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EUROPEAN POLICY TRENDS TOWARDS FLEXIBLE SPECTRUM MANAGEMENT

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Introduction

This article discusses, in some detail, the main policy and regulatory evolutions in Europe up until February 2007, which are intended to contribute significantly to the introduction of systems and services relying on flexible spectrum management. Although business stakeholders as well as many academics consider necessary regulatory reform as a volatile and thus uncertain requirement for innovation, these reforms do not come about because of themselves. This is to say, policy action is in most cases undertaken as a result of constituency pressure, and information as well as persuasion flows, particularly in highly specialised and technical domains, guide the policy process throughout its conception, implementation, monitoring and evaluation phases (Hogwood and Gunn 1984; Dunn 2004). On the other hand, cabinets and administrations, which are sufficiently sensitive to future policy requirements and have the resources to exploit this sensitivity, may well devise policy and regulatory reforms well before an industry consensus around them takes shape. In other words, the policy trends discussed in this paper are in most cases a mix of Government initiatives and a reaction to industry demands. Modern policy processes often provide both formal and informal channels through which stakeholders may influence these processes.

One difficulty of studying issues of spectrum policy in the European Union (EU) is that this policy domain is largely a competence of the Member States. The 2002 Radio Spectrum Decision of the European Commission did create a framework for EU-wide spectrum policy making aimed at ensuring "co-ordination of policy approaches and, where appropriate, harmonised conditions with regard to the availability and efficient use of radio spectrum necessary for the establishment and functioning of the internal market in Community policy areas, such as electronic communications, transport and R&D" (*Radio Spectrum Decision*, Preamble 2), but the Commission has no spectrum to manage of its own and, as the preamble points out, continuously needs to ensure that its policy initiatives

are in line with the competences attributed to it by the Treaties.[1] As a consequence, the European Commission is very much dependent upon the Member States when it comes to the conception, implementation and monitoring of its Union-wide policy measures. A first instrument of co-ordination is the Radio Spectrum Policy Group (RSPG), set up in 2002, which consists of high level experts from national administrations as well as a diverse set of observers. Via the adoption of opinions and the organisation of consultations in preparation of such opinions, the RSPG, for which the Commission serves as secretariat, advises the Commission on issues of radio spectrum policy, co-ordination of policy approaches and efficient use of radio spectrum. (European Commission 2002, 2007a; RSPG 2007). A second forum for inter-level deliberation, mainly aimed at the formulation of technical implementing measures, is the so-called comitology procedure, specifically through the Radio Spectrum Committee (RSC) which is composed of representatives of the Member States and is in liaison with the different national authorities responsible for spectrum management; this committee is shared by a representative from the European Commission. A third way of co-operation is the issuing of mandates by the Commission (via the RSC) to the European Conference of Postal and Telecommunications Administrations (CEPT), which again consists of representatives of 47 national administrations – thus transcending by far the Union's membership;[2] these mandates, for which procedures are outlined both in the Radio Spectrum Decision (Art. 4 §3) and in a Memorandum of Understanding signed in January 2004 between the Commission and the CEPT (European Commission 2004a), deal with the harmonisation of frequency allocation, the availability of information and other measures for technical implementation. Finally, yet equally important, it is the Member States which are responsible for the transposition of any Directives resulting from all of the above policy-making mechanisms,[3] giving them a certain degree of flexibility as to the timing and the specific implementation of EU-wide spectrum policies. Moreover, the day-to-day administration of spectrum also resides with the different National Regulatory Authorities (NRAs) for spectrum management, and

1 Preamble 7 of the Radio Spectrum Decision repeats this requirement very clearly: "Where it is necessary to adopt harmonisation measures for the implementation of Community policies which go beyond technical implementing measures, the Commission may submit to the European Parliament and to the Council a proposal on the basis of the Treaty."

2 http://www.cept.org

3 As opposed to Commission Decisions, such as those adopted by the RSC, which have to be implemented as such and are directly applicable.

issues such as assignment and licensing procedures, or the decision whether to use competitive selection procedures for the assignment of radio frequencies, as well as audiovisual policies remain under the exclusive competence of the Member States.

The outline above is not intended to give an exhaustive overview of EU spectrum policy competences and procedures. What it aims to prove is that, for a significant part of the spectrum policy domain, there is no such thing as a European policy, even when taking into account all the harmonisation, consultation and planning procedures that are inherent to this specific policy domain and that take place not only on a regional, European level, but also on a multi-regional and global scale (eg via the ITU and its World or Regional Radio Conferences). Where EU-wide frameworks are created, national administrations – except in the case of Commission Decisions – have room for influencing policies and for implementing them according to their own time scheme and local priorities. Nevertheless, a number of trends in European spectrum policy are clearly visible, and are being implemented both on a EU-level (by launching consultations, creating regulatory frameworks and / or taking specific and binding measures for them) and by the Member States. In the sections below, some of these trends, which are of significant importance for the successful introduction of reconfigurable wireless systems, will be discussed. One of these is the introduction of spectrum trading, or secondary trading of spectrum; another is the evolution towards more dynamic forms of spectrum management which, on a Community level, is currently being given shape by the so-called Wireless Access Policy for Electronic Communications Services (WAPECS). As mentioned, it is impossible to draw out detailed policy roadmaps for these principles as this would imply a description of 25 Member States' policies. Therefore we shall limit ourselves in this article to the Community-wide policy evolutions in these two domains, complemented by the current situation in some Member States, particularly the UK and Germany.

The introduction of spectrum trading

The introduction of spectrum tradeability constitutes significant evolution in spectrum policy, which is of great importance in the context of reconfigurable networks and services. As the European Commission puts it, "the concept of spectrum markets is a radical shift in how spectrum could be managed in Europe" (European Commission 2007a). Indeed, in some countries, for more than a 100 years spectrum management has followed a so-called command and control model.

In its most traditional form, this model means that administrations are both responsible for negotiating frequency allocations internationally, and deciding on precise usage of the bands as well as on the users permitted to use the frequencies (assignment).[4] When there is spectrum scarcity, a beauty contest (ie a competition where frequencies are awarded based on what is considered to be the "best" offer, usually defined by a number of quantitative and / or qualitative criteria, and thus unlike an auction where the price offered is primordial) is usually held to decide who receives a licence to use the spectrum. In a market with relatively few players, this was (and still is) a system which gives administrations maximal knowledge on spectrum activity, relatively large degrees of control over spectrum usage and moreover minimised interference between services making use of spectrum. However, many problems have arisen with this *dirigiste* approach to spectrum management. Particularly in the US, beauty contests started to be challenged in court as demand started to outweigh supply, and were gradually replaced, first by lotteries and eventually by auctions. As a consequence, beauty contests became considered as being too unpredictable and, in those countries where the command and control system was applied, this system was criticised for the perceived slowness and inherent inflexibility with which government administrations manage the spectrum, resulting in tardy adaptations to technological innovation, heavy influencing by lobbying and an excessive emphasis on avoiding interference, leading to suboptimal use of spectrum; moreover some authors claim that governments, unlike private companies, do not have the incentive to find the most efficient and popular use for spectrum, because contrary to enriching them (as it would private entities) such modifications only imply a higher workload for these administrations (Benjamin 2003; Analysis & Partners 2004; Ofcom 2005b; WIK 2006).

The introduction of auctions marked the start of a second model for spectrum management, namely market mechanisms.[5] As the FCC already pointed out in 1999,

4 To this could be added that, at least at the international level (particularly within CEPT) as well as within a number of regulators formerly making use of a command-and-control model *stricto sensu*, this model has by now evolved into what regulators prefer to call a negotiations and consensus model, in which discussions and negotiations are taking place between the various stakeholders (including the national spectrum agencies, manufacturers, operators, representatives of governmental use (eg: civil aviation, scientific, maritime, military), in order to find national, regional and/or global agreements on the nature and the conditions of the use of a particular frequency band, and in which consensus between these stakeholders is envisioned.

5 WIK (2006) gives a description of different kinds of auctions at pp. 31-33. Many economic theories exist concerning the advantages and disadvantages of auctions over other ways of assignment. However, such analysis of different modes of initial assignment is outside the scope of this article.

the idea behind this is that "efficient spectrum markets will lead to use of spectrum for the highest value end use" (FCC 1999:32), because the parties that have identified the highest value (ie revenues) for the spectrum will be willing to pay the most for it, and will win the auction. A second step in this process is to allow obtained spectrum licenses to be traded between players, meaning that spectrum usage rights are transferred from one party to another in a secondary market.[6] The economic significance of this is that, apart from confronting the cost of acquiring spectrum through an auction, the licensee also needs to address the cost of retaining its spectrum, and will not do so if its value is suboptimal, leading to more efficient use of frequencies (WIK 2006:12). A principle often quoted to denote the importance of tradeability of spectrum is the Coase theorem, which states that

> "the initial allocation of a good does not matter from an efficiency perspective so long as property rights are clearly defined and the goods can be freely exchanged – because, provided that there are no frictions in the trading process, exchange will lead to an efficient outcome" (Coase 1961, quoted in Analysis & Partners 2004:20).

In order to further optimise efficiency, Administrative Incentive Pricing may be applied to the ownership of licences; in such a regime, contrary to mere cost-recovery pricing, usage fees for spectrum are periodically levied which reflect the opportunity cost associated with the spectrum, so that the licence owner is again confronted with the cost of retaining his spectrum (WIK 2006:37; Marcus *et al* 2005:22) To be able to do this, of course, implies that an exact definition of usage rights, in all its aspects, is given.[7] Also, government intervention might be needed to deal with possible market failures which undermine the basic validity of the Coase theorem, such as excessive transaction costs impeding efficient trade to take place (eg when interference requirements are unclear, leading to costly negotiations, or when a large operator needs to buy spectrum from many small users), the fact that willingness to pay might not be identical to social value of the service offered, or the positive and negative externalities which might be associated to the use of certain frequencies (such as public policy objectives) (Analysis & Partners 2004:21-22).

A third and final model gaining popularity is the commons model, also known as the open access, unlicensed or licence-exempt model. In this model, administrations only decide on the designation of the spectrum to a certain type of application or system (usually complemented by a set of usage conditions), after which all users

6 ie a market which exists after the initial selling of goods in a primary market (in this case, the initial assignment of spectrum to a certain party).

7 A comprehensive list of criteria to be identified is given by WIK (2006) pp. 15-17.

are free to use such technology in the prescribed frequency band. Instead of being protected from interference through the designation of licensed operators, technical requirements imposed, for example upon equipment, intend to limit this interference. The commons model has become particularly popular with the advent of various technologies for short-range, low-power communications, such as WiFi and Bluetooth, and is furthermore mainly used for smaller-scale, non-commercial applications (Analysis & Partners 2004:26). Many – although not all[8] – authors agree, however, that an exclusive usage right will remain essential for services that require very high investments and therefore demand guaranteed capacity as well as protection from interference and that, insofar as sufficient spectrum is freed up for licence-exempt use (which, at least according to Ofcom,[9] is not very far from the actual allocation today), when there is sufficient spectrum available for licence-exempt use, market forces should be the guiding principle for the assignment of usage rights (WIK 2006:8; Ofcom 2005b:5). In this article we therefore limit ourselves to the discussion of policy steps towards these market based principles. However, we do come back to this balance between different models of spectrum management in the concluding section of this article.

Table 1: Ofcom's planned rebalance of management schemes

Command and Control		The Market	Licence Exempt
1995	95.8%	0.0%	4.2%
2000	95.8%	0.0%	4.2%
2005	67.8%	27.1%	4.2%
2010	22.1%	73.7%	4.2%

As with flexible spectrum usage, several countries inside as well as outside of the EU are currently taking steps to introduce secondary trading. In the UK, for example, Ofcom has outlined a roadmap towards assigning almost three quarters of the spectrum via market mechanisms (see Table 1 taken from Ofcom 2005a:12). To this end, a consultation was organised at the end of 2003, a statement published in August of 2004 and draft spectrum regulations (again followed by consultation) released in the second half of that year. Also, the mentioned Spectrum Framework Review of November 2004 and its Implementation Plan of January 2005 dealt with

8 In his article on spectrum abundance, Benjamin refers to a number of advocates of open-spectrum access on a massive scale, such as Yochai Benkler, George Gilder and Eli. M. Noam.

9 The French administration shares this view.

the issue. The Spectrum Trading Statement contained a class-by-class timetable for the introduction of spectrum trading, which can be found in Table 2 taken from Ofcom (2005c:8), and the regulator indicates that, at least as far as 2004 and 2005 are concerned, it is on schedule with this time plan. As for the introduction of spectrum trading in other than the 2G and 3G bands, Ofcom hopes to have cleared out most of the policy and technical issues by the end of 2006. Also, in order to improve the functioning of the spectrum market, the regulator has committed itself to providing up-to-date information to stakeholders on what allocations and assignments have been made, as well as whether or not these are tradeable. For this, three registers exist: the UK Plan for Frequency Authorisation (UK PFA), providing contextual information about which frequencies are available for assignment, for what purpose the different frequencies have been allocated and whether these can be traded; the Wireless Telegraphy Act register (WTR), providing basic information about individual licences, and the Transfer Notification Register (TNR), displaying details of proposed trades notified to Ofcom, trades in progress and completed trades (Ofcom 2007).

Table 2: Ofcom timetable for spectrum trading introduction

2004	2005	2006	2007	other
Analogue Public Access Mobile Radio (PAMR)	Wide area Private Business Radio (PBR)	Emergency services	2G and 3G mobile	Mobile satellite
National paging	On-site PBR		Programme Makers and Special Events (PMSE)	Satellite shared with terrestrial services
Data networks	Digital PAMR		Aviation and maritime communication	Radio broadcasting
National and regional PBR	10GHz FWA		Radio navigation (Radar)	Television broadcasting
Common Base Stations	32Ghz			
Fixed Wireless Access (FWA)	40GHz			
Scanning telemetry				
Fixed terrestrial links				

In the US – which, in part because of its limited number of neighbours, great land mass, homogenous and large internal market, has always been a hotbed for innovation in spectrum management – the FCC has been contemplating spectrum trading as early as 1980. In 2000, the Commission released a Policy Statement on Secondary Markets, indicating its desire to move towards market-based mechanisms for spectrum management, while noting that considerable degrees of flexibility already existed at that time (such as the already mentioned xG mobile networks, satellite broadcasting and Private Land Mobile Radio Services. (WIK 2006:110).[10] Similarly, The Spectrum Efficiency Working Group recommended in 2002 that

> "the Commission fundamentally alter the existing balance among these models – which is dominated by legacy command-and-control regulation – by expanding the use of both the exclusive use and commons models throughout the spectrum, and limiting the use of the command-and-control model to those instances where there are compelling public policy reasons"

and further stated that

> "the exclusive use model should be applied to significant parts of the spectrum, particularly in bands where scarcity is relatively high and the transaction costs associated with market-based negotiation of access rights are relatively low. Where spectrum is scarce but transaction costs are high, the exclusive use model still may be most appropriate, since wherever scarcity exists, there will be competing claims to this resource, and the exclusive use model is most effective at balancing these claims." (FCC 2002:32).

Consequently the FCC's First and Second Report and Order on Secondary Markets, released in 2003 and 2004 respectively, greatly simplified already existing transfer as well as leasing procedures for a wide range of so-called Wireless Radio Services (WRS) and gradually extended these bands, strongly reducing Commission intervention in many of these transfer or leasing processes (FCC 2003, 2004). As far as this leasing is concerned, two options are possible: either a spectrum manager lease takes place, without prior approval by the FCC, in which the licensee retains both *de jure* control over the licence and *de facto* control over the leased spectrum, or a *de facto* transfer lease is concluded – with FCC approval – in which the lessee takes control over the spectrum for the duration of the lease (either short or long term) and is primarily liable towards the FCC for compliance with regulations. (Ofcom 2005b:60; FCC 2003:93-182). So far, the system seems to have promoted efficiency without causing adverse side effects (WIK 2006:135).

10 Interestingly, the BNetzA report (see p 114) quotes a Commissioner saying that at the time, thousands of licenced transfers were already be pprocessed by the FCC every year.

The European Commission has followed these trends, taking steps to create a regulatory framework for the introduction of spectrum trading. First of all, the (non-obligatory) possibility to introduce secondary trading was included in the new regulatory framework (Art. 9 §3), which was approved in 2002 and came into force in July 2003. As is the case with flexibility of usage rights, the Commission's specific approach then started with the request for an RSPG Opinion, made to the Group in August 2003. This request clearly referred to evolutions within Member States (notably in the UK and in Germany) as well as outside the EU (US and Australia)[11], and the e-Europe and Lisbon strategy objectives as arguments for EU policy in spectrum trading (European Commission, 2003). Between February and April 2004, the RSPG launched a public consultation on the topic, which spurred 27 responses, mostly from vendors, broadcasters, telecoms operators and industry interest groups (RSPG 2004a). In parallel, a study was made by Analysys Consulting, DotEcon, Hogan and Hartson, which was completed in May 2004. The study revealed that, at the moment of its release, one third of the Member States had either not implemented measures for secondary trading or were not planning to do so, and that there were divergent opinions on the benefits of such measures and the possible side effects relating for example to competition. (Analysis & Partners 2004:163-169). It therefore recommended that the Commission take steps to obligate spectrum trading (and liberalisation) in Member States in all its possible forms, whilst leaving the specific implementation of such introduction to the MSs, because this would bring significant welfare benefits to the EU which would by far outweigh the additional costs of, for example, monitoring and mitigating interference. Still according to the report, a Community-wide approach was necessary in order to ensure that innovative companies could deploy their activities in a sufficiently large market by acquiring spectrum in different Member States; furthermore, Member States should further have the right to reclaim spectrum usage rights, for example in order to harmonise usage of bands on an EU-level, and should publish clear registers of both spectrum assignments and trades. Finally, in order to maximise benefits, a harmonised approach to the selection of suitable bands for secondary trading was suggested (Analysis & Partners 2004:265-272)].[12]

11 References are made to the FCC Task Force On Spectrum Policy, to Ofcom's Spectrum Framework Review, to the mentioned study of WIK for BNetzA in Germany. Specifically with regard to the US, a quote from a speech in Washington by former Information Society Commissioner Liikanen is also included: "In Europe we have a legacy of different national measures and approaches which are still standing in the way of many of the possible innovative approaches to spectrum management. That said, it is imperative that we advance and we can learn from the US. Jointly we should be able to develop a series of innovative approaches which are of interest world-wide".

12 A proposed set of suitable bands is also outlined in this section of the report.

In November 2004 the RSPG published its Opinion. The document starts off with some reserve, stating that spectrum trading

> "could be beneficial in certain parts of the spectrum, provided that sufficient safeguards are implemented by administrations to ensure that the potential benefits of this introduction are not offset by adverse consequences [and that] European harmonisation of spectrum trading rules should not be considered until Member States have greater experience of secondary trading, because such rules might delay the developments in countries where secondary trading is being introduced and might have negative impact in countries that are more hesitant".

The opinion advocates a phased introduction of spectrum trading in a number of bands, with a certain degree of commonality between the approaches of the different Member States, while excluding trading (or only allowing it after careful studies) from other bands where benefits are lower and/or risks or practical difficulties are higher; these include the bands used for government, broadcasting and scientific purposes. Besides stressing the continued role of CEPT in harmonising bands and commenting on usage rights, the Opinion also sets out four possible areas for action at EU level: 1) monitoring of roll-out and implementation of secondary trading by the RSPG; 2) sharing of knowledge and best practices between the Commission, the Member States and spectrum users on secondary trading experience, definition of spectrum rights and obligations, interference management etc; 3) giving consideration to ways in which licences may be made more flexible and technology-neutral in pursuing harmonisation objectives, taking into account the work of the CEPT's ECC/PT8 project team; 4) considering, through RSPG and RSC, the scope for a common approach to national information requirements for trading, with specific attention to the potential role of the European Frequency Information System, a database hosted since 2002 by the European Radiocommunications Office[13] (RSPG 2004b).

Looking at these rather cautious findings from the RSPG regarding a European approach to secondary trading, it may come as no surprise that the Commission did not immediately – as the Analysys study had recommended – draft binding measures, but instead first published a Communication on the issue in September 2005, entitled *A Market Based Approach to Spectrum Management in the European Union*. In this document, the Commission announces its target to put into practice both secondary trading and flexible spectrum usage in the entire EU by

13 http://www.ero.dk.

2010, by implementing regulatory measures in the course of the review of the regulatory framework for electronic communications networks and services, as well as by starting a co-ordination process to avoid delays and spectrum fragmentation in the period leading to a harmonised European framework. The main argument given by the Commission to start a harmonised approach, besides the achievement of Lisbon and 2010 strategies, is that diverging Member States' (MS) policies continue to limit the development of the internal market and, thus, reduce the expected full benefits brought by secondary trading and flexible use.[14] The decision by one MS not to introduce spectrum reforms, so the Commission argues, will create costs for other MSs, whereas when one country would reform its policies, this would cause benefits for all other MSs. Moreover, "introducing spectrum tradability at EU level would bring about the conditions for seamless cross-border services on the basis of rules applied throughout the Community and create one of the world's largest markets in spectrum-supported services. It would rapidly improve the competitive position of the EU and deliver a strong impetus to innovation."[15] Therefore, six issues are proposed on which a European concensus is needed. The first is the objective, namely the introduction of spectrum trading and flexible use by 2010. The second aspect is the spectrum bands involved: here, the Commission strongly argues for the involvement of a wide set of frequencies,[16] but excluding defence, scientific or globally managed (eg aviation and satellite) services. A third

14 The Analysis *et al* study expected these to amount to EU8-9 billion per year, whereas another mentioned study by Jerry Ellig from the George Mason University calculated an annual gain of USD 77 billion in the US, claiming that "spectrum allocation accounts for more than two-thirds of the total costs of federal telecommunications regulation to consumers and society."

15 This argument seems rather questionable since there currently still does not exist an internal market for services that are already harmonised throughout Europe (eg 2G and 3G services). Various obligations ranging from national roaming obligations to interconnection tariffs are highly diverging throughout the EU. A harmonisation at the EU implies a solution for all of these differences besides technical parameters, which might prove to be a slow and difficult process.

16 Including terrestrial mobile communication services (public services such as 2G and 3G, and closed ones such as PMR and PAMR), terrestrial fixed-wireless communication services (such as WLL, BWA and microwave links) and terrestrial TV and radio broadcast services. Interestingly, Public Service Broadcasting is not excluded from this: "While the special nature of public service broadcasting has to be taken into account, it should be recognised that the possibility for spectrum users to trade and use the frequencies in a more flexible way are options and not obligations. It may also be necessary to reassess the assumption that broadcasting as a public interest automatically requires terrestrial spectrum, since coverage obligations increasingly can be fulfilled by means other than terrestrial wireless transmission, given the growing reality of convergence and multiple platforms. This does not contradict the objective to safeguard the delivery of public service broadcasting, nor the continuing validity of other public policy objectives."

aspect deals with transitory issues, ie the safeguarding of existing licence holders' interests (eg by giving them increased flexibility of use) and compatibility with competition and general community law, while a fourth is concerned with the definition of spectrum rights. The necessary co-ordination of information through the creation of Europe-wide databases for allocations, assignments, spectrum availability and regulations[17] is a fifth priority for harmonisation. A final issue is service and technology neutrality wherever consumer demands (eg interoperability) do not justify limitations on these concepts. The Commission proposes to include the issues of tradeability (1st) and technological and service neutrality (6th) during its framework review, whereas a co-ordination process will be started to reach the other four objectives.[18] (European Commission 2005)

At the time of writing of this article, the Commission has proposed no specific measures. As of November 2006, the Committee on Industry, Research and Energy of the European Parliament, supported by opinions from the Culture and Education and of the Internal Market and Consumer Protection Committees, had only published a draft report, entitled Towards a European Policy on the Radio Spectrum (European Parliament 2006a, 2006b, 2006c)

The road to WAPECS

Besides spectrum tradeability, the concept of technology and service neutral frequency assignment and change of frequency usage is another significant policy evolution with regard to the introduction of software-defined radio and reconfigurable networks. In June 2004, the European Commission issued a request for opinion to the RSPG with regard to a coordinated EU spectrum policy approach

17 Possibly through the EFIS database.

18 To this needs to be added that several Member States, while sharing the views of the EC on the objective, ie to optimise spectrum management, have diverging views with respect to the means that should be employed to reach such optimal use of the spectrum. For example, some regulators feel that public interest objectives such as the need to protect users from harmful interference, are not necessarily considered compatible with an exclusive market based spectrum management. Similarly, the claim of the EC to significantly increase the amount of "commons bands", according to some of these regulators, is challenged by the fact that it would certainly lead to sharing and compatibility issues, at least as long as smarter technologies (including cognitive radio) are not available to make sure that these difficulties would not arise. A third point of criticism is that market based mechanisms cannot ensure the availability of harmonised frequency bands at the European level while such possibility of harmonisation is necessary for industry to develop new and innovative services and applications. Finally, some of the regulators also believe that present regulation provides enough guarantees in terms of technology neutrality, and fear that reinforced provisions will lead to either an inefficient use of the spectrum or to harmful interference. This demonstrates the point made earlier that a "European" spectrum policy is in reality hard to define.

concerning wireless access platforms for electronic communications services (WAPECS) (European Commission 2004b). This move was spurred not only by the fact that more and more wireless technologies were becoming available for which suitable spectrum needed to be found (802.11x, 802.16, UMTS-HSDPA, LTE, DAB and the DVB family, just to name a few), but also it was felt[19] that present spectrum policies could be made more flexible, with less stringent licencing schemes attached to the use of numerous frequency bands, so as to encourage fast introduction of innovative and competitive services and, thus, facilitate the development of the internal market.[20]

Several evolutions and pressures from diverse major stakeholders reinforced this argument. Firstly, 'traditional' 2G and 3G wireless communications operators were among the first to call for reforms: while the first 2G licences were approaching their expiry date (in 2005), operators in the 900 and 1800 MHz bands had already been asking for more flexibility in these bands, in order to upgrade their networks to hybrid 2G / 3G standards. Secondly, other services such as PAMR[21] started using technologies that were increasingly hard to distinguish from 3G – 3G-like applications started to be operated in bands originally allocated to PAMR. Thirdly, convergence between mobile communications and broadcasting (where the former started to include point-to-multipoint audiovisual services, and the latter enriched its content with data for interactive applications) resulted in a desire by operators of mobile technologies to use broadcasting frequencies and *vice versa*, eg to provide a return path. Finally, some Member States as well as progressive spectrum administrations outside of the EU were already contemplating more flexible approaches to spectrum management, and some had even started implementing measures.[22] (RSPG 2005a) In the US, for example, the FCC argued as early as 1997 that "in order for competition to bring consumers the highest valued services in the most efficient manner, we believe competing users of spectrum need flexibility to respond to market forces and demands. This flexibility includes the freedom to determine how they will use spectrum, how much spectrum they need, and the geographic area in which they will provide service" (Rosston & Steinberg 1997:10).

19 At least, by the Commission although not shared by all stakeholders.

20 Hence the rationale for EU initiative in this domain.

21 Originally meant only for push-to-talk, point-to-multipoint communication systems between closed user groups, mainly used by public services.

22 This clearly illustrates the introductory point that policy making in this domain is a mixture of proactive and reactive regulation.

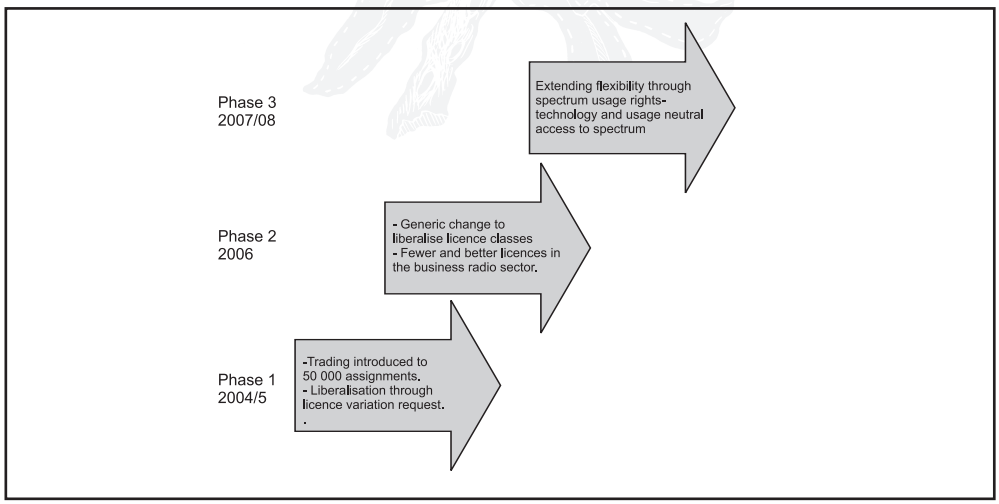
A similar stance was taken in the FCC's 1999 Spectrum Policy Statement (FCC 1999:3) and in 2002, the Commission's Spectrum Efficiency Working Group again recommended that the FCC take steps towards flexible spectrum use (FCC 2002:21). In the mean time the FCC, authorised by the Communications Act to do so (WIK 2006:104) has already introduced such flexible uses, for example in the 2500-2520/2670-2690 MHz, 2 GHz and L bands.[23] Also, change of use between 2G, 3G and even B3G (beyond 3G) services is already perfectly possible in the US, due to very flexible licences for these services. (WIK 2006:109-110). In the UK, Ofcom first launched a consultation on Spectrum Trading and Liberalisation in November 2003, and subsequently started its Spectrum Framework Review (end 2004), which proposed "making licences more inherently flexible by removing unnecessary or disproportionate restrictions so users could change use or technology without applying to Ofcom" (Ofcom 2005b:32). The UK regulator believes that up to 72% of spectrum may be liberalised in this manner, "allowing change of use of spectrum without any intervention and with no specific restrictions, although possible usage will be limited through the use of a spectrum mask" (Ofcom 2005c:51).[24] In the beginning of 2005, the regulator published its Spectrum Framework Review Implementation Plan. In this report, while still wholeheartedly supporting the evolution towards flexibility in spectrum usage and announcing that it would in the future remove restrictions in existing as well as new licences as much as possible, Ofcom did discern two issues which justify a temporary delay of usage restrictions removal as far as 3G licences are concerned, the first being the sheer magnitude of change that spectrum management is currently undergoing and possible short-term negative effects of this change on the commercial plans of the five existing mobile network operators, and the second being that certain frequencies had recently been auctioned to fixed services and that the terms of this auction – at least for a limited period of time – needed to be respected. In practice, several options for the introduction of these principles were put forward, including immediate release of restrictions, and transitory periods to respectively 2007 and 2015; similar sets of

23 FCC examples: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-215235A1.pdf, http://hraunfoss.fcc.gov/edocs_public/-attachmatch/FCC-01-256A1.pdf quoted in *Report of the Spectrum Efficiency Working Group*.

24 This would imply a two-fold set of spectrum usage rights, one "restrictive" minimal set to which all operators need to apply, and one set of "specific" usage rights which apply to the current use of the spectrum and are less demanding than the restrictive set, but need to be agreed with neighbouring spectrum users on an *ad-hoc* basis. (Cf. Annex D of the *Spectrum Framework Review* report). One might wonder how efficient such a system will be in practice, noting that spectrum users might have to negotiate with their own competitors on suitable protection masks before being able to sell their spectrum to third parties.

options (five in total) where outlined for the 2G bands (Ofcom 2005c). In a subsequent 2006 consultation on Spectrum Usage Rights, Ofcom set out detailed options for introducing liberalisation in this field, as well as a three-phased approach to this introduction (see Figure 1, taken from Ofcom 2006). Finally, in Germany the Bundesnetzagentur (BNetzA) commissioned a study into Flexible Spectrum Management in 2005, concluding that "as far as possible, usage rights should be both technology- and service-neutral" and requiring a flexible re-design of the National Table of Frequency Allocations and the Frequency Usage plan, as well as the definition of clear spectrum masks (WIK 2006:227-235).

FIGURE 1: OFCOM'S PHASED APPROACH TO SPECTRUM LIBERALISATION



Again, the section above is not intended to be exhaustive as to the regulatory roadmap for dynamic spectrum management – not even within the few EU Member States taken as an example. Instead, it illustrates that operators and regulators are asking for and already implementing the policy reforms outlined by WAPECS. Taking this into account, as well as the equally discussed practice of the European Commission to cooperate with the Member States in various ways for the formulation and implementation of its Community spectrum policy, it may come as no surprise that WAPECS, as an EU policy, is in fact the result of intensive co-ordination between the different stakeholders involved. First, as mentioned, the RSPG formulated an opinion on the subject, which was finalised in November 2005 (RSPG 2005a). The Opinion starts by defining WAPECS specifically as:

> "…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 and electronic communications services 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."

The WAPECS system would thus theoretically allow any digital technology over any platform to offer any service possible (including IP access, multimedia, multicasting, interactive broadcasting and datacasting) over any frequency band (both licenced and unlicenced) and / or network, while recognising that such an approach is subject to technical co-existence requirements tailored to each specific band.

As a second step, the RSPG launched a questionnaire among its members regarding current and intended usage of a pre-defined list of wireless platforms, aimed at identifying the relevant frequency bands for WAPECS, the range of licencing approaches which have or could be used, the rights that have been applied, the obligations that have been applied and some spectrum related challenges. From this the Group compiled a first list of broadcasting, fixed, mobile and Short Range Device (SRD) frequency bands for which there existed reasonable consensus about their suitability for WAPECS. Next, a public consultation was organised in order to collect stakeholder views in order to formulate the opinion. (For a more elaborate overview of consultation responses, see RSPG 2005b) As a consequence, the Opinion itself contains an overview of the current constraints to WAPECS, the long-term policy goals to be achieved as well as the challenges for Member States. As for constraints, five are identified: 1) legacy issues arising from the method of assignment of individual usage rights, which has resulted in differing economic values for frequency bands and networks; 2) lack of flexibility in some existing licences, particularly arising out of national and international agreements and in many cases aggravated by long licence durations;[25] 3) excessive technological prescriptions in some licences; 4) the desire by Member States to protect certain public policy objectives, eg Services of General Economic Interest, which among others contains Public Service Broadcasting, as well as emergency services; 5) current use of bands by non-communications services, eg governmental, military or scientific use.

25 An additional problem is that EU legislation currently does not allow a change of use for frequencies which have been harmonised within the Union. This includes GSM (2G) and UMTS (3G) networks.

The longterm policy goals in their turn may be summarised as the need to facilitate rapid access to spectrum for new technologies in order to promote competitiveness and innovation, to ensure a coherent authorisation scheme and to achieve technological as well as service neutrality (RSPG 2005a:12-14).

However, the RSPG is careful in its approach to WAPECS and points out a certain number of challenges to be addressed by the MS that justify a certain level of continued regulation and co-ordination: 1) ensuring access to adequate amounts of spectrum to meet the needs of consumers and business in the future environment without disadvantaging services of general interest (such as public-sector broadcasting) and without picking technology winners; 2) increasing flexibility and enhancing harmonisation: removing regulatory constraints on the electronic communications services to be offered but, where justified, keeping some on the technologies to be used as this will facilitate identifying what appropriate minimal technical co-existence requirements to avoid the risk of interference must be met and maintaining the protection of other services and applications (eg governmental services); 3) maintaining a stable and predictable regulatory framework; 4) avoiding spectrum fragmentation where it could lead to inefficient use of spectrum, by carefully considering the effects of the reduction of the regulatory constraints on harmonised bands; 5) facilitating standardisation through, at least, the establishment of a harmonised set of technical requirements for the usage of certain frequency bands to benefit from economies of scale; 6) identifying transition arrangements which ensure that legacy issues are dealt with smoothly.

In its opinion, the RSPG also recognised that, while the conditions of authorisation should be equitable between similar electronic communication services potentially operating in various frequency bands, using different technologies but which target similar mass markets, there are still reasons which would prevent and will continue to prevent consideration of the same access conditions to all networks. Similarly it recalls that certain technological requirements may be imposed by Member States or at EU level.

With regard to the implementation of WAPECS, the RSPG argued that whereas a revolutionary, "big bang" approach would potentially distort existing services, it would be equally unwise to wait for all existing licences to expire, and therefore proposes that specific actions and dates for implementation be set out in detail, leaving room for Member States to implement "earlier if they see fit and taking account of local circumstances". The Group, in its Opinion document, asks the Member States (via the RSC) to take the frequency propositions made within the

document as a starting point to compile a new list of suitable frequencies for WAPECS, to identify all existing constraints to the inclusion of these frequencies, to identify measures for improving coherence of authorisation conditions as well as technical requirements for WAPECS, and to define implementation packages. (RSPG 2005a:14-15).

At the subsequent RSC meeting in March 2006, the European Commission proposed a first set of bands to be further investigated by the Member States and invited the Committee to liaise with other bodies regarding the duties conferred onto it by the RSPG. In particular, the assistance of the Communications Committee (COCOM) for the investigation of existing conditions to right of usage was suggested, and a mandate to CEPT was proposed to examine the technical and operational conditions needed to avoid harmful interference. Furthermore, the Commission invited the RSC to collect data from its members regarding the different national roadmaps for WAPECS and the implementation packages formulated for it, as well as to identify its own list of frequencies eligible for inclusion into WAPECS (RSC 2006b). The liaison with COCOM and the mandate to CEPT were agreed upon by the RSC (RSC 2006a), and a mandate was issued in July 2006. Under this mandate, CEPT will review existing technical conditions attached to the right of usage of the set of frequency bands identified by the RSC (to which the 900 MHz band was added), to identify future common and minimal technical conditions for these frequency bands, to urgently (by end 2006) look into the technical feasibility and support for operating technologies other than GSM in the bands currently used for 2G mobile services, and to additionally investigate 1800-1805 MHz (upper ex-TFTS) band. (European Commission 2006). An interim report on CEPT progress was released in December 2006; among other things, the document demonstrated considerable variation in current technical conditions attached to rights of use, and the existence of certain degrees of flexibility in certain bands (such as the 3.5GHz, the 470-862 MHz and current 2G bands) (RSC 2006c). CEPT activities hope to be completed by July 2007. In parallel, the WAPECS concept is included in the review of the EU regulatory framework for electronic communications, which has started in 2006.

However, the Commission has not awaited the outcome of the CEPT study and the framework review to release a Communication on the matter, entitled *Rapid Access to Spectrum for Wireless Electronic Communications Services Through More Flexibility*. In this Communication, dated February 2007, the Commission outlines and motivates the steps it is currently taking to introduce spectrum flexibility in an

initial, coherent set of bands (repeating the steps and motivations already outlined above) and sets out a specific outline for 2007. In general, the Commission proposes

> "that a flexible, non-restrictive approach to the use of radio resources for electronic communications services, which allows the spectrum user to choose services and technology, should from now on be the rule, as opposed to the restrictive approach which is often still used today. Measures which deviate from the new approach may still be taken, but must be duly justified (eg for public safety and security) and take into account their impact on innovation, competition, investment and social value"[26] (European Commission 2007c:5)

While still holding to the obligation to offer services within particular frequency bands, the Commission aims to remove exclusive use of frequencies and to counter harmful interference through the use of technology-neutral, usage conditions with regard to channels, power limits and guard bands. Besides the earlier mentioned 2G bands which need to be opened up for 3G services, the Commission gives the current examples of the 2.6Ghz band desired by WiMax as well as UMTS operators and the 470-862Mhz band now used primarily for broadcasting to further show the urgent need for introducing such steps towards flexibility.[27]

Besides summarising the work currently being undertaken in the already-mentioned initial "package" of frequency bands, the Communication announces its intention to: 1) translate its results into a Recommendation on common and minimally necessary conditions attached to the rights of use before the end of the year (after which minimal technical usage conditions and standards may be set through implementation measures under the Radio Spectrum Decision and the R&TTE Directive respectively); 2) urgently look into the GSM and 2.6GHz cases; 3) mandate ETSI to develop adequate harmonised standards for equipment operating in flexible bands, and 4) further consult with industry on issues of spectrum management reform (European Commission 2007c).

Conclusion

This article has provided an overview of policy trends leading towards more flexible forms of spectrum management. While it has been demonstrated that, in a number of countries as well as on the EU level, there is a shift of policy focus from the command-and-control model to more market based forms of spectrum management,

26 An identical message was given in the concluding remarks by Ruprecht Niepold, Head of the European Commission's Spectrum Policy Unit, at the SPORT VIEWS final conference, Brussels, 16 March 2007.

27 These frequency bands belonging to those currently being investigated by the CEPT.

including secondary trading and flexible use of spectrum, other mechanisms have not been abandoned, and there is currently no consensus among regulators as to what constitutes the optimum balance between them. Discussions between these regulators in bodies such as the CEPT and at conferences show that, even though all regulators are in favour of more efficient ways of dealing with increased spectrum management complexity, many are cautious about speedy implementation of market-based mechanisms and continue to have serious doubts about interference issues, day-to-day manageability of such mechanisms as well as about the added value of and possible business models for services relying on advanced spectrum resource management techniques and opportunistic, cognitive radios. Moreover, some manufacturers and operators (such as those united in the UMTS forum) have expressed similar doubts, and lively debates are continuing also in the academic community (besides the policy and regulatory documents already referred to, see for example Benjamin 2003; Forge & Blackman 2006; Hazlett 2006; Hazlett & Spitzer 2006; Xavier & Ypsilanti 2006). At the same time, continued importance is attributed to other mechanisms to promote innovation in telecommunications networks and services, for example through the standardisation of technologies, the harmonisation of frequency bands[28] and – with inclusion of these former two steps – the introduction of unlicenced bands referred to in section II.[29] Therefore, the focus of this article on market-driven spectrum management certainly does not imply that this approach is uncontested or acted upon with identical vigor in all EU Member States, but rather tries to shed light on this specific, promising aspect of spectrum management reform. Additional regulatory, economic and business modeling studies will need to be carried out in order to evaluate whether flexible spectrum management is indeed feasible, profitable and innovation-inducing and will as such dominate other management mechanisms in the future. ❑

28 Recent examples being the 5GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (12/02/2007), the 2GHz frequency bands for the implementation of systems providing mobile satellite services (14/02/2007) or the harmonised use of the radio spectrum for equipment using ultra-wideband technology (UWB, 21/02/2007).

29 A topic on which the European Commission has also announced its desire to make progress in 2007 (European Commission 2007c).

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