



# Progress on key spectrum initiatives

A review and update of the SFR and SFR:IP

Publication date:

Information  
Note  
3 April 2008



# Contents

| Section |                            | Page |
|---------|----------------------------|------|
| 1       | Introduction               | 1    |
| 2       | Benefits to date           | 8    |
| 3       | Progress and revised plans | 10   |
| 4       | Future plans               | 19   |

## Section 1

# Introduction

### Why we are publishing this note

- 1.1 The Spectrum Framework Review (SFR) was published in 2005 and set out an outline plan for spectrum management until 2010. We are now just over halfway through this period and at a sensible point to assess how well we are achieving the key aims of the SFR to move towards market mechanisms, to assess any changes that might be needed in the light of events and to update the actions included within the SFR as appropriate. It is intended that this note will provide a useful update for stakeholders including spectrum licence holders and those interested in using spectrum in the future.

### A reminder of Ofcom's spectrum strategy

#### Classes of spectrum

- 1.2 In the SFR we discussed how spectrum management fell into three different classes – command & control, market forces and licence exempt.
- *Command & Control* is where the regulator makes most of the key decisions about the manner in which the spectrum is used including either the usage (eg mobile) or the technology (eg GSM) or in some cases both.
  - *Market forces* is where the market is able to decide on the manner in which the spectrum is used. The regulator sets a few basic restrictions to prevent interference to others and then licence holders can decide upon the use and technology that is optimal.
  - *Licence exempt* is where anyone is allowed to access the spectrum without a licence as long as their equipment conforms to certain conditions such as limits on transmitter power.
- 1.3 We argued that a mix of these different classes was needed in order to cope with the wide range of applications and uses that derived value from using the spectrum. We showed that it had to remain the responsibility of the regulator to determine what the most appropriate mix was.
- 1.4 In determining an appropriate mix we firstly considered the optimal amount of spectrum for licence exempt usage. We showed that although licence-exempt access enabled a range of innovative new ideas and generated consumer value that there was little need for any additional allocations because the current provision was relatively lightly used, especially at 5GHz. However, we promised to continue to monitor utilisation and to consider providing additional spectrum if congestion seemed likely. We discuss this in more detail below.
- 1.5 For the remaining spectrum we argued that there should be a strong preference towards market forces. By this we meant that spectrum should be tradable with minimal restrictions on usage and technology. Our arguments for this are summarised below.

## Preference for market forces

- 1.6 The command & control approach used widely to date “works” in so much as it licenses spectrum to particular users and ensures that excessive interference is avoided. This allows a range of uses of the spectrum in a stable and predictable environment. However, it is unlikely that it achieves the full objective of a spectrum manager of maximising the value derived from the spectrum. To do this, the regulator would need to make sure that spectrum was divided up between all the different possible uses and users in a way which maximised benefits to end users of spectrum using services<sup>1</sup>. Since it is almost impossible to predict the value that each different service provides under any given spectrum allocation it is difficult to see how a “command and control” approach to managing the radio spectrum could maximise value.
- 1.7 In times where supply of spectrum exceeded demand, or where there were a relatively small number of services, it was more plausible that the regulator might approach this goal. However, increasingly, demand for the spectrum has grown as has the number of spectrum-using services. There have been many pieces of evidence that suggest that regulators are failing to maximise value under such circumstances. For example:
- Some regulatory decisions, such as the allocation of spectrum to the ERMES paging system or the TFTS in-flight phone system in Europe, have resulted in spectrum being unused for over a decade. Clearly, it could have been put to an alternative use which would have resulted in some value.
  - Widely differing valuations for the spectrum at auction suggests that the balance between different uses is incorrect - for example, prices in the 3G auctions were over 100 times higher on a comparable basis than the spectrum auctions at 3.4GHz despite the two bands being relatively similar in their physical properties.
  - Many new applications or technologies have had difficulty in gaining access to spectrum – for example the iBurst cellular technology or more recently Mobile TV systems. While it is not certain that these would increase the value of the spectrum, their difficulty in entering the market may be a symptom of an excessively rigid system.
  - Some applications which have historically been granted spectrum free, especially in the public sector, have not modernised their systems or reviewed spectrum planning for many decades despite the availability of more efficient technologies and the increased demand for spectrum, suggesting there are insufficient incentives for some users to optimise their use of the spectrum<sup>2</sup>.
- 1.8 In addition, the increasingly blurred line between different services such as broadcast and mobile communications is making it difficult to operate a command & control approach where certain uses are allowed and others not.
- 1.9 Economists have long argued that market mechanisms should be applied to radio spectrum. Seminal papers in this area start with Coase in 1959<sup>3</sup>. The essential idea

---

<sup>1</sup> These services can be either commercial ones, purchased by firms and households, or public services such as national defence which governments ‘provide’ on behalf of their citizens.

<sup>2</sup> Although, note that there are structural reasons such as the ability of departments to retain revenue raised which may mean spectrum-related incentives alone may be insufficient to achieve this goal.

<sup>3</sup> R. H. Coase, *The Federal Communications Commission*, 2 J.L. & ECON. 1 (1959).

here is to allow pricing mechanisms to act as an incentive for holders of spectrum to optimise their use – buying more if their business case can justify it, selling spectrum if they have excess, and adopting new technologies that can use spectrum more efficiently where economically viable. Economic theory and practical experience suggests that in a market which is performing well, this will lead to an allocation of spectrum that maximises economic value. Under such an approach the regulator sets out rules that enable markets to function while ensuring that interference is controlled and then takes a back seat, leaving it to the market to determine the use and users of the spectrum.

- 1.10 A market instrument that has already been widely adopted is the use of auctions to distribute spectrum. Auctions are valuable because they are more likely to identify the best user of the spectrum than a regulator using administrative allocation. But auctions on their own still ‘freeze’ the assignment of spectrum. They need to be accompanied by mechanisms to trade and change the use of spectrum as market conditions change and new services become available. Together these mechanisms are what we term “market forces” and they enable spectrum to be used in the manner that generates the greatest value.
- 1.11 However, in the SFR we noted that there were some areas where it was difficult to make full use of market mechanisms or where restrictions have to be imposed, in particular where spectrum usage required international harmonisation in applications such as aeronautical use and satellite transmission and here an appropriate mix of market forces and command & control should apply. In particular, we believe that the opportunity cost of spectrum should be clear in such cases because there is often scope for some change of use, or additional usage in the short term and without a clear opportunity cost it may be difficult for appropriate longer-term decision to be made.

### **Spectrum for licence-exempt applications**

- 1.12 Licence-exemption is an important usage of spectrum. It enables many applications that add substantial value to users including WiFi distribution of data around the home and office, Bluetooth wireless links between devices such as cellphones and headsets, cordless telephones, baby monitors, remote car key fobs and much more. However, it adds relatively little economic value to the use of the spectrum – recent studies suggest that perhaps only around 1% of the value generated by using the spectrum comes from licence-exempt applications. Hence, while it is important to provide licence-exempt spectrum, the success of applications such as WiFi should be placed in context with the applications that dedicating spectrum to licence-exemption might displace, such as cellular.
- 1.13 As we promised in the SFR, we have attempted to characterise the congestion in the licence-exempt spectrum. In 2007 we embarked on a series of measurements in a range of locations and across all of the key bands<sup>4</sup>. We recognise that these measurements are not perfect and that it is extremely difficult to characterise fully congestion in licence-exempt bands, nevertheless, the measurements do provide some useful indications. Broadly, they show that most of the bands are relatively lightly used. Even the highly popular 2.4GHz band is only around 20% used on average and 40% used in the busiest locations. The 5GHz band, seen by many as an “overflow” when 2.4GHz becomes overly congestion, is almost completely unutilised. This leads us to believe that there is no pressing need for additional spectrum to be found for licence-exempt allocations, although there may be sound

<sup>4</sup> See [http://www.ofcom.org.uk/research/technology/overview/state\\_use/aims2/le\\_summary.pdf](http://www.ofcom.org.uk/research/technology/overview/state_use/aims2/le_summary.pdf)

spectrum management reasons for exempting the spectrum in any case, as discussed in our Licence Exempt Framework Review (LEFR).

- 1.14 Some also believe that licence-exempt spectrum is a key area for innovation. While we agree that there is innovation in these bands, we believe that in general innovation in licence-exempt devices occurs in licence-exempt bands whereas innovation in licensed devices occurs in licensed bands. So, for example, the innovations that led to the Blackberry-style wireless email or GPS navigation-based applications occurred in licensed spectrum. They did not start in licence-exempt spectrum and then migrate across to licensed spectrum. Hence, an appropriate balance of licensed and of licence-exempt spectrum is needed to encourage both forms of innovation.
- 1.15 In summary, we remain fully committed to the provision of licence-exempt spectrum, but believe that it must be carefully balanced with the provision of licensed spectrum, taking into account the likely economic value under both approaches across a range of frequencies. Given that licence-exempt allocations are generally lightly used this suggests to us that there is currently no need to allocate more. However, this may change in the future and we will keep this issue under review.

### **Spectrum as a policy tool**

- 1.16 We also argued that spectrum should not be used as a policy tool. By this we meant that spectrum should not be set aside for particular applications in order to achieve a policy goal such as the provision of high definition television. Nor should additional licence conditions be placed on spectrum awards to achieve social objectives such as requirements to provide coverage to rural communities. This is somewhat different from the policy approach adopted by our predecessor, the Radiocommunications Agency and some other regulators and hence it is worth restating our thinking here.
- 1.17 Spectrum is an input to a process that delivers some end service. For example, spectrum is one input used by cellular operators in their delivery of a cellular telephony service. But spectrum alone is insufficient; operators also need staff, equipment, power, sites for masts and so on. If spectrum is provided in a manner that is designed to achieve policy goals – for example a larger allocation of spectrum in return for delivering coverage to rural communities – this tends to result in an overall reduction in the value that the economy derives from the spectrum.
- 1.18 The reason for this is that users of spectrum, such as operators, need to make trade-offs between all the different inputs they use. For example, it is generally possible to use less spectrum by building additional cell sites and installing additional equipment. Operators will tend to seek the optimum balance for themselves by selecting the point which minimises their costs while generating the outputs, or services, they believe necessary. However, if the price of spectrum is distorted, for example by being reduced in return for rural coverage, then they will make a different trade-off. With less expensive spectrum they will now choose to use more spectrum and less equipment in order to deliver the same output.
- 1.19 While this change in spectrum use will be desirable for the operator, it will be sub-optimal for the economy as a whole. Because the operator is using more spectrum than they would under a market approach, there is less spectrum available for other applications and the overall value that can be derived from the spectrum is lower. Given that spectrum generates in excess of £40bn per year of value to the UK economy, even a small percentage reduction in efficiency could have a very large financial value.

- 1.20 Economic theory is very clear that where a particular output is desired then any interventions to achieve this should, where possible, be made at the output stage, not at the input stage. Interventions made to inputs distort the market and result in a less efficient use of inputs, reducing the overall value to the economy. The true economic cost of spectrum is its opportunity cost – the use of spectrum for one technology or service typically denies its use for others and the opportunity cost reflects the loss to society of this option. Decisions on choice of inputs should respond to price signals that reflect economic cost.
- 1.21 Unfortunately, the use of spectrum as a policy tool is seductive. It appears to many that policy goals can be achieved “for free” through attaching conditions to spectrum since no direct funding is required from the Government, or other similar body. The alternative of direct subsidy requires often difficult budgetary discussions and enables scrutiny and analysis as to whether value for money is being achieved. Hence, for politicians, public interest bodies and others, using spectrum to achieve their goals rather than direct intervention can be seen as simpler to achieve and easier to explain.
- 1.22 However, as we have set out above, what appears to be a cost-free intervention will actually result in a cost to the economy, which may in some cases be many billions of pounds. This cost is not immediately apparent because it is in terms of benefits that will not be received in the future due to inefficient allocation of spectrum. Nevertheless, it is very real and can have a noticeable impact on consumers, citizens and the economy.
- 1.23 Intervention at the output stage also makes the cost of providing the public goal very clear which invariably makes for better policy discussion and decision than when that cost is hidden.
- 1.24 It is for these reasons among others that, for example, we consider the free provision of additional spectrum for high definition TV (HD-TV) is inappropriate from a spectrum management viewpoint. Although on the face of it, it appears to deliver HD-TV to society at apparently none, or little cost, this is not so, and the value lost due to preventing other applications could be substantial. In the same way that the broadcasters do not expect, nor receive, free employees or free broadcasting equipment, neither is it appropriate for them to receive free, or discounted spectrum.
- 1.25 In some cases we have inherited policy conditions attached to licences issued by previous regulators. We will consider carefully whether these conditions should remain in force, or should be removed, taking into account the effect that the change could have on optimal use of the spectrum, as well as other issues such as competition and the availability of services to citizens and consumers.
- 1.26 The key message is that while the use of spectrum to achieve policy goals is seductive in that it appears to allow worthy objectives to be achieved at no cost, this is far from the truth. It is likely to be more costly than intervention at the output stage and it results in less clarity as to the cost of achieving the objective. It should generally be avoided.



## Hoarding and speculation

- 1.27 We expect that as a market in spectrum becomes established we may see similar activities to those that occur in other markets, such as speculative acquisition. In general, we do not see this as a problem. For example, a speculator who conjectures that a new technology will shortly emerge and who buys spectrum but then leaves it unused as technology develops may increase the value derived from the spectrum. This is because, were it immediately put into use, it might prove more difficult to reform to the new technology with resulting loss in value to consumers. Speculators may also play useful roles in consolidating fragmented spectrum holdings or otherwise adding value to the market. Given that this kind of activity can be very beneficial to consumers, we do not generally propose to employ “use it or lose it” clauses which would limit licensee’s flexibility about when and how to use spectrum.
- 1.28 We do, however, need to be wary of the risk that the acquisition of spectrum could be anti-competitive. For example, an operator might acquire spectrum purely in order to prevent the entry of a new competitor. Given the already competitive nature of most wireless services and the increasing amount of spectrum available in a wide range of bands we do not expect to see this happening, but it is an important issue that we will consider carefully. If we believe that the risk is large enough then there are powers available to take appropriate action.

## Our vision

- 1.29 Based on this strategy, in the Spectrum Framework Review we set out a vision for spectrum which can be summarised as:

|  |
|--|
| <p style="text-align: center;"><b>The Ofcom Spectrum Vision</b></p> <ol style="list-style-type: none"><li>1. Spectrum should be free of technology and usage constraints as far as possible. Policy constraints should only be used where they can be justified;</li><li>2. It should be simple and transparent for licence holders to change the ownership and use of spectrum; and</li><li>3. Rights of spectrum users should be clearly defined and users should feel comfortable that they will not be changed without good cause.</li></ol> |
|--|

- 1.30 We noted that we would achieve this by:
- Providing spectrum for licence-exempt use as needed, but our estimates were that little additional spectrum would be needed in the foreseeable future, growing to 7 per cent of the total spectrum;
  - Allowing market forces to prevail through the implementation of trading and liberalisation where possible. We aimed to implement these policies in around 72 per cent of the spectrum; and
  - Continuing to manage the remaining 21 per cent of the spectrum using current approaches.

- 1.31 We noted that there would be circumstances when we could not fully achieve this vision. In these cases we promised that we would explicitly explain why we have departed from it.
- 1.32 We still believe this to be the correct vision and are not intending to change it at this stage.

## Section 2

# Benefits to date

### What has been achieved

- 2.1 Much has been achieved in the three years since the publications of the SFR Statement. In particular:
- Four auctions have been held (1781-1785MHz paired with 1876-1880MHz, 412-414MHz paired with 422-424MHz, 1785-1805MHz (Northern Ireland only) and the set of 10GHz, 28GHz, 32GHz and 40GHz).
  - Three major auctions are well in train (“L-Band”, the “2.6GHz” band and the digital dividend).
  - Spectrum Usage Rights (SURs), our proposals for technology-neutral licensing have been progressed to the point of being implemented in an auction.
  - Ultra-wideband (UWB) has been enabled on a licence-exempt basis.
  - Spectrum trading has been implemented across a range of licence classes and a number of trades have occurred.
  - A number of licences have been varied to allow greater flexibility.
  - The introduction of trading and liberalisation to the “2G” spectrum bands has been identified as problematic, possible solutions have been developed and a consultation held.
  - The “Cave Audit” considering mechanisms to introduce market forces to Governmental spectrum holdings has been completed, the recommendations generally accepted by Government and Ofcom, and Ofcom has participated in substantial work to help turn the recommendations into reality.
- 2.2 These key advances have been achieved against a background of continual management activity including:
- Working within the European Union on a wide range of initiatives.
  - Taking part in key regional and international spectrum conferences which have delivered important agreements for the UK.
  - Simplifying and issuing a wide range of licences.

### Citizen and Consumer benefits

- 2.3 The value that the UK derives from the use of radio spectrum is estimated to have risen from approximately £28bn in 2002 to around £42bn in 2006. This value has predominantly been realised by consumers in increased consumer surplus from using mobile phones and consuming broadcast entertainment. It is clear that the benefits afforded by spectrum are substantial and growing fast.

- 2.4 Without a counter-factual case it is difficult to say how much of this would have occurred under different spectrum management regimes. In practice, it may be rather too early to see significant benefits from our reforms. This is because:
- We are mid-way through the implementation of our market-based approach and as we discuss below have yet to apply it to some of the most valuable spectrum.
  - Changes in spectrum management policies often take 5-10 years to have a major impact since it typically takes this long to acquire spectrum, construct a network and build a substantial subscriber base. For example, the benefits of the 3G auctions in 2000, in spectrum identified internationally in 1992, are only now in 2008 having a significant impact on the overall value of spectrum to the economy.
- 2.5 As we discussed in the Impact Assessment published with the SFR, it is very difficult to predict quantitatively the impact that our reforms will have because they aim to allow increased competition and innovation – the specific outcomes of which are very hard to foresee. However, our expectation is that the increased flexibility afforded by market mechanisms will allow a wider range of new ideas and services to be introduced and for their introduction to be more rapid than would otherwise be the case. This will bring benefits to consumers in terms of greater choice and more competition. For example, the flexibility we are offering in the “L-Band” auction will allow a wide range of different services and networks to be deployed including mobile TV, mobile multimedia, enhanced cellular services and more. Without such flexibility it might be that only a single service could be offered, restricting choice and competition.

### Section 3

## Progress and revised plans

### Introduction

3.1 This section looks at each of the areas identified in the SFR as being important components of our overall spectrum management programme. It compares progress with that predicted in the SFR and where appropriate provides revised plans and timescales.

### Spectrum release

3.2 The SFR and its accompanying document the SFR Implementation Plan (SFR-IP) set out the auctions that we planned to conduct as shown below.

**Table 3.1 : Auction plan as set out in the SFR:IP**

| <b>Bands below 3GHz</b>  | <b>2005-2006</b> | <b>2006- 2007</b> | <b>2007-2008</b> |
|--|------------------|-------------------|------------------|
| 1781-1785 MHz/1876-1880 MHz<br>(GSM/DECT guard bands)              | •                |                   |                  |
| 2290-2302 MHz  | •                |                   |                  |
| 2010-2025 MHz  | •                |                   |                  |
| 410-415 MHz/420-425 MHz, 872-876 MHz/917-921 MHz (Ex-Inquam bands) | •                |                   |                  |
| 2500-2690 MHz  |                  | •                 |                  |
| 1452 -1492 MHz (L Band)  |                  | •                 |                  |
| 1790-1798 MHz  |                  |                   | •                |

3.3 In practice many of these auctions have taken longer than we had foreseen, for a range of reasons. Broadly these have either been because we needed to await a key EC decision, for example on whether the band was to be designated for a particular use, or because we discovered additional use of the band, often by Government agencies that required investigation. Four auctions have been completed successfully and we intend to auction almost all the bands set out in the SFR:IP within the following modified timescale. In addition, we intend to auction the spectrum liberated through digital switchover (the “digital dividend”). Our revised plan and timetable is shown below.

**Table 3.2 : Revised auction plan**

| <b>Bands below 3GHz</b>                               | <b>Date completed</b> | <b>FY 2008-2009</b> | <b>FY 2009-2010</b> |
|---|-----------------------|---------------------|---------------------|
| 1781-1785 MHz/1876-1880 MHz<br>(GSM/DECT guard bands) | May 2006              |                     |                     |
| 2010-2025 MHz   |                       | •                   |                     |
| 410-415 MHz/420-425 MHz                               | Oct 2006              |                     |                     |
| 872-876 MHz/917-921 MHz                               |                       | •                   |                     |
| 2500-2690 MHz   |                       | •                   |                     |
| 1452 -1492 MHz (L Band)                               |                       | •                   |                     |
| 1790-1798 MHz   | May 2007              |                     |                     |
| 10, 28, 32 and 40GHz                                  | Feb 2008              |                     |                     |
| Digital dividend (multiple awards)                    |                       | •                   | •                   |

3.4 While we will work hard to achieve these revised timescales, there remain risks that actions outside our control, such as activities within the EU, might cause delay.

### Trading

3.5 In the SFR we said that we would change the balance of spectrum management methods as follows:

**Table 3.3: Change in spectrum below 3GHz as set out in the SFR<sup>5</sup>**

|             | <b>Command &amp; Control</b> | <b>The Market</b> | <b>Licence Exempt</b> |
|-------------|------------------------------|-------------------|-----------------------|
| <b>1995</b> | 96%                          | 0%                | 4%                    |
| <b>2000</b> | 96%                          | 0%                | 4%                    |
| <b>2005</b> | 69%                          | 27%               | 4%                    |
| <b>2010</b> | 22%                          | 74%               | 4%                    |

**Table 3.4: Change in spectrum between 3GHz and 60GHz as set out in the SFR**

|             | <b>Command &amp; Control</b> | <b>The Market</b> | <b>Licence Exempt</b> |
|-------------|------------------------------|-------------------|-----------------------|
| <b>1995</b> | 96%                          | 0%                | 4%                    |
| <b>2000</b> | 95%                          | 0%                | 5%                    |
| <b>2005</b> | 31%                          | 61%               | 8%                    |
| <b>2010</b> | 21%                          | 69%               | 10%                   |

3.6 Our view was that a band of spectrum could be classified as managed by the market if trading had been implemented although we would also aim to liberalise the spectrum as far as possible. Hence, the tables were based in part on the information in the Spectrum Trading Statement which predicted the introduction of trading as follows:

<sup>5</sup> For the figures in this and subsequent tables we have used a weighting method whereby the bandwidth available is divided by the centre frequency. This gives equal weighting, for example, to 10MHz bandwidth in the 100MHz band as to 100MHz bandwidth in the 1GHz band. Note, also that these figures are only approximate because in many cases there is shared use of bands and it is not possible to definitively allocate the spectrum usage between the sharers.

**Table 3.5 : Trading timetable as set out in the Trading Consultation**

| 2004                      | 2005  | 2006               | 2007  | beyond  |
|---------------------------|---|--------------------|---|---|
| Analogue PAMR             | Wide area PBR, on-site PBR and digital PAMR | Emergency services | 2G & 3G mobile<br><br>Aviation & Maritime communication and radar | Mobile satellite and satellite shared with terrestrial services<br><br>Radio broadcasting and television broadcasting |
| National paging           |   |                    |   |   |
| Data networks             |   |                    |   |   |
| National and regional PBR |   |                    |   |   |
| Common Base station       |   |                    |   |   |
| Fixed wireless access     |   |                    |   |   |
| Fixed                     |   |                    |   |   |

3.7 In practice, as with spectrum release, it has taken longer than expected to implement trading in some licence classes. In part the delays relate to the need to align implementation with a major upgrade of our IT infrastructure which is currently underway. In addition, 2G liberalisation has proven more complex and time-consuming than we originally expected.

3.8 We have implemented trading to all the classes proposed for 2004. Our plans for the implementation of the remaining classes are as follows.

**Table 3.6 : Revised trading timetable**

| 2008  | 2009  | beyond  |
|---|---|---|
| Wide area PBR, on-site PBR and digital PAMR | Aviation & Maritime communication and radar | Mobile satellite and satellite shared with terrestrial services |
| Emergency services                          | Completion of 2G and 3G mobile              | Radio broadcasting and television broadcasting                  |
| Commencement of 2G and 3G mobile            |   |   |

3.9 In addition, we have made the licences awarded in the four auctions held to date tradable and also the licences in the 71-76GHz/81-86GHz bands (awarded on a first-come first-served basis). We will continue to make auctioned licences tradable as far as possible.

3.10 Broadcasting represents a substantial part of the spectrum by value, but it is a complex area given the way in which this spectrum was originally distributed and the other obligations that apply to most licence holders. We intend to study this area in more detail in the coming year and hope to set out our thoughts on appropriate levels of implementation of trading and liberalisation to this sector in due course.

3.11 As recognised in the initial SFR consultation, the international nature of satellite services and the fact that frequencies are harmonised internationally limits the scope for allowing change of use in the UK. We do not, therefore, have any current plans for bringing forwards proposals for trading and liberalisation.

- 3.12 As a result of the delays identified above, the SFR targets will not all be met, and we propose to revise them as shown below.

**Table 3.8 : Revised timetable for the implementation of market mechanisms<sup>6</sup>**

|        |                   | Predicted<br>in the<br>SFR | Current<br>position | Revised<br>prediction for<br>2010 |
|--------|-------------------|----------------------------|---------------------|-----------------------------------|
| 0-3GHz | Licence-exempt    | 4%                         | 4%                  | 4%                                |
|        | Market mechanisms | 66%                        | 27%                 | 54%                               |
|        | Command & Control | 29%                        | 68%                 | 41%                               |
| 3GHz+  | Licence-exempt    | 10%                        | 10%                 | 10%                               |
|        | Market mechanisms | 69%                        | 61%                 | 66%                               |
|        | Command & Control | 21%                        | 29%                 | 24%                               |

- 3.13 The table shows we will not meet our SFR objectives for 2010, particularly below 3GHz, mostly as a result of it being unlikely that broadcast spectrum, which contributes 13%, will be tradable by that time. Nevertheless, we intend to achieve the percentages set out in the SFR for 2010 in due course.

### Spectrum markets

- 3.14 As of November 2007, the number of trades recorded were as follows:

**Table 3.7 : UK trades recorded to date**

| Licence class                     | Licences on<br>issues as at 31<br>March 2007* | Licences<br>traded | Percentage of<br>licences traded in<br>licence class since<br>trading began |
|-----------------------------------|---|--------------------|---|
| Fixed links                       | 365   | 7                  | 2%  |
| Business Radio CBS                | 563   | 3                  | 1%  |
| Broadband Fixed Wireless Access   | 14  | 6                  | 43%   |
| Business Radio Public Mobile Data | 4   | 1                  | 25%   |
| Concurrent spectrum access        | 12  | 1                  | 8%  |

- 3.15 Some of these trades were “administrative”, for example transferring licence holdings within a group of companies or occurring as a result of corporate takeovers, but nevertheless, there is value even in these forms of trading.
- 3.16 It is not easy to determine whether the amount of trading activity to date is “appropriate” or whether there are factors hindering market activity. This is because there is insufficient experience around the world as to what the appropriate levels of activity are. In assessing the success of markets to date relevant factors include:
- The amount of activity on the introduction of trading will depend on the degree to which spectrum was inappropriately assigned before trading was introduced. If assignments were generally appropriate then limited trading might be expected.

<sup>6</sup> Note that these percentages do not take account of any spectrum that might be returned to the private sector from Government bodies as discussed later in this section. We would generally expect returned spectrum to be released in a liberalised manner.



- Although trading has been rolled out across a number of licence classes, and a very large number of licences, these are not the licences that generate the greatest economic value to the UK economy – much of that comes from mobile and broadcast usage. Indeed, by economic value, trading has so far only been applied to around 12% of spectrum when measured by the economic value generated.
- It takes some time to change spectrum usage, particularly where infrastructure is involved. Hence, it might be many years from the introduction of trading before licence holders are in a position to make changes to their spectrum use.
- The secondary market for spectrum might be expected to be depressed while there is substantial primary market activity – ie auctions. With large amounts of spectrum coming into the market as indicated above then there is both less need to obtain spectrum by trading and more risk that the amount paid under trading will prove inappropriate as market values change with increased supply.

3.17 With our awards programme predominantly completing in 2009 at which point we also expect to have extended trading to most other licence classes it might therefore be expected that the secondary market will become more important beyond 2009. We anticipate that such a market might be enhanced by:

- The provision of as much information as possible including, where relevant and practical, information on the price of auctions or trades where known, information on band ownership and information on usage constraints relevant to the band.
- The availability of a “broker” who can assist in bringing together parties wishing to buy and sell spectrum (the equivalent of an “estate agent” for housing).
- The use of band managers in certain bands.
- The simplification of trading procedures where possible.

3.18 We would hope that some of these functions would be provided by commercial entities but equally there is likely to be a role for Ofcom to play. We will investigate further and take appropriate action during 2008 and 2009.

## **Liberalisation**

3.19 By liberalisation we mean the removal of licence terms that restrict the licence holder to particular technologies or applications. Liberalised licences are both technology and usage neutral. Liberalisation is a critical part of our spectrum management framework. Without the ability for licensees to change the use they make of the spectrum, the application of market forces will be severely limited and regulatory interventions will continue to be needed. A study conducted for the EC estimated that of the benefits arising from increased flexibility around 11% were due to trading but 89% to liberalisation.

3.20 We identified a number of actions that we would take to achieve liberalisation including:

- Awarding new licences on a technology and usage-neutral basis. This has been achieved in each of the Ofcom spectrum auctions to date.

- Amending the terms of existing licenses to remove restrictions. This has also been done in a number of cases.
- 3.21 One part of our approach to liberalisation as set out in the SFR was to create a new type of licence conditions called spectrum usage rights (SURs). These bring substantial advantages over existing licence types because they directly regulate the interference that a licence holder can cause to others, rather than indirectly regulating this through limiting transmitter power or other similar restrictions. In particular, in an environment where change of use is allowed, a licence holder might change from say a PBR usage to a cellular usage, with dramatic increase in base station density and commensurate large increases in interference caused to neighbours (indeed, this is broadly what happened with Nextel causing excessive interference to public safety applications in the US). Under existing licence conditions there would be no restrictions to prevent this, whereas under SURs the increased interference would only be allowed to a point below which it was significant. This would prevent neighbours suffering problematic increases in interference while at the same time permitting the maximum flexibility within this interference limit.
- 3.22 SURs were first discussed in the SFR. Following from the SFR we undertook a more detailed study into SURs during 2005 and then published a consultation in 2006. This led to SURs being proposed for the L-Band auction in 2008. A statement on SURs was issued in 2007.
- 3.23 We now consider SURs to be developed to the point that they can form part of our “toolkit” for spectrum licensing although the application of SURs to any particular case may require some further specific work. In general, we will offer an option to use SURs in auctioned spectrum but will also consider any request from stakeholders to use alternative approaches and will consider each auction on a case-by-case basis. We will also give consideration to any licence holder that wishes to change the terms of its licence to SURs although we will generally not impose a change of licence terms to SURs for existing licence holders who prefer their current form of licences.

### **Licence-exemption**

- 3.24 In the SFR we made a number of suggestions concerning licence-exempt (LE) applications.
- 3.25 The first of these was the supply of an additional 250MHz of spectrum for LE, perhaps at 5GHz. We said that we would monitor the usage of the 5GHz band in order to predict when demand in the band might exceed capacity and that once it was clear that this was likely to happen at some predictable point in the future, we would conduct an economic study to assess whether more spectrum should be made available for licence-exempt use and act accordingly. As discussed earlier, we have conducted the first such measurements. These show that there is currently very little use at 5GHz and hence no likelihood in the foreseeable future of demand exceeding supply. For this reason we have decided not to licence-exempt any additional spectrum in the 5GHz band at present.
- 3.26 The second suggestion was to allow the use of higher powers in rural areas where it was thought that the possibilities of interference were lower while there might be benefits from the greater range that would result. We said that during 2005 we would conduct a detailed study into how this might be implemented and how interference with existing users would be avoided and that we would consult on detailed proposals early in 2006. We did this, and concluded that allowing increased powers was not appropriate because the benefits were limited while the risks were great that

high power devices would migrate out of rural areas and cause significant problems to LE users in urban areas.

3.27 The third set of suggestions was around simplifying a range of licences.

- With regard to Maritime ship radio licensing, after discussions with the MCA and relevant stakeholders, we held a consultation in February 2005 proposing free ship radio licences valid for the life of the vessel. We issued a policy statement in December 2005 based on our proposals. Implementation of the reformed licensing regime commenced in December 2006.
- With regard to aeronautical licensing, we held a series of meetings with the CAA on how best to reduce the regulatory burden. Work was then deferred in light of the project to implement the Government response to the (Cave) Independent Audit of Spectrum Holdings. Depending on the outcomes of the Cave programme we will revisit the best way to achieve this objective.
- With regards to on-site business radio, we consulted on this in summer 2006 and published a statement in January 2007 covering the whole of the business radio reforms. This year we are introducing a light licence category for pre-select devices, on-site systems with a base station and terminal to terminal systems. The licence costs £75 and has a 5 year term.
- With regards to CB radio, a consultation proposing to make CB (and also CADS) exempt from the need for a Wireless Telegraphy Act licence ended in September 2006. A second consultation on the draft WT Act Exemption Regulations closed during November 2006. CB radio equipment became WT Act licence exempt in December 2006.

3.28 In addition, we have given detailed consideration to the optimal manner to structure and manage LE bands, culminating in the publication of the Licence Exempt Framework Review (LEFR) in November 2007. We are now taking forwards the ground-breaking proposals included within the LEFR including opening up much of the frequency bands above 60GHz to LE usage, establishing a “noise floor” below which LE usage is permitted and enhancing the efficiency of LE use through so-called politeness protocols.

## European and Global issues

- 3.29 Our long-stated preference has been to lead the way in spectrum reform, but also to work closely with other regulators. It seems likely that if market reforms were only implemented in the UK this would significantly restrict the value that they could deliver. This is because if a change of use were made in the UK it might not be possible to make that same change in other countries, resulting in reduced economies of scale and a lack of roaming. However, if most countries implemented market mechanisms then the market could engineer a change of use and ownership as necessary across as many countries as needed.
- 3.30 In 2004, when we published the SFR, market mechanisms had been introduced in varying degrees in Australia, New Zealand the US and Guatemala.
- 3.31 In the last year there have been indications of further movement towards market mechanisms. Canada has recently announced a review which has the intention of introducing property rights. The European Commission has also pursued flexible spectrum management through its WAPECS initiative, its recent mandate to CEPT to

develop flexible licensing approaches and its proposals to reform spectrum management across the EU following its review of the regulatory framework for electronic communications. This in turn has led to greater flexibility in a range of European countries.

- 3.32 The EU approach is particularly significant to us. This is because:
- The EU creates a framework for applying market mechanisms across 27 Member States, including some of the largest developed economies in the world.
  - The EU can have direct control over our policies.
  - We have an opportunity to influence EU players (i.e. the Commission, other Member States and the European Parliament).
- 3.33 We have been active in the EU since the formation of Ofcom, including chairing the RSPG committee for a year and this work has brought many benefits. We will continue to work within the EU and with any other interested spectrum managers to ensure that market-mechanisms are implemented on a similar basis across as wide a geographical area as possible.

### Public sector spectrum

- 3.34 After the publication of the SFR, the Chancellor requested Professor Martin Cave to conduct an audit of public sector spectrum holdings – the “Cave Audit”. This looked predominantly at spectrum used by the MoD, civil aviation and maritime sectors.
- 3.35 Ofcom worked closely with Professor Cave and his team during the audit and since then has invested substantial time and resource in implementing its recommendations. While the Audit had many recommendations the over-riding objective was to encourage more efficient spectrum use.
- 3.36 Many public sectors users of spectrum operate under Crown immunity and have no spectrum licence. This makes it impossible for these bodies to trade spectrum, as their rights and obligations to use the spectrum are not codified and so cannot be transferred to others. Professor Cave recommended that Crown bodies should be granted Recognised Spectrum Access (RSA). This is akin to a licence and specifies the rights and obligations which can be traded and converted to a licence when transferred to non Crown bodies. Ofcom expects to consult on Regulations to enable it to grant Crown RSAs during Spring 2008 and expects to grant the first Crown RSA around the end of the year.
- 3.37 Among the incentives recommended by Professor Cave was the extension of administrative incentive pricing (AIP) to a wider range of Governmental holdings. Ofcom is in the final stages of agreeing modified AIP levels with the MOD and will consult during spring 2008 on the extension of AIP to the civil aeronautical and maritime sectors. The MOD, which has faced AIP for some years, is preparing plans to dispose of more spectrum.
- 3.38 Ofcom issued a Statement in January 2008 on a framework to define public sector spectrum usage rights and allow Government to release spectrum direct to the market.
- 3.39 Greater use of bandsharing was a major recommendation from the Audit and Ofcom has sponsored a range of trials and studies to demonstrate the conditions under

which bandsharing could work. It is now the responsibility of the Government departments which may benefit from spectrum trading to take this work forward. Use of private sector partners (band managers) is being actively considered by a number of departments.

## Section 4

# Future plans

### We will continue with our existing strategy

- 4.1 Three years into the process of implementing the SFR we remain convinced that the approach we set out there is the most appropriate for managing radio spectrum. We have not seen any evidence to persuade us to change our approach, nor have we encountered any issues or difficulties which have made our approach unworkable.
- 4.2 However, across many of the initiatives we have pursued we have discovered that implementing our agenda was more difficult than we had initially envisaged. The reasons for this are many and varied, but often stem from the complexity of the existing use of spectrum. For example, in preparing spectrum for auction we have sometimes encountered more difficulty than expected in obtaining and defining details of public sector usage, or found that detailed work is needed on the relationship to usage in adjacent bands. The potential impact of some of our proposals on competition has also required careful attention, as evidenced, for example, in our consultation on 2G liberalisation. International developments have also been a factor. It has been necessary in some cases to bring about a change in the international regulatory framework. It is for these, and other, reasons that we are moving somewhat more slowly than we had envisaged in the SFR – *but on the same course and with the same destination*.
- 4.3 The last three years have seen many important items of work that underpin the remainder of our agenda. We have set in place most of the pieces that we need to complete our spectrum release programme, have developed and implemented SURs and have made significant progress on international issues. This makes us confident that we will be able to complete the SFR agenda.
- 4.4 Equally, we are not complacent. There are some very significant challenges ahead, including liberalising broadcasting, completing the liberalisation of mobile and creating an active trading environment. We have learned the lesson of the last three years and do not expect these to be completed quickly, despite our best endeavours.

### How we see the future usage of spectrum

- 4.5 We believe, and many of our advisors agree, that spectrum might become less scarce in the future. There is more than enough spectrum for almost any applications that can be envisaged, the problem at the moment is that this spectrum is not always held by those best placed to make use of it to meet user needs.
- 4.6 This is evidenced by the dramatic changes in price paid for spectrum which has very similar physical characteristics – an indication of the scarcity of spectrum for some applications compared with the relative abundance for others.
- 4.7 Our hope is that the widespread application of market forces will eventually address this situation. Those who do not value spectrum so highly can trade it to those that do. As spectrum is liberalised it can be moved from one application to another, reducing the change in value of spectrum in the same band. This could, for example, result in much larger allocations to mobile applications, enabling very high bandwidth services. Equally, we are pragmatic in understanding that it takes many years, sometimes decades, for bands to be opened, new standards to be developed and

networks to be deployed. That, of course, is no reason not to continue on this path and we will strive to bring forward the benefits to society of more efficient spectrum allocation and use as quickly as possible.

- 4.8 Overall, it is clear that there is tremendous scope for wireless services to revolutionise our lives but only if spectrum can be made available in sufficient quantity and at a low enough cost. We believe that it can, and that the route set out in the SFR is the best way to enable this vision.