

## Study on Spectrum Management in the field of Broadcasting

### EXECUTIVE SUMMARY

## Implications of Digital Switchover for Spectrum Management

Prepared for the European Commission (DG Information Society)

**Authors:**

John Burns

Aegis Systems Ltd

Phillipa Marks

Indepen Consulting Ltd

Florence LeBorgne

IDATE

Richard Rudd

Aegis Systems Ltd

The opinions expressed in the Study are those of the authors and  
do not necessarily reflect the views of the European Commission.

© ECSC-EC-EACAE, Brussels – Luxembourg 2004



## 1 INTRODUCTION

This Study on Spectrum Management in the Field of Broadcasting has been prepared for the European Commission (EC) Directorate for the Information Society (DG INFSOC) by Aegis Systems Ltd, Indepen Consulting Ltd and IDATE. The Study focuses on the implications of digital switchover and technology / service convergence for radio spectrum management. In particular, it considers the extent to which a “digital dividend” might be realised in terms of spectrum released for other uses post-switchover and potential roles for the EU in maximising the benefit from any such dividend.

The structure of the Study final report is as follows:

**Chapter 2** provides a high level overview of the current status of radio spectrum management and broadcasting internationally.

**Chapter 3** examines the opportunities and challenges presented by the switchover from analogue to digital broadcasting.

**Chapter 4** considers what national and international policymakers might do to ensure that the regulatory environment can best support the opportunities and overcome the challenges.

**Chapter 5** focuses specifically on the spectrum planning process and how this can provide the flexibility needed to maximise the benefit from switchover and convergence.

**Chapter 6** summarises our key findings and conclusions, and considers potential roles for the EC in facilitating the switchover process and maximising stakeholder benefits.

The remainder of this executive summary highlights the main findings and recommendations emerging from the Study.

## 2 SUMMARY OF FINDINGS

### 2.1 Estimating the “Spectrum Dividend” arising from switchover

(Section 3.2)

**Key Points:**

- **Digitisation reduces spectrum requirement for TV broadcasting to between a third and a half of existing analogue requirement, based on today’s services and coverage**
- **Any spectrum dividend will depend on the number of digital TV channels, picture definition, coding technology, coverage and reception mode (fixed portable or mobile)**

The ending of analogue TV broadcasts will reduce significantly the amount of radio spectrum required to maintain existing terrestrial TV services. We estimate that switchover would enable existing national terrestrial TV services to be delivered with typically between a third and a half of the existing spectrum requirement. This figure allows for the high degree of regionality required in some countries and for provision of indoor reception at 70% of locations, broadly comparable with today’s analogue service. If reception were restricted to fixed, rooftop aerials this would reduce the spectrum requirement further to as little as 10% of the current requirement. Conversely, providing for widespread mobile TV reception could increase the requirement back to the current level. Transmitting all programmes in cinema-style high definition format (HDTV) could similarly increase the spectrum demand, if today’s technology is deployed.

Any spectrum dividend therefore depends very much on the nature of future digital TV services, in particular the extent to which mobile or portable reception and/or HDTV transmission are considered part of the standard service offering. The choice of technology (e.g. coding and modulation schemes) and the number of programme channels are also key drivers: the above estimates are based on replication of today’s analogue services, comprising typically up to five national services with regional or local variations, and the use of today’s digital compression technology (MPEG2).

Introduction of new TV channels will necessitate further spectrum or risk compromising picture quality, but this could be largely or wholly offset by the adoption of more efficient coding schemes such as MPEG4. The spectrum requirement is likely to be less if a multi-platform approach to universal access is taken, enabling the current onerous coverage obligations on terrestrial networks (which pre-date availability of satellite and cable alternatives) to be relaxed.

## 2.2 Making the most of the Spectrum Dividend *(Section 3.5)*

### Key Points:

- **Beyond provision for existing general interest services, the market should determine how broadcast spectrum is used in the longer term**
- **In an uncertain market environment, regulation should provide maximum flexibility to cater for different evolution paths**

The spectrum dividend arising from switchover could be used in a number of ways, including:

- the provision of additional TV programmes
- TV enhancements such as mobile reception or HDTV
- introduction of new convergent<sup>1</sup> multimedia services
- “re-farming<sup>2</sup>” of spectrum to new applications, such as 3G mobile.

Enhancements or new services could also be facilitated by technology developments, such as improved compression and coding standards (enabling more programme channels or higher definition to be achieved with no increase in spectrum) or mobile-optimised transmission technology such as the “handheld” variant of the DVB standard that is currently under development (DVB-H).

Beyond any requirement to maintain existing “general interest” broadcast services, we believe that the market should essentially determine how the current broadcast spectrum will be used in the long term, and that the regulatory environment should provide the maximum flexibility to cater for the different possibilities. For new services that fall outside the scope of “general interest” regulation, we would expect broadcasters to be subject to the same authorisation conditions as would apply to any other electronic communications service: indeed, such a requirement is implicit in the new EU regulatory framework.

We would recommend therefore that additional programme channels should be free of any general interest obligations that would merit any special treatment with regard to spectrum access, and that this should also apply to enhancements such as HDTV or mobile reception.

---

<sup>1</sup> Convergence is a term used to describe the increasing deployment of multiple digital media such as broadcasting, telecommunications and information technology to deliver integrated multimedia content and services

<sup>2</sup> Re-farming refers to changing the technical planning criteria for radio spectrum to accommodate services that could not be readily accommodated otherwise, such as wide area bi-directional mobile services in broadcast spectrum

## 2.3 Market Evolution and Convergence *(Section 3.8)*

### Key Points:

- **Innovation is best supported by a technology-neutral regulatory framework where technology is regulated only in terms of technical co-existence**
- **Innovative new wireless services can only develop if there is reasonable assurance that spectrum will be available**
- **Convergence and flexibility would be facilitated by extending the primary allocation of broadcast spectrum to include mobile services**

New technology developments such as the DVB-H standard<sup>3</sup> and IP Datacasting<sup>4</sup> blur the traditional distinctions between broadcast and telecommunications services, enabling the delivery of both conventional TV programmes and convergent multimedia content to mobile receivers in a manner that makes technically efficient use of available spectrum. Such convergent services can coexist technically with broadcast services and should not be hindered by the imposition of legacy-based rules that impose particular standards or service concepts.

We believe that innovation is best supported by a technologically neutral regulatory framework, where technology is mandated only to the extent necessary to ensure technical co-existence. We also believe that a European market for such innovations can only develop if there is assurance that at least some spectrum will be available to support them if they prove to be successful. We believe that this can be done in the context of the planning process that is being developed in the current ITU Regional Regulatory Conference, providing European proposals for flexible planning are adopted. The long-term evolution of convergent services would be further facilitated by extending the primary allocation of the spectrum to embrace mobile as well as broadcast services, and we recommend that this initiative be pursued at the 2007 World Radio Conference (WRC 07).

In the longer term, when digital broadcasting and other new services such as 3G mobile are established and a clearer picture of future spectrum demand emerges, there may be benefit in a more flexible approach to spectrum allocation. For example, it may be preferable to replace the existing service based definitions with alternatives that reflect the physical characteristics of radio transmissions, such as whether they serve an entire geographic area or merely connect two fixed points. Such deliberations should be pursued within the CEPT in the context of preparations for future WRCs.

---

<sup>3</sup> A variant of the European digital broadcasting standard that is optimised for delivery of content to handheld devices such as mobile phones

<sup>4</sup> A technique for simultaneous delivery of multimedia content to a large number of mobile terminals

## 2.4 Spectrum Refarming (Section 3.9)

### Key Points:

- **Refarming to accommodate non-broadcast services should not compromise existing flexibility in spectrum use**
- **Accommodating a “return path” in broadcast spectrum could reduce spectrum available for other convergent services and reduce flexibility overall**
- **Demand for a return path in the broadcast spectrum is questionable**

The growth of convergent services raises the question of whether spectrum should be “re-farmed” to accommodate bidirectional mobile services as well as unidirectional broadcast or convergent services. In principle, there is a strong argument for re-farming on flexibility grounds, so long as it can be implemented in a way that does not compromise existing flexibility.

The principal benefit of the UHF broadcast spectrum for a mobile operator would be the enhanced coverage provided by the lower frequencies, for example the UMTS Forum recently suggested that this spectrum could be attractive for extending 3G mobile services into remote areas<sup>5</sup>. However this would be dependent on the use of frequency division duplex (FDD) technology, which requires separate “sub-bands” to be designated for the forward and return paths. To be attractive to manufacturers, these sub-bands would need to be harmonised internationally, at least within Europe and preferably globally. Within the harmonised region, the sub-bands need to be cleared of high power TV broadcasts, since these would otherwise interfere with the reception of low power mobile signals. Consensus would need to be reached on the amount of spectrum required and the appropriate parts of the UHF spectrum that should be refarmed. This is likely to require extensive market and technical studies and protracted negotiation between equipment vendors, operators, regulators and broadcasters.

The potential benefit of such re-farming would need to be carefully balanced against the loss of spectrum to support high power unidirectional services, whether these are conventional broadcasts or new, convergent applications. We expect that by switchover the rollout of 3G mobile services will be substantially complete and so the long term demand for re-farmed UHF spectrum in developed countries is therefore questionable. Our research has found that interest from the mobile community is primarily focussed on the use of unidirectional “downlink” transmissions to support mobile and convergent services<sup>6</sup>.

---

<sup>5</sup> Document FM(04)99, input to ECC FM meeting on 26<sup>th</sup> – 30<sup>th</sup> April 2004. There was no support for any action in response to the input.

<sup>6</sup> This is supported, for example, by the current involvement of Nokia and Vodafone in separate trials of IP Datacasting technology

We believe that flexibility to support new services will be best supported by a spectrum planning approach that enables the market to determine the optimum use of spectrum over time, and does not favour any specific technological approach. We do not support any short term move to designate spectrum for bi-directional services unless a cost-benefit analysis demonstrates a clear case for this, since we believe this would reduce the overall flexibility by excluding high power unidirectional transmissions.

## 2.5 **Switchover Policy Issues** *(Section 4)*

### **Key Points:**

- **Even limited presence of high power analogue transmissions in Europe constrains introduction of new services**
- **Disparity between national broadcasting markets makes a common EU timescale for switchover unworkable**
- **Switchover decisions should take account of the associated costs and benefits**

The high powers emitted by analogue TV transmitters and the sensitivity of domestic analogue receivers to interference mean that even the limited continuation of analogue services in a few Member States will constrain the introduction of new services. Any spectrum dividend will therefore only be fully realisable upon the complete cessation of analogue broadcasts within the EU and neighbouring countries. Hence the timing of switchover will be a key factor in determining the benefits derived.

Disparity between national broadcasting markets in the EU means a common timescale for switchover is unlikely to be workable. The transition process therefore has to accommodate different switchover schedules in neighbouring states and avoid disruption to existing TV services.

National switchover decisions should take account of the costs and benefits associated with switchover, and their dependence on the method and timing deployed. For example, early switchoff of analogue services could entail substantial additional costs to upgrade consumer equipment, whilst excessive delay could deny the opportunity for industry and consumers to benefit from new innovative services or content.

A key factor in the timing of switchover will be the maturity of the digital and non-terrestrial TV markets in each Member State, since this will determine the number of viewers who are affected when analogue terrestrial services cease. For this reason, early switchover is more feasible in countries such as Germany where there is already a very high penetration of cable or satellite services. Elsewhere, where many viewers are content with existing analogue services the challenge will be to persuade these users that the cost of upgrading to digital is justified in terms of the benefits provided. This may entail the provision of additional programme channels

or enhanced functionality (such as mobility or portable reception) and it will be important to assess the benefits that these provide against the opportunity cost arising from the additional spectrum that would be consumed.

## 2.6 Economics of Radio Spectrum *(Section 4.6)*

### Key Points:

- **Spectrum auctions have highlighted the economic value of spectrum**
- **UK estimate of annual marginal spectrum value to broadcasters is €1.5 - €1.8 million per MHz**
- **The price paid for scarce radio spectrum should reflect the marginal value of the spectrum**

Recent UMTS auctions where the amounts bid were as high as €14M per MHz per annum<sup>7</sup> highlighted the potential economic value of radio spectrum to users and suggested there could be a sizeable “opportunity cost” if spectrum is allocated in a sub-optimal manner. By comparison, the marginal value of spectrum to TV services has been estimated in a recent UK study to be in the range £1M - £1.2M (€1.5 - €1.8M) per MHz per annum.<sup>8</sup> These estimates were based on the impact on coverage of having less spectrum and then calculating the cost of replicating that coverage using other transmission platforms (i.e. satellite and cable). The same study estimated the marginal value of 900 MHz GSM spectrum in the UK at £1.68M (€2.5M) per MHz.

Whilst it would be unrealistic to infer that broadcast spectrum would attract the level of payments that were realised in the early UMTS auctions, there is a case for ensuring that the price paid for scarce radio spectrum reflects the opportunity cost of the resource. This would encourage each user to acquire only sufficient spectrum to meet its actual needs and provide an opportunity for others who value the spectrum more highly to enter the market, for example using the mechanisms described below.

## 2.7 New Approaches to Spectrum Management *(Section 4.6)*

### Key Points:

- **Spectrum auctions or trading provide an incentive to use spectrum efficiently and could speed up switchover**
- **Administrative Incentive Pricing could also hasten switchover**

<sup>7</sup> Source: “Study on Administrative and Frequency Fees related to the licensing of networks involving the use of frequencies”, Aegis Systems and Connogue, report for DG INFSOC, November 2001, page 139

<sup>8</sup> The methodology for calculating these values is set out in “An Economic Study to Review Spectrum Pricing”, Indepen, Aegis Systems and Warwick Business School, February 2004.

- **Broadcasters should face the marginal opportunity cost of radio spectrum, as they do for other resources they consume**

Market based approaches such as spectrum auctions or trading enable spectrum users to determine the price they are willing to pay for the resource they consume, providing an incentive to use spectrum in an efficient manner. Such approaches include overlay auctions, whereby spectrum may be auctioned to new users whilst continuing to be available to the incumbent user (e.g. an analogue broadcaster) for a pre-defined period. The new user may then negotiate compensation arrangements to achieve an early vacation of the spectrum if required. Overlay auctions have been successfully deployed in countries such as Australia, New Zealand and the USA.

Similarly, spectrum trading could provide incumbent broadcasters with an incentive to expedite switchover in order to release some of their spectrum into the market place, offsetting the costs incurred by switchover. Trading is currently the subject of another current EC Study and at least one Member State (the UK) has already announced its intention to introduce spectrum trading, including its eventual extension to broadcasters. There are a number of complexities arising from the manner in which broadcasting spectrum is currently planned for analogue services which would require trading to take place within a defined national regulatory framework under which broadcasters collectively co-ordinate any release of spectrum.

Administrative incentive pricing (AIP), where the fee paid by holders of individual rights of use for radio frequencies reflects the marginal opportunity cost arising from the denial of that spectrum to other users, is a further means by which analogue broadcasters could be encouraged to hasten their migration to a digital platform. Broadcasters often argue that they should not be subject to AIP since they pay for their spectrum indirectly through general interest obligations. However, these obligations are in place to address general interest objectives and not spectrum efficiency. To promote spectrum efficiency broadcasters should face the marginal opportunity cost of their use of spectrum, just as for example they pay an unsubsidised price for electricity and other inputs they use.

### 3 CONCLUSIONS AND RECOMMENDATIONS

Market and technology uncertainty, combined with differing national emphases in broadcasting policy, limit the scope for direct action by the EU on digital switchover. However, the long term economic benefits of switchover and convergence are likely to depend on there being an opportunity for any new services to evolve on a broadly pan-European basis. We have therefore identified a number of areas where the EU could provide support in relation to internal market aspects of switchover. These fall into two broad areas, namely facilitating a timely switchover process and maximising the opportunities that arise from digitalisation and convergence post-switchover.

#### 3.1 Facilitating Switchover *(Section 6.2)*

##### **Recommendation 1: Benchmarking**

Benchmarking provides an opportunity for NRAs to identify and learn from good practice elsewhere, either within the EU or in other industrialised countries such as Japan and the USA. We recommend that annual benchmarking of the progress made towards analogue switchoff is incorporated into the e-Europe monitoring process and we suggest that a useful starting point would be assessing Member States' compliance with the eEurope Action Plan.

##### **Recommendation 2: Cost Benefit Analysis**

The optimum timing of switchover depends on the balance between the costs of switchover and the benefits that digitalisation will bring. This will vary between Member States depending on the state of the national TV market, and it is important that each NRA addresses this balance to achieve the full potential benefit of switchover. The EU should therefore encourage Member States to undertake cost-benefit analyses, which should be informed by market research to establish user preferences and willingness to pay for particular service attributes, e.g. in relation to choice of platform or introduction of new services like mobile TV and datacasting.

##### **Recommendation 3: Promoting Consumer Awareness**

Achieving timely switchover whilst maintaining public support for the benefits of digital transmission will depend on consumers being properly informed when purchasing TV equipment or services. We believe that a universal labelling scheme, making clear to consumers at the time of purchase whether or not a TV set is already digital enabled and if not stating clearly what are the options available to upgrade (e.g. plug-in module, set-top box etc), would best meet this objective. The scheme should also extend to other receiving equipment such as video recorders. Similar schemes have been successfully applied to support other EU policy initiatives relating to consumer goods, such as the promotion of energy efficiency for washing machines and refrigerators. We therefore recommend that the EU evaluate the options for introducing such a scheme, based on experience of other

consumer products, and undertakes research to assess the potential costs and benefits.

**Recommendation 4: New Approaches to Spectrum Management**

We believe there is a role for the judicious application of new approaches to spectrum management such as the use of auctions, trading and administrative incentive pricing. In particular, consideration should be given to the use of financial incentives to speed up the transition process and the use of trading to support flexibility in the future use of the spectrum.

### **3.2 Maximising Opportunities from Switchover and Convergence**

*(Section 6.3)*

**Recommendation 5: Access to Multiplex Transmission Capacity**

A key requirement in opening the market for new broadcast or convergent applications is access either to radio spectrum or transmission capacity. The latter is a particular issue during the transition phase. There is therefore a case for setting aside a minimum of, say, 20% of capacity on one or more multiplexes for trialling of new applications or services. In the longer term, a viable secondary market in DTT transmission capacity can be envisaged, akin to the market for satellite transponder capacity.

**Recommendation 6: Differentiating between “General Interest” and other broadcast services**

We suggest there is a case for the separate treatment of broadcast services that are currently subject to general interest provisions and those that operate on a purely commercial basis. The latter should have no greater claim to limited spectrum resources than any other commercial application (e.g. mobile telephony or datacasting). We would further suggest that existing general interest provisions should not extend to service enhancements such as high definition or mobile TV. Where broadcasters require spectrum for either new services or enhancements that extend beyond their general interest remit, this should be acquired via the market in the same manner as other, non-broadcast users.

**Recommendation 7: Spectrum Refarming**

We believe that future flexibility in the evolution of broadcast, mobile and convergent services would be enhanced by extending the primary allocation status of the current broadcast spectrum to include all these services. We therefore recommend that the EU's Radio Spectrum Committee works with CEPT to develop a European Common Position to support this objective at the 2007 World Radiocommunications Conference (WRC 07). We further suggest that the RSPG should also seek to develop a position with regard to longer term deliberations on terrestrial wireless interactive multimedia services (TWIMS), including the possible need for a more flexible allocation framework to replace the existing legacy-based allocations to the

broadcast and mobile services. We recommend that technical and market studies are undertaken to establish whether there is likely to be a longer term demand for bi-directional services in the existing broadcast spectrum and to assess the relative costs and benefits that would result from re-farming spectrum to accommodate such services.

**Recommendation 8: Catering for New Services under the existing planning regime**

Regardless of the outcome of any re-farming initiative, we believe there are potential market opportunities for new, convergent services that could be accommodated readily under the existing planning regime, especially if the 2004 / 2006 Regional Regulatory Conference adopts European Common Proposals for allotment and spectrum mask – based planning. However, these opportunities may be constrained if spectrum cannot be made available throughout Europe to support new services.

We therefore recommend that the EU's RSC, in conjunction with the CEPT, initiates a process to develop an ECC Decision that would require signatories to commit to identify a minimum number of existing broadcast frequency channels to be made available post-switchover on a technology and service neutral basis, subject only to compliance with the technical planning criteria agreed at RRC-04/06. These channels could be used for new services such as datacasting, additional TV services or TV enhancements such as mobile reception or HDTV, according to local market demand. We suggest that, initially, at least eight channels should be made available: this would provide scope for at least two national services<sup>9</sup>, whilst leaving sufficient spectrum for the universal terrestrial delivery of existing general interest channels where this is required.

**Recommendation 9: Dealing with existing non-broadcast uses**

We suggest that where possible and where there is a scarcity of spectrum in the UHF broadcasting bands, Member States should seek to identify alternative bands for existing non-broadcast services in these bands. We also consider that non-civil use of this spectrum should take account of the opportunity cost arising from the denial of spectrum to civil users and that Member States should be encouraged to consider the application of Administrative Incentive Pricing to such use. The transition period from analogue to digital broadcasting provides an opportunity for NRAs to review non-broadcast allocations and the terms and conditions associated with them with other relevant national bodies, to identify alternative bands and to establish a plan for migration of these other services where there is excess demand for commercial spectrum use.

---

<sup>9</sup> Assuming a frequency re-use of 4; improved re-use may be feasible with some technologies

**Recommendation 10: International and Cross-Sector Co-Operation**

We suggest that co-operation between the EU and other like-minded nations in the area of convergent technologies be encouraged, for example by including this within the remit of the existing Action Plan for EU-Japan co-operation. This could also prove useful in addressing the potential market for other audiovisual developments such as HDTV.

Finally, the EU may wish to consider hosting periodic workshops to encourage cross-sector participation between content providers, transmission network operators, equipment vendors and other key stakeholders to ensure that the full potential of convergence can be realised.