 kHz.	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	865-868 MHz Radio frequency identification applications	Licence exempt.	ERC/REC 70-03, Annex 11	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	868-868.6 MHz Non-specific Short Range Devices	Licence exempt.	Maximum radiated power: ≤ 25 maw e.r.p. Duty Cycle ≤ 1% or LBT. No channel spacing, however the whole stated frequency band may be used	Licence excempt.	Licence exempt.	Licence exempt.	-	-
	868.6-868,7 MHz Alarms The whole frequency band may also be used as 1 channel for high speed data transmissions	Licence exempt.	Maximum radiated power: ≤ 10 mW e.r.p. channel spacing: 25kHz Duty Cycle ≤ 1%.	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	868.7-869.2 MHz Non-specific Short Range Devices	Licence exempt.	Maximum radiated power: ≤ 25 mW e.r.p. Duty Cycle ≤ 1 % or LBT	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	869.2- 869.250 MHz Social Alarms	Licence exempt.	Maximum radiated power: ≤ 10 mW e.r.p. channel spacing: 25kHz Duty Cycle ≤ 0,1 %	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	869.250–869.300 MHz Alarms	Licence exempt.	Maximum radiated power: ≤ 10 mW e.r.p. channel spacing: 25kHz Duty Cycle ≤ 0,1 %	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	869.300-869.400 MHz Non-specific Short Range Devices	Licence exempt.	Maximum radiated power: ≤ 10 mW e.r.p. channel spacing: 25kHz	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	869.400–869.650 MHz Non-specific Short Range Devices The whole frequency band may also be used as 1 channel for high speed data transmissions	Licence exempt.	Maximum radiated power: ≤ 500 mW e.r.p. Duty Cycle ≤ 10 % or LBT	Licence exempt.	Licence exempt.	Licence exempt.	-	-

	869.650–869.700 MHz Alarms	Licence exempt.	Maximum radiated power: ≤ 25 mW e.r.p. channel spacing: 25kHz Duty Cycle ≤ 10 %	Licence exempt.	Licence exempt.	Licence exempt.	-	-
	869.700–870.000 MHz Non-specific Short Range Devices	Licence exempt.	Maximum radiated power: ≤ 5 mW e.r.p.	Licence exempt.	Licence exempt.	Licence exempt.	-	-
Poland								
	military systems	-	-	-	-	-	-	-
862-864 MHz	SAP/SAB	-	exposure limit 0.1 W/m^2	10 years	Yes, with the same licence conditions	8000 PLN per year	-	HCM Agreement
	military systems	-	-	-	-	-	-	-
864-868 MHz	CT2	-	exposure limit 0.1 W/m^2	until 2008	Yes, with the same licence conditions	600 PLN per year	-	-
868-869 MHz	military systems	-	-	-	-	-	-	-
	military systems	-	-	-	-	-	-	-
869-870 MHz	CDMA2000	Nationwide coverage	exposure limit 0.1 W/m^2	until 2018	Yes, with the same licence conditions	280 000 PLN per year	-	-
Portugal	The band is currently being used by SRDs, radio license exempt regime under general authorisation.	Coexistence of different SRD applications, operating on a non-protected and non-interference basis.	In accordance with ECC Decisions and Recommendations in force, namely: *Decisions:* 2006/771/EC, 9-11-06 2006/804/EC, 23-11-06 ERC/DEC/(01)04 ERC/DEC/(01)09 ERC/DEC/(97)06 ERC/DEC/(01)18 *Recommendations:* ERC/REC 70-03 Annex 1, 7, 10, 11 and 13.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Romania	Military use (on one hand), Mobile service (as for the civil use), consisting of applications exempted from individual licensing, according to ERC/REC 70-03 and to: ECC/DEC/(01)02, ERC/DEC(97)06, ERC/DEC(01)04,	Not the case.	According to the national radio interfaces, relevant for each type of application. (i.e. RO IR: 01, 08, 11, 12, 18).	Not the case.	Not the case.	Not the case.	Not the case.	Not the case.

	ERC/DEC(01)18.							
Sweden	SRDs according to ERC/REC 70-03 which includes non-specific SRDs, Alarms, Wireless audio applications, Radio microphones, RFID	None	5-500 mW e.r.p. for non-specific SRDs (EN 300 220), 10 mW e.r.p. for wireless audio (EN 301 357) and radio microphones (EN 300 422) and 100 mW-2 W for RFID (EN 302 208)	None	Licence exempted – no transfer of rights	Licence exempted – no fees	Licence exempted - no commitments	ERC/REC 70-03
Switzerland	862-863 MHz: "Mobile Service" for Police 863-870 MHz: Short Range Devices according to ERC/REC 70-03	862-863 MHz: "Mobile Service" 863-870 MHz: Short Range Devices	according to ERC/REC 70-03	none	None	none	none	according to ERC/REC 70-03
United Kingdom	863 to 865 MHz SRD cordless Audio and Radio Microphones	Compliant apparatus may be used terrestrially in the UK without further restriction on location or time	No technical restriction beyond those detailed in ERC/REC 70-03	Users may operate apparatus for so long as they wish to maintain it.	Apparatus is Licence Exempt. Question is not applicable	Nil	Nil	Apparatus must not cause harmful interference to other radio communications apparatus. Please refer to Article 4.4 of the ITU-R Radio Regulations and to the Introduction of ERC/REC 70-03.
	865 to 868 MHz RFID							
	868 to 868.6 MHz Non Specific SRD							
	868.6 to 868.7 MHz Alarms		There is an anomaly between the ERC/REC 70-03 and the referenced ERC/DEC/(01)09. The UK regulations meet the Duty Cycle restriction of the ERC Decision. I.e. 0.1 %.					
	868.7 to 869.2 MHz Non Specific SRD		No technical restriction beyond those detailed in ERC/REC 70-03					
	869.2 to 869.25 MHz Social							

	Alarms							
	869.25 to 869.3 MHz Alarms							
	869.3 to 869.4 MHz Non Specific SRD							
	869.4 to 869.65 MHz Non Specific SRD							
	869.65 to 869.7 MHz Alarms							
	869.7 to 870 MHz Non Specific SRD							

Existing rights of use in bands:	Condition **1** **Service, type of network or technology**	Condition **2** **Effective and efficient use / coverage**	Condition **3** **Technical and operational conditions**	Condition **4** **Maximum duration**	Condition **5** **Transfer of rights**	Condition **6** **Usage fees**	Condition **7** **Commitments in selection procedure**	Condition **8** **Obligations in international agreements**[3]
1785-1805 MHz								
Austria	Mobile Service Sub-band 1785-1800 MHz: Short Range Devices Sub-band 1800-1805 MHz: currently not used	Sub-band 1785-1800 MHz: Effective and efficient use of spectrum in accordance with relevant sharing studies carried out by WGSE. No coverage requirements. Sub-band 1800-1805 MHz: currently not used	Sub-band 1785-1800 MHz: In accordance with ERC/REC 70-03 Annex 10f and Annex 13c as well as EN 301 840 and EN 301 357 Sub-band 1800-1805 MHz: Currently not used in accordance with ECC/DEC/(02)07	Not applicable (general licence in sub-band 1785-1800 MHz)	Not applicable (general licence in sub-band 1785-1800 MHz)	None	Not applicable (general licence in sub-band 1785-1800 MHz)	None
Croatia	Radio microphones and Assistive Listening Devices ERC/REC 70-03	-	-	-	-	-	-	-
Czech Republic*	Guard band (1785-1785.7 MHz) Professional Wireless Microphones (1785.7-1795 MHz) SRD Wireless Audio Applications (1795- 1800 MHz Not used (1800-1805 MHz)	N/A Designated for Individual licenses (no licenses issued yet) Operated under General Authorization No. VO-R/10/03.2007-4 N/A	All transmissions are prohibited Maximum e.i.r.p. 10 mW, in case of body-worn types maximum e.i.r.p 50 mW) Radiated power 20 mW No channel spacing According to ECC/DEC/(02)07 Reserved for European harmonization	N/A (Expected 5 years) N/A N/A	N/A N/A N/A N/A	N/A Yearly fee according to Goverment Decree No. 154/2005 Coll. N/A N/A	N/A N/A N/A N/A	N/A N/A N/A N/A
Cyprus	The Radiofrequency Plan of the Republic foresees the following applications: 1. Mobile applications (within the band 1785 - 1800 MHz) - **It should be noted that a public consultation was conducted on December 2006 for the band 1790-1800 MHz, which ended on January 2007, for the flexible usage of this band on a technology and a service neutrality principle. The responses for this public consultation are being examined. No decision has been taken so far concerning the authorization procedure and the associated terms and conditions.** 2. Radio microphones (EN 301 840, ERC/REC 70-03 within the band 1785.7-1799.4 MHz) - **General authorisation and registration. No registration for such authorisation is received so**							

	far. Terms and conditions will be determined after receiving a registration. 3. TFTS (EN 301 423, REC T/R 42-0 1 within the band 1800-1805 MHz)- **It should be noted that the TFTS service will be removed from the allocation due to the adoption of the ECC DEC (02)07.**							
Estonia	Radio microphones	1785-1800 MHz	General authorization based on EC and ECC decisions and recommendations					
	SAP/SAB (Service Ancillary to Programme making and broadcasting)	1785-1800 MHz	Frequency authorisation in accordance with CEPT regulation	Temporary or every year prolongation	Not permitted	240 EEK with a bandwidth of up to 50 kHz; 600 EEK with a bandwidth 50 kHz to 500 kHz; 1200 EEK with a bandwidth of 500 kHz to 4 MHz; 2400 EEK with a bandwidth higher than 4 MHz up to 14 MHz; 4800 EEK with a bandwidth higher than 14 MHz up to 100 MHz; 12 000 EEK with a bandwidth of 100 MHz and higher; + one-and-a-half times the state fee rate for a transmitter of one fixed radio link	First come first served basis	
	Wireless audio applications	1795-1800 MHz	General authorization based on EC and ECC decisions and recommendations					
	UWB devices		General authorization based on EC and ECC decisions and					

			recommendations					
Finland	1785-1800 MHz radio microphones 1800-1805 MHz under study, available for flex use	available in whole country, no limitations in coverage	radio microphones according to relevant European harmonised standards	at the moment licence for radio microphones is for 3 years, automatically renewed	not relevant for radio microphones, licence will be granted to every applicant	for licensed microphones an annual spectrum fee is collected, approx. 18e/transmitter, depending on the number of transmitters	--	--
France[ix]	1785-1800 MHz Wireless microphone	Not defined		Not relevant	Not relevant	no	no	No
Germany	SRD (wireless audio applications) (1795– 1800 MHz)	General frequency assignement	EN 301 357 EN 300 220	2016, with option to extend		Free		ERC/REC 70-03, Annex 13
	Radio microphones (1785-1800 MHz)	General frequency assignement	ERC-Recommendation 70-03, Annex 10 + 13	31.12.2016, with option to extend as long as ERC/REC 70-03 Annexes 10 + 13 exist		Free		ERC/REC 70-03
	Wireless audio applications (1795-1800 MHz)	General frequency assignement	ERC-Recommendation 70-03, Annex 10 + 13	31.12.2016, with option to extend as long as ERC-Rec. 70-03 Annexes 10 + 13 exist		Free		ERC/REC 70-03
	takticel radio relay (1800-1805 MHz)	Military use		31.12.2008				
Hungary	**1785-1800 MHz** 2 application of SRD	-	ERC/REC 70–03 Annexes	-	-	-	-	-
	1800-1805 MHz Former TFTS band, empty	-	-	-	-	-	-	-
Ireland	Service neutral ECN Technology Neutral	Use-it-or-lose-it obligation	Mask to protect GSM1800	15 years	Licence transfer only	€150 000 reserve price on auction.	None	Cross-border threshold to be observed
Lithuania	Not current usage							
Malta	-[x]	-	-	-	-	-	-	-

Moldova	**1700 - 1710 MHz** Fixed Meteorological-Satellite (space-to-Earth) Mobile except aeronautical mobile **1710 – 1747.5 MHz** Fixed Mobile **1747.5 – 1770 MHz** Fixed Mobile **1770 - 1785 MHz** Fixed Meteorological-Satellite (Earth-to-space) (space-to-Earth) Mobile **1785 - 1790 MHz** Fixed Meteorological-Satellite (Earth-to-space) (space-to-Earth) Mobile **1790 - 1805 MHz** Fixed Mobile	-	Parts of the band 1710-1785 MHz paired with 1805-1880 MHz can be used for implementation of Digital Communication System DCS1800 in conformity with ERC Decision ERC/DEC/(95)03.	For DCS1800 – 15 years	-	Fees are different for different services	For DCS1800 – Contest	-
Norway	**1785 – 1800 MHz** Wireless Microphones	Licence excempt.	Maximum radiated power: ≤ 50 mW e.r.p. Channel separation shall not exceed 200 kHz AM not allowed.	Licence excempt.	Licence excempt.	Licence excempt.	-	-
	1800 – 1805 MHz The conditions are flexible and the mask is defined based on the 3GPP TS 25.105 V3.6.0 (2001-03) technical specifications, but the actual usage is iBurst technology	There is no coverage demand in the licence, but the actual coverage can be found on iBand's webpage, www.iband.no	The conditions are flexible and the mask is defined based on the 3GPP TS 25.105 V3.6.0 (2001-03) technical specifications, but the actual usage is iBurst technology	The licence is valid until 31 December 2023.	The licence may be traded wholly or in part and there is no general restrictions on the types of trade. When the transfer of rights and obligations normally referred to as a "sale" is planned, the transfer must be approved and registered with the Norwegian Post and Tele-	The fee for 2007 is approxi-mately NOK 260.000,-	-	-

					communications Authority.			
Poland	**1785-1800 MHz** Military systems	-	-	-	-	-	-	-
Portugal	**1785 - 1805 MHz**[xi] The band 1785-1800 MHz is available for SRD (Radio microphones)	Operation on a non-protected and non-interference basis.	In accordance with ECC Decisions and Recommendations in force, namely: ERC/REC 70-03 Annex 10.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
	The band 1800-1805 MHz is currently not in use in Portugal. ECC/DEC(02)07 applies to the 1800-1805 MHz Band.							
Romania	Military use (on one hand), Mobile service (as for the civil use), consisting of appli-cations exempted from individual licencing (i.e. radiomicro-phones), accor-ding to ERC/REC 70-03.	Not the case.	According to the national radio interfaces, relevant for this application. (i.e. RO IR: 11, 18).	Not the case.	Not the case.	Not the case.	Not the case.	Not the case.
Sweden	Military service	None	None	None	None	Annual fees – one sum for all rights of use – approx. 99.500 €.	None	
Switzerland	**1785-1800 MHz:** Short Range Devices according to ERC/REC 70-03 **1800-1805 MHz** "MOBILE" Possible extension Band for IMT-2000	1785-1800 MHz: Short Range Devices	According to ERC/REC 70-03	None	None	None	None	According to ERC/REC 70-03

United Kingdom	**1785-1800 MHz** Allocated to FIXED and MOBILE on primary basis **1800-1805 MHz** Allocated to MOBILE services on a primary basis and Fixed services on a secondary basis.							
	1790-1798 MHz is available to the Home Office for emergency services use.	Not used in Northern Ireland. There is still a requirement by the emergency services for fixed applications in mainland UK (police and fire).Band is one leg of fixed point 2 point system.	Usually of a 200kHz channel band width and used fixed point 2 point. UK Home Office standards used.	Emergency Services will require use of this band until satisfactory migration to Airwave (TETRA) is achieved. (c.2010)	Subject to agreement from the UK Strategic Spectrum Committee.	Currently users are charged Administrative Incentive Pricing. This may vary with time subject to UK policy for spectrum pricing.	N/A	N/A
	1785-1805 MHz (Northern Ireland) is currently subject to an Ofcom auction process.	No coverage requirements. Use of individual frequencies to be managed by the licensee.	Licensee must use the spectrum mask that is relevant to the distance separating a station that is installed and operated at a fixed location within the band and pre-existing GSM 1800 base stations operating in the band 1751-1781.5 MHz. Site clearance (EMC) required (conditions apply).	15 year fixed term followed by annual renew.	All rights and obligations will be tradable from the date of the award.	The auction process will determine the fees payable for the licence. If the licensee continues to hold the licence beyond the minimum term of 15 years, there may be additional charges in line with UK policy for spectrum pricing at that time	Nil	Licensee will be subject to Memorandum of Understanding regarding frequency co-ordination between the UK and Republic of Ireland.

Existing rights of use in bands:	Condition **1** **Service, type of network or technology**	Condition **2** **Effective and efficient use / coverage**	Condition **3** **Technical and operational conditions**	Condition **4** **Maximum duration**	Condition **5** **Transfer of rights**	Condition **6** **Usage fees**	Condition **7** **Commitments in selection procedure**	Condition **8** **Obligations in international agreements**[3]
57– 59 GHz								
Austria	Fixed Service (point-to-point duplex links)	Effective and efficient use of spectrum in accordance with relevant sharing studies carried out by WGSE. No coverage requirements	In accordance with ERC/REC 12-09 (as amended in Stockholm, 2004) and EN 302 217-1, EN 302 217-3, EN 302 217-4, and EN 301 751	Not applicable (general licence)	Not applicable (general licence)	None	Not applicable (general licence)	None
Croatia	-	-	-	-	-	-	-	-
Czech Republic*	Guard band (57-57.1 GHz)	N/A	All transmissions are prohibited.	N/A	N/A	N/A	N/A	N/A
	Fixed service (57-59 GHz)	3 individual P-P licences for together 7 frequencies issued for trials and testing	Maximum e.i.r.p. 15dbW. Channel spacing 50 MHz. Frequency tolerance $50x10^{-6}$. International coordination required.	Till 2010	Probably possible but a lot of frequencies is still available	Yearly fee according to Goverment Decree No. 154/2005 Coll.	N/A	N/A
	Guad band (58.9-59 GHz)	N/A	In the band 57.8-58.9 GHz also national coordination require All transmissions are prohibited	N/A	N/A	N/A	N/A	N/A
Cyprus	The Radiofrequency Plan of the Republic foresees the following applications: 1. High density fixed links (EN 301751, REC T/R 22-03, ERC/REC 12-09) **– The usage is subject to an individual right of use in accordance to the Radiocommunication (Authorisations) Regulations of 2004 and 2007. No application for such authorisation is received so far. Please see Appendix for more details.** 2. Passive applications (Atmospheric temperature sounding) - **Authorisation exempt in accordance to "**The Radiocommunications (Use of Radiofrequencies by Radioequipment that is Exempted from the Obligation to obtain an Authorization) Order of 2005 (P.I. 317/2005, 15.7.2005)"**. Also the radioequipment should comply with Part IV of the Radiocommunications Laws, which adopts the R&TTE Directive.**							

Estonia	HDFS systems (High-Density Fixed Service)	57-59 GHz	Frequency authorisation in accordance with CEPT regulation	Every year prolongation	Not permitted	240 EEK with a bandwidth of up to 500 kHz; 480 EEK with a bandwidth of 500 kHz to 4 MHz; 600 EEK with a bandwidth higher than 4 MHz up to 14 MHz; 1200 EEK with a bandwidth higher than 14 MHz up to 100 MHz; 2400 EEK with a bandwidth of 100 MHz and higher + one-and-a-half times the state fee rate for a transmitter of one fixed radio link.	First come, first served basis	
Finland	57.00 – 58.20 GHz point-to-point digital fixed radio links 58.20 - 59 GHz available for flex use	available in whole country, no co-ordinated frequency planning	Channel plan according to ERC recommendation ERC/REC12-09 Annex A; standards EN 301 751, EN 300 408; antenna standard EN 300 833; radiation pattern envelope class 3;	the maximum duration of a licence is 6 years	licence will be granted to every applicant	frequency fee about 70 € / link		
France[xii]	Not yet defined							No
Germany[xiii]								
Hungary **57,1-58,9 GHz**	Fixed digital point-to-point systems	–	ERC/REC12-09 and ECC/REC/(01)05	3 years, prolong able	–	One time reservation fee : 7000 HUF/station ~ 28 EUR/station ---------- Usage fee for a link: 16800 HUF/month ~ 67 EUR/month	–	–

						for 100 MHz bandwith --- Usage fee for a link: 8400 HUF/month ~34 EUR/month for 50 MHz bandwith		
	Fixed digital point-to-multipoint systems	–	ERC/REC 12 - 09	3 years, prolong able	–	One time reservation fee : 7000 HUF/station ~ 28 EUR/station --- Usage fee for a cell: 4500 HUF/month ~ 18 EUR/month for 100 MHz bandwith --- Usage fee for a cell: 2250 HUF/month ~ 9 EUR/month for 50 MHz bandwith	–	–
Ireland	Fixed Service Infrastructure network	Planning undertaken by NRA	See ComReg doc. 98/14R on www.comreg.ie	1 Year Annually Renewable Licence	None	€ 1000 per link per year	None	Cross border threshold
Lithuania	Not current usage							
Malta	Fixed, P-P link	-	✓	✓	✓	-	-	-
Moldova	**57 – 58.2 GHz** Earth Exploration-Satellite (passive) Fixed Inter-Satellite Mobile Space Research (passive) **58.2 – 59 GHz** Earth Exploration-Satellite (passive) Fixed Mobile Space Research (passive)	This frequency band is not used yet						

Norway	There is no current use in this band.	-	-	-	-	-	-	-
Poland	HDFS according to the EN 300 408 no licence needed	-	-	-	-	-	-	-
Portugal	Earth Exploration Satellite (passive) FIXED service (point to point applications)	The band is currently not in use in Portugal.						
Romania	Exclusively civil use. Band allocated for the Fixed service and designated for high density fixed links applications. This band is not yet used.	General terms and conditions valid in the fixed service will apply.	Not the case yet.	Not the case yet.	Not the case yet.	[xiv]General fees for radiorelay links will apply.	Not the case yet.	[xv]General provisions relating to international frequency coordination in the border areas will apply.
Sweden	Fixed service	None	10 mW transmitter power and 25 dBW e.i.r.p.	None	Licence exempted – no transfer of rights	Licence exempted – no fees	Licence exempted – no commitments	ERC/REC 12-09
Switzerland	Fixed, Point to Point according to ERC/REC 12-09, Annex A	Fixed, Point to Point according to ERC/REC 12-09, Annex A	according to ERC/REC 12-09, Annex A	None	None	According to license provisions	None	According to ERC/REC 12-09, Annex A

United Kingdom	point – point fixed links	Frequency use follows CEPT ERC/REC. 12-09 i.e 57.1-58.9GHz. 57-57.1GHz and 58.9–59GHz not used as specified in ERC/REC 12-09 in order to improve coexistence with adjacent services.	UK Interface Requirement 2000 based on ERC/REC 12-09 for p-p fixed links on uncoordinated/-unprotected basis. Radio equipment and antennas deployed in this band must comply with the essential requirements of Directive 1995/5/EC. 25dBW max EIRP. 10dBm max transmitter power. 50, 100MHz channel spacing. Radio systems meeting ETSI spectral efficiency class 2 and above which meet the stated channel arrangements may be deployed in this band. Frequency use follows ERC/ERC 12-09. i.e. 57.1-58.9GHz. 57-57.1GHz and 58.9–59GHz not used as specified in ERC/REC 12-09 in order to improve coexistence with adjacent services. Operators are exempt from the site clearance process on the basis that the following conditions are met: 1) The maximum height of the antenna or its supporting structure does not exceed 30 metres above ground level; 2) A new installation does not increase the height of an existing site by 5 metres or more.	Licence exempt for point - point fixed links.	Not applicable. Licence exempt for p-p fixed links.	None.	None.	None.

*NOTE: Czech Republic: For information is attached Section 23 of Czech Act on electronic communication
Transfer of the Rights Resulting from the Assignment of Radio Frequencies
(1) An undertaking may only transfer its rights resulting from the assignment of radio frequencies to any other undertaking with the prior consent of the Office. The Office shall only grant such consent if such a transfer
a) Does not distort economic competition in the electronic communications area in terms of the use of radio frequencies;
b) Does not lead to any change in conditions of the use of the radio frequencies the use of which was harmonised on an international basis.
(2) The conditions and procedures for transfer of the rights resulting from the assignment of radio frequencies according to in Subsection 1 above shall be determined by the Office by a measure of general nature.
(3) The Office shall publish the information on transfers of the rights resulting from the assignment of radio frequencies.

****Note CYPRUS:**

Condition **1** **Service, type of network or technology**	Condition **2** **Effective and efficient use / coverage**	Condition **3** **Technical and operational conditions**	Condition **4** **Maximum duration**	Condition **5** **Transfer of rights**	Condition **6** **Usage fees**	Condition **7** **Commitments in selection procedure**	Condition **8** **Obligations in international agreements**
FIXED	National Coverage	See table below	Authorisation ends on 31/12 every year but it can be renewed yearly.	Not yet, possible only with the issuance of an Order from the Director of the Department of Electronic Communications.	Depending on the b/w used.	NA	NA

Technical and Operational Conditions for Radio Fixed Services (i.e. Fixed Links)

1. All individual rights of use are subject to the following common terms, limitations and conditions:

(a) The operational parameters of the stations or apparatus using the frequencies, which are the subject matter of the authorization, must be those prescribed in the authorization;

(b) the authorized entity is responsible for operating all stations and apparatus using the frequencies, which are the subject matter of the authorization, without causing harmful interference to other radiocommunications systems;

(c) the authorized entity shall have in its possession the original authorization and shall present it to all persons authorized by the Director, if asked to do so.

(d) Before installing antennas and masts, the authorized entity shall be obliged to receive the approval of the office responsible for town planning and housing as provided in any law for the time being in force relating to town planning and housing, as amended or replaced from time to time;

(e) (i) the installation of antennas and masts shall be based on the conditions and limitations related to the security of aeronautical aviation, as provided by the International Civil Aviation Convention of 1944 and its Thirteen Protocols of 1947 to 1988, and in particular the Annexes to the aforementioned Convention, referred to in subparagraph (ii) herein below, as amended or replaced from time to time. The Director of the Department of Civil Aviation is obliged to provide the undertaking with all relevant information concerning the conformity of antennas and masts to these provisions, within fifteen (15) days from the date when the undertaking in writing requests the Director of the Department of Civil Aviation to define the said conditions and limitations,

(ii) The Annexes to which subparagraph (i) refers are the following:

(A) International Standards and Recommended Practices, Aeronautical Communications, Annex 10 to the Convention of International Civil Aviation, Volume I (Radio Navigation Aids) Fifth Edition of Volume I – July 1966, International Civil Aviation Organization,

(B) International Standards and Recommended Practices, Aerodromes, Annex 14 to the Convention of International Civil Aviation, Volume I, Aerodrome Design and Operations, Third Edition – July 1999, International Civil Aviation Organization;

(f) without prejudice to the provision of section 34(1)(a)(ii) of the Radiocommunications Laws of 2002-2006 ("Law") and as amended or replaced from time to time, the authorization shall expire on December 31 of each calendar year and shall be renewable annually, on the condition that the authorized entity pays the renewal fee as provided in the Radiocommunications (Fees) Regulations; in case that the authorized entity fails to pay, the authorized entity shall be obliged to stop using the frequencies, which are the subject matter of the said authorisation; if the said entity wishes to continue to use the frequencies, it shall be obliged to repeat the procedures prescribed in these Regulations for the authorization to use the frequencies and pay the fees prescribed in the Radiocommunications (Fees) Regulations;

(g) the authorized entity is responsible for securing that the equipment using the frequencies complies with the provisions of Part IV of the Law and the provisions of the Radiocommunications (Radio Equipment) Regulations and any Orders issued there under;

(h) the electromagnetic radiation levels resulting from the emissions of the stations or apparatus using the frequencies must be in conformity with the levels specified by the European Union Act entitled "Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)" (OJ L 199 of 30.7.1999, p. 59), as amended or replaced from time to time;

(i) the Minister may, when a state of emergency is proclaimed or a state of civil defense is proclaimed, restrict the use of the station or apparatus using the frequencies or temporarily or permanently close down the station or apparatus either immediately or on the expiry of such period as he may specify; he shall exercise this power by a written notice served on the authorized entity;

(j) in case the station or apparatus using the frequencies interferes with radiocommunications systems related to national security or defense, the authorized entity is obliged to stop operating the said station or apparatus, if asked to do so by the Director in writing.

2.-(1) In addition to the terms, limitations and conditions, referred to in Regulation 1, each individual right of use referred to in this Regulation, shall be subject to the terms, limitations and conditions stated in the following paragraphs, as the case may be.

(2) Authorizations granted for fixed radio services shall be subject to the following terms, limitations and conditions:

(a) the authorized entity shall be obliged to respond to any request for coordination of the station, made by any applicant for an authorization for individual rights of use, within two weeks days from the date of receipt of such a request;

(b) in case the authorized entity does not commence using the frequencies, within a period of two (2) months from the day of granting the authorization, the Director shall have the right to terminate the said authorization.

ANNEX 2: MODELS FOR DEFINING LEAST RESTRICTIVE TECHNICAL CONDITIONS IN INDIVIDUALLY LICENSED BANDS

Models for Individually Licensed Bands (taken from CEPT Report 019)

This section identifies some models that may be applicable for developing least restrictive technical conditions for the access to spectrum:

- Model 1: Traditional compatibility and sharing analysis method (e.g. using ACLR and ACS);
- Model 2: the Block Edge Mask (BEM) model that can be divided into two sub-classes, the transmit power BEM (model 2A) and the EIRP BEM (model 2B);
- Model 3: the Power Flux Density (PFD) mask model based on determination of aggregate Power Flux Density;
- Model 4: the Power Spectral Density (PSD= transmitter masks based on the determination of aggregate PSD (transmitted power spectral density) within a specified area;
- Model 5: an Hybrid model based on a combination of models 2 (or 4) and 3;
- Model 6: the Space-centric model.

Model 1: Traditional compatibility and sharing analysis method

This model is the one that has been used for years for the sharing and compatibility studies. These studies aim at defining criteria to allow different radiocommunication services, systems or applications using different/adjacent or same frequency bands.
This is based on the knowledge or the set of assumptions regarding the technical characteristics of the new envisaged system and the other systems with which sharing or compatibility has to be performed.

In terms of compatibility of adjacent frequency bands parameters such as ACLR or ACS are of paramount importance as they defined the Adjacent Channel Interference Ratio (ACIR), i.e.

The following key parameters are also used in this model:

- transmitting side: radiated power, bandwidth, ACLR and/or unwanted emission transmitter mask, antenna characteristics (gain and height);
- receiving side: sensitivity, selectivity, inter-modulation, co-channel rejection and blocking, antenna characteristics (gain and height);
- Channel Access / mitigation techniques (duty cycle, LBT, …).

Model 2: The Block Edge Mask (BEM) approach to define spectrum usage rights (SURs)

Introduction

This model was used, for example, for Point-to-Multi-Point FWS in the band 3.4-3.8 GHz addressing the situation whereby no decision is taken beforehand by an administration regarding the technology anticipated. It provides flexibility and freedom for operators to choose how to make best use of the spectrum. It consists in assigning one or more blocks of spectrum to an operator.

Block edge masks control interference between radio systems by defining a power/frequency envelope within which radio transmitter emissions must remain. This is done by specifying a maximum in-block transmission power in addition to out of block or out of band powers. The parameters listed in the Model 1 method are thus not always present in the BEM definition of minimum technical conditions, but are used in the analysis stage where compatibility between the relevant reference systems is considered, see further below. Masks are usually, but not always, applied to systems/transmitters that are considered most likely to cause interference.

In practice, block edge masks that have been defined to date (e.g. ECC/REC/(04)05 for central stations in 3.5 GHz, and ECC/REC/(01)04 **Error! Reference source not found.**for 40 GHz) impose more stringent out of block emission requirements than those normally specified for intra-system performance based on channel emission masks defined in harmonised standards. These out of block emission levels necessarily reflect a balance between the feasibility of these more stringent emission requirements at and just beyond block edges, an acceptable probability of interference experienced in an adjacent network and efficient deployment of the spectrum assigned within a block.

Mask Specification

A spectrum mask is usually defined as a maximum permitted power spectral density within a given bandwidth (e.g. dBm/MHz) and may have different measurement bandwidths (and units) for the various portions of the mask – thus making the mask appear to be graphically discontinuous.

In determining any block edge mask, assumptions have to be made about the type of systems that are most likely to be deployed, the WAPECS reference systems, as discussed in section 4.3. Once these assumptions are made, including transmitter spectrum mask and deployment details such as transmitter density, and antenna types, a block edge mask can be developed.

In addition, in order to protect adjacent services in determining BEM, some knowledge of the system to be protected, as well as the 'masked' system, is required. The mask is derived under typical assumptions for the adjacent system's receiver characteristics such as antenna gain, sensitivity and selectivity and if the mask is defined in terms of total power output as is the case for a transmit power mask, it may also consider the typical transmitter's antenna characteristics.

It should be noted that, in complex networks, where also non line-of-sight (NLoS), indoor, outdoor and mobile connections are foreseen, such as in cellular systems, coexistence studies can only rely on probabilistic methodology. Therefore, the mask can be derived only defining an acceptable coexistence objective (e.g. minimum C/I in the adjacent block), LoS and NLoS propagation models, as well as a suitably low Occurrence Probability of worse cases where the coexistence objective is exceeded.

It should be noted that in some limited number of cases additional specific mitigation techniques might be necessary. This can be left to a specific arrangement exercise between operators.

It has to be noted that BEM characteristics for BS and TS may differ.

Impact of the density of transmitters on the BEM

- Impact of an increase of the density of transmitters, with the same transmit BEM

This scenario is illustrated in Figure 6. For both BEM types (see 2A and 2B below), although theoretically aggregate emissions from multiple transmitters could be higher than that specified in masks, in practice the single transmitter case typically dominates. One notable exception to this occurred in the US, where Nextel rolled out a dense commercial digital cellular network in spectrum originally intended for low density professional public access mobile radio (PAMR) applications; as a result significant interference was caused in neighbouring channels. One important effect however is that although the maximum interference levels will not increase, the *area* where interference is high will increase. It is thus important to include reliable deployment information in the development of the BEM, since the BEM method itself will not restrict a very dense deployment.

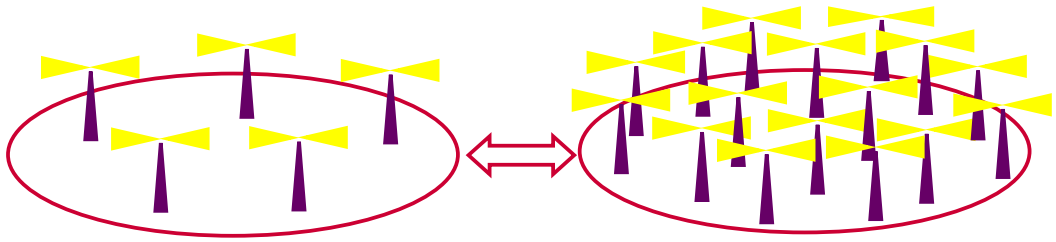


Figure 1: More transmitters, same mask

However, it's worth noting that cellular operators regularly increase transmitter densities in particular areas to boost network capacity, but they do so without causing additional interference (particularly to themselves) by using lower transmit powers (from so called micro or pico-cells).

- Fewer transmitters, higher transmit power

This scenario is illustrated in Figure 7. If a licence holder chose to deploy a system that required higher emission powers from fewer transmitters - which may not necessarily cause more interference - a mask would not permit that (if the increased power exceeded the mask limits).
Alternatively, the block edge mask approach will protect a victim receiver for which compatibility was achieved in a single case interference assessment; however it may suffer from interference if the emission power or e.i.r.p. increases.

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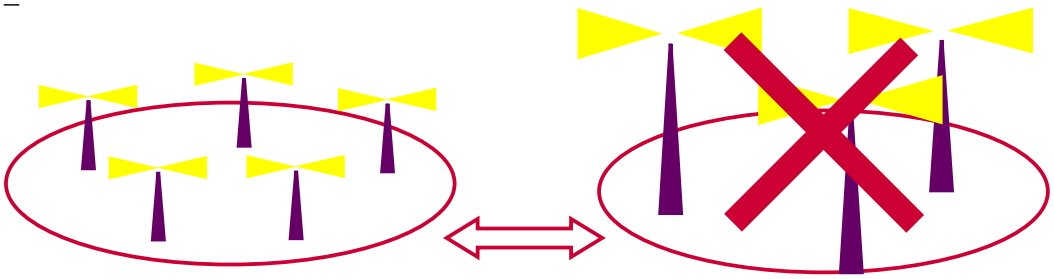

Figure 2: Fewer transmitters, higher transmit power – not permitted

Mask Types

Masks can be defined in various ways, but two common types are *transmit power masks* and *EIRP masks*. They are outwardly very similar, but the transmit power mask defines an absolute limit for a given transmitter's total output power (or transmitter output power spectral density) at a certain distance from the edge of the block, whereas the EIRP mask defines that limit as if a power (or the power spectral density) were radiated equally in all directions, even if it is not. For a transmitter system with a 0dBi omni-directional antenna the two mask types are equivalent.

- Model 2A BEM - Tx Power

Transmit power masks set a boundary upper limit on emissions that arise from any single transmitter.
Provided that they have been derived under appropriate assumptions for the transmitting antenna system, they tend to self limit the probability of interference (because, in general higher TX antenna gain leads to increased directivity) but, unless an associated maximum antenna gain is jointly defined, do not control the maximum worst-case interference level. Once the transmitting antenna is known, an adjacent channel user can predict the maximum expected interference from any single transmitter.

Transmit power masks permit greater flexibility than EIRP masks, but specific determination of the expected interference requires detailed information about the transmitting antenna system.

- Model 2B BEM – EIRP

EIRP block edge masks can be based upon transmit power block edge mask levels including the peak gain of the antenna system.

In principle, once an EIRP BEM is determined, for a given transmitter, any technology that fits within the mask should cause no more interference than the system(s) used as a reference. However, if a new technology will use a mix of output power and antenna gain/directivity quite different for the original assumptions made in the study leading to the BEM definition, the occurrence probability of worse cases might significantly change. Therefore, an EIRP BEM should always be supplemented by some minimum transmit antenna requirement (e.g. minimum gain derived from the typical assumptions made in the study).

EIRP masks set a boundary upper limit on emissions that an adjacent channel user can expect to see from a single transmitter – even if detailed knowledge about that system is unknown. EIRP masks effectively define a maximum range (for a given receiver system) for any interference, under assumptions regarding maximum transmitter density, and its occurrence probability, under assumptions of minimum transmit antenna gain/directivity, and so may be regarded as more predictable.

EIRP masks have benefits from the regulator's perspective in that, once a minimum antenna gain is respected, the various antenna types, feeder losses, etc., that an operator might deploy in their system, do not have to be considered and this simplifies compatibility analysis by only requiring detailed parameters for the victim system. As the EIRP mask does not consider the particular deployment details for the transmitting technology it is effectively technology neutral, but not necessarily application or service neutral.

Difference between block edge masks and equipment specific spectrum emission masks[7]

Equipment specific spectrum emission masks apply to individual radio equipment and are developed to ensure intra system compatibility. They are usually expressed in terms of conducted power at the antenna connector of the equipment and therefore do not explicitly deal with the antennas that may be attached to the equipment. These emission masks are related to

[7] This is further illustrated in section 1 of the ECC Report 131 on the derivation of a BEM for terminal stations in the 2.6 GHz frequency band.

the specific transmitter characteristics and channel arrangement of the technology concerned so different technologies may have different equipment spectrum emission masks. Often, these emission masks form part of the conformity assessment regime for equipment.

Block edge masks, on the other hand, apply to the entire block of spectrum that is assigned to an operator, irrespective of the number of channels occupied by the chosen technology that the operator may deploy in their block. These masks are intended to form part of the authorisation regime for spectrum usage. They can cover both emission within the block of spectrum (i.e. in-block power) as well as emissions outside the block (i.e. Out-of-block emission). The Out of block domain extends to both edges of the WAPECS band. The BEM requirements should be applied without prejudice to any other requirements e.g. R&TTE Directive including spurious emission domain limitation. Emissions limits in the spurious domain and requirements in relation to the R&TTE Directive also apply.

It may be the case that for a chosen technology, the actual equipment spectrum emission mask (when taken together with the appropriate antenna characteristics and chosen operating power) falls within the requirements of the block edge mask when the equipment uses a channel at the very edge of a licensed block. In other cases, unless the operator takes some mitigation action, the actual equipment spectrum emission mask (when associated with the appropriate antenna characteristics and desired operating power) may not fall within the requirements of the block edge mask when the equipment is operated on a channel at the very edge of a licensed block. In that case, operators should ensure compliance with a block edge mask by one or more of the following as appropriate:

- operating at lower powers for channels at block edges where their chosen equipment would otherwise not meet the requirements of the mask,;
- applying additional filtering (BS only);
- moving their outermost channels inwards from the block edge.

Model 3: PFD MASKS - Aggregate PFD approach

Summary description

The aggregate PFD (Power Flux Density) SUR method aims to offer certainty by specifying directly the levels of interference that a licensee may generate to neighbours. The main difference compared with the BEM approach is that regulation is given on the expected aggregate received power on the victim rather than on the emission power from a single interferer. This approach gives the licensee's neighbours certainty in understanding the levels of interference they can expect, whilst still allowing the licensee flexibility in spectrum usage since any change of use or technology is allowed as long as it does not increase these levels of interference. However, this approach creates additional complexity due to the need for additional assumptions for the density of deployment in a given geographical location.

The aggregate PFD method allows a clear mean by which neighbouring (both spectral and geographical) parties can consider a change in licence terms between themselves through commercial negotiation and seek regulatory approval for it . In case of more than two parties, there may be a need to consider an apportionment factor. Licence restrictions stated in aggregate PFD terms would make any negotiation simpler because one licence holder could explicitly agree to a change in the interference they would experience by a simple change to relevant aggregate PFD parameters. A holder wishing to make a change that would cause the technical limits to be exceeded could negotiate with, and secure the agreement of affected neighbours licence holders or others users. It would be then open for the user, having secured the affected parties' agreement, to present this proposal to the regulator who will then consider the application and may vary the licence accordingly.

Aggregate PFD interference restrictions

The in-band and out-of-band interference are controlled by placing restrictions on the aggregate PFD that a licensee may generate in an area as follows:

- The average PFD at a height H m above ground level should not exceed X dBW/m2/MHz at more than Y% of locations in any area A km2.

Geographical interference is controlled by placing restrictions on the aggregate in-band power flux density at a boundary, as is currently used in cross border agreements between neighbouring countries.

- The average PFD at or beyond a geographical boundary at a height H m above ground level should not exceed X dBW/m2/MHz.

By specifying interference restrictions in this way a neighbouring licensee knows directly what levels of interference they may expect to receive across their service area and can plan accordingly.

This approach allows flexibility both in the deployment density of transmitters and in the individual transmitter powers in the deployment. This is bounded however by the aggregate interference levels that can be generated in any area. For example, a higher density network could be rolled out by an operator, but only if the power of transmitters in any area of the network were reduced enough to meet the aggregate limits on interference. Conversely, if a network of higher power transmitters is desired, this can be achieved with a commensurate reduction in density of transmitters across any given area or other mitigation techniques (e.g. sector antennas).

This approach can be combined with the BEM approach since one (the pfd approach) is particularly suitable to deal with geographical compatibility while the BEM approach may be more appropriate for compatibility in adjacent frequencies (see Model 5). This gives an advantage in providing certainty as to the maximum EIRP of any transmitter in a network, thus capping the levels of interference likely from any transmitter in the network, whilst also offering additional safeguards in terms of reducing the risk of interference if neighbours choose to change their deployment.

Defining SURs for spectrum blocks - likely usage

Where SURs are applied to a cleared band, for example during an auction design process, there are no existing users or expected levels of interference. In this method, it is proposed that the SURs should be designed for the most likely uses of that band. Corresponding reference systems are discussed in section 4.3 of CEPT Report 019

Working on the assumption that each technology for the reference systems is designed such that it could operate satisfactorily with other identical technology uses in adjacent channels[8] (e.g., a 3G FDD system will work if another 3G FDD system is in the adjacent block), the in-block and out-of-block SUR aggregate PFD levels can be set depending on the system transmit specifications and the likely deployment density. This is done using a modelling tool which predicts the signal strength at points on a measurement grid based on the allowed in-block transmitter power and assumed transmitter densities.

The out-of-block aggregate PFD emissions (falling within the cleared band) are simply found by taking the in-block aggregate PFD emissions and subtracting the difference between the in-block and out-of-block power levels on the transmitter mask, as defined under model 2B (EIRP BEM).

Model 4: Aggregate PSD Transmitter Masks

Definition

This approach defines the SUR in terms of aggregate PSD (transmitted power spectral density) within a specified area. This would take into account the aggregation of the emissions on a particular frequency of all of the transmitters within a specified area, considering the density of transmitter deployment. This could be defined at the input to the transmitter antenna.
However, this approach may be difficult to put in practice, notably for TS. In addition, the consequence of change in the spectrum usage (e.g. change between FDD and TDD) may need be assessed.

It may prove necessary to define “correction factors” for some aspects of transmitter deployment, perhaps relating to antenna radiation pattern in the vertical plane, antenna height, and high power transmitters (which generally have a low deployment density and high antenna elevation). It might also be necessary to place some restrictions on duplex direction.

Mask Determination

The aggregate PSD transmitter mask can be simply derived from the transmit power mask by multiplying it by the expected maximum number of transmitters to be deployed within a defined reference area, with consideration of “correction factors” described in 4.4.4.1. This provides the flexibility to deploy fewer transmitters of higher power (such as might be used to provide coverage of rural areas with low population density) as well as more transmitters of lower power (such as urban micro cells).

Model 5: The Hybrid Approach

This is not a specific model as such, but consists in combining some of the models described in the previous sections.
The "hybrid" approach distinguishes between adjacent frequency and co-frequency interference.

The reason for this distinction between adjacent frequency and co-frequency interference is as follows:

Models limiting the transmitted power in adjacent bands like BEM - EIRP (model 2b) and aggregate PSD transmitter mask (model 4) may be more appropriate to control adjacent frequency interference than co-frequency interference.

[8] In practice, this means that the designers of this technology should have set the OOB spectrum mask appropriately such that similar deployments in neighbouring bands do not result in excessive interference.

On the other hand, the aggregate PFD model (model 3), widely used in frequency planning (for example in cross-border coordination agreements) is suitable to address scenarios related to co-frequency compatibility in geographically different service areas. Actually, controlling adjacent frequency interference to another system in the same geographical area using the aggregate PFD model would require more complicated calculations. Two hybrid models are considered, models 5A and 5B. Hybrid model 5A is a combination of models 2b and 3, whereas hybrid model 5B is a combination of models 4 and 3, as indicated in Table 3:

	Adjacent frequency interference between systems in the same geographical area	**Co-frequency interference between systems in different geographical areas**
Hybrid model 5A	BEM - EIRP (model 2b)	Aggregate PFD (model 3)
Hybrid model 5B	Aggregate PSD transmitter mask (model 4)	Aggregate PFD (model 3)

Table 3: Description of hybrid models

Model 6: Space-Centric Management

The space-centric model has been used in Australia for over a decade to enable self-management of spectrum licences.

This model is used in Australia to assist the management of interference between new devices (not between new and legacy devices), and utilizes a set of explicit transmit rights (with implicit receive rights) *i.e.* spectrum rights that define maximum radiated power at each antenna (EIRP) rather than maximum field strengths (PFD) away from antennas. Protection from all interference mechanisms is therefore specified indirectly rather than directly. There are different transmit rights for Base and Customer equipment.

While specific legacy services that require protection continue to be coordinated with new devices in the conventional manner, the practical effect of the explicit transmit rights for the authorisation of new devices is to create precise levels of 'guard space isolation' separately for, and in relation to, all interference mechanisms, so that spectrum licensees have all the necessary **practical technical and legal tools** to independently and without negotiation:

- design any type of new (innovative) technology and service;
- authorise the operation of the equipment;
- manage interference between their new equipment and other new devices operated outside the space of their spectrum licence by other spectrum licensees, without the limitations of worst case device coordination, ambiguous interference settlement responsibilities and field strength measurements; and
- avoid non-reciprocal spectrum access caused by unlike new services (e.g. FDD/TDD) authorised under adjacent spectrum licences thereby preserving the utility/value of their spectrum licences.

The meaning of 'guard space isolation' is traditionally taken in relation to devices (device-centric management), to have the same meaning as 'coordination', *i.e.* minimum distance, frequency and time separation between transmitters and receivers to supplement hardware isolation in order to achieve interference free operation. However, in relation to a spectrum space (space-centric management), 'guard space isolation' means minimum distance, frequency and time separation for radiated transmitter emission levels in relation to the geographic, frequency and time boundaries of that space.

Conventionally, three interference categories are considered in the design of any equipment standard. Hardware isolation is designed separately for, and in relation to:

- Interference Category A (linear type in-band interference from area-adjacent transmitters)
- Interference Category B (linear type in-band interference from frequency-adjacent transmitters)
- Interference Category C (non-linear type out-of-band interference from frequency-adjacent transmitters)

In addition, before operating equipment, the hardware isolation is usually supplemented by a coordination procedure where guardspace isolation is provided between transmitters and receivers, also separately for, and in relation to, each interference Category A, B and C. For example:

Hardware Isolation:

(a) Category A: e.g. minimum wanted-to-unwanted ratio
(b) Category B: e.g. out-of-band transmitter emission and receiver IF filter roll-off characteristics
(c) Category C: e.g. receiver RF filter and interference susceptibility

Guard space Isolation:

(a) Category A: e.g. co-channel reuse distance;
(b) Category B: e.g. adjacent channel(s) reuse distance
(c) Category C: e.g. inter-modulation checks

The space-centric model is a general solution for flexible spectrum rights which addresses the general interference situation, including non-linear type interference mechanisms arising between non-co-located devices and where necessary, signal level statistics affected by multiple signals (aggregation). Therefore, the space-centric model limits radiated power at each transmit antenna in order to establish precise levels of guardspace isolation at spectrum space boundaries in relation to all three interference categories:

(a) Category A (linear) along the geographic area boundary: device boundary criterion
(b) Category B (linear) at the frequency boundaries: radiated out-of-band emission limits
(c) Category C (non-linear) at both the area and frequency boundaries: maximum in-band radiated power limit plus model coordination procedure.

The device boundary criterion authorises transmission (but only in relation to Category A interference between new devices) when the necessary distances from the transmitter, based on the power the device radiates in all directions and the effective antenna height, are fully contained by the geographic area of the spectrum licence. The device boundary criterion is a single, precisely defined algorithm contained in a legal Determination. The device boundary criterion is not a model for coverage or service area. Rather, it is a clearly defined transmit right, independent of what levels may actually occur on, or past a geographic boundary. The primary objectives when designing the device boundary criterion are to facilitate efficient market processes by:

- establishing a single, clear and legally robust rule for the transmit right and thereby, the settlement of Category A interference without difficulty including without legal intervention or field strength measurements; and
- for wireless network design purposes, informing area-adjacent spectrum licensees of the maximum level of in-band power that can be radiated in a particular direction from a particular site at any time during the licence period so that those licensees may act to protect their receivers.

Spectrum licensees use the device boundary criterion as a starting point for their proprietary coordination procedures which include high resolution propagation models of their own choice, to establish the necessary level of protection for their new receivers from interference caused by new transmitters in area-adjacent licences.

The radiated out-of-band emission limits are similar to EIRP masks discussed in model 2B.

In order to avoid worst case coordination by licensees and increase efficiency in spectrum usage, non-linear interference mechanisms are managed with a non-linear type transmit right. The maximum in-band radiated power limit provides an upper bound to the extent of Category C interference mechanisms and the model coordination procedure provides minimum frequency-distance separation requirements in relation to formally registered new devices operating outside the area and frequency boundaries of the spectrum licence. This provides a precise level of non-linear guard space isolation. The practical effect of application of the coordination model is to clearly define transmit rights (guard space provision) relating to Category C interference for new devices. The notional receiver model it incorporates is not an explicit receive right. Application of the model provides a very simple yes/no criterion for determining which licensee is causing Category C interference and consequently, who is responsible for its settlement.

Use of the model coordination procedure requires a centralised online device database. Spectrum licensees in Australia are happy with the requirement for a centralised online data base not only because of the legal and technical certainty it provides in relation to the management of Category C interference between new devices. A centralised online data base is as an essential tool for the management of interference generally including between new and legacy services, as well as being an essential input for establishing the real utility/value of a spectrum licence for an auction and subsequent trading. Once database requirements and an online central register are established by the regulator, industry is also able to proceed to automate its engineering processes, which is a significant saving for industry. For more details, see[9] .

The space-centric model allows a licensee to self-manage interference between his new devices and any new devices operating in adjacent spectrum licences without negotiation because the licensee can precisely determine the necessary hardware isolation on the basis of the precise levels of guard space isolation provided by the spectrum rights. Because the spectrum rights are defined in relation to guard space isolation alone, hardware isolation or equipment design is then a variable. Note that if necessary, the guard space isolation may also be varied using the licence conditions as clear negotiation benchmarks.

By only using explicit transmit rights the uncertainty of propagation is removed from spectrum right definition and the traditionally combined processes of device authorisation and device coordination become separate tasks. This makes the authorisation of dynamic spectrum access practical. Authorised operating frequencies can be predetermined from the spectrum licence conditions for use by a cognitive function which subsequently manages interference dynamically.

In Australia, the space-centric model provides legally clear and technically precise inputs to all the self-managed industry processes that are necessary for commercial investment in innovative wireless services including services utilising dynamic spectrum access[9] .

[9] ITU Workshop on Market Mechanisms for Spectrum Management (22-23 January 2007); Space Centric Management: A General Solution for Equitable Access to Radio Spectrum Space under Conditions of Flexible Use; Michael Whittaker

[1] "Word" or "Excel" format should be used
[2] Justifications should be attached to the relevant conditions, if necessary by footnote
[iii] For the purposes of this exercise, "international agreements" should be understood to cover different forms of transnational cooperation rather than as international treaties in a strict legal sense; in case other conditions are affected by obligations in "international agreements", comments in the columns of such affected conditions should be inserted

[iv] The band 862 - 870 MHz is a military band on an exclusive basis, except 869.2- 869.7 MHz shared between electronic communications and defence
[v] In the band 862-864.1 MHz and 869-873 MHz, frequencies in the non-civil aeronautical radionavigation service may be assigned on a primary basis according to the National Table of Frequency Allocations.
[vi] No frequency assignments shall be made to stations established with additional equipment.
[vii] - Not subject to individual rights, the conditions have been included in the general authorisation
[viii] This band is used by various short range devices as per ERC/REC 70-03, on a non- protection/non-interference basis
[ix] The band 1785-1800 MHz is a military band on an exclusive basis; the band 1800-1805 MHz is shared between electronic communications and defence
[x] Part of this band is used by short range devices as per ERC/REC 70-03, on a non-protection/non-interference basis
[xi] The possibility to allow a more flexible use of the whole 1785-1805 MHz band is currently being analysed, as a result of CEPT on-going studies on this issue.
[xii] The band 57-59 GHz is shared between electronic communications, defence and space
[xiii] The frequency band 57-58 is general licensed in Germany for Fixed Service applications
[xiv] The fees depend on the bandwidth of the transmission (between 24 and 312 euros/year) and are applied for each transmitting frequency of the link.
[xv] When technical conditions for this band will be made available via the "HCM Agreement" (Vilnius 2005), these will be applied in the bilateral coordination with the neighbouring signatory countries.