OFFICE OF COMMUNICATIONS

# Award of available spectrum: 1452 – 1492 MHz

The document consults on the proposed grant of wireless telegraphy licences to use this spectrum and on the associated auction process

Consultation

Publication date: 31 March 2006

Closing Date for Responses: 9 June 2006

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## Section 1

# Executive Summary

1.1 As part of Ofcom's plans to implement its strategy of ensuring optimal use of the radio spectrum it has developed a programme of awards of wireless telegraphy licences that is designed to put unused or under-used spectrum into the market. One such award is of wireless telegraphy licences for the spectrum band 1452 – 1492 MHz.

1.2 This consultation sets out in detail Ofcom's proposals for the award of wireless telegraphy licences to use these frequencies, in the light of responses it received to the Spectrum Framework Review: Implementation Plan consultation document published in January 2005[1] and the October 2003, Opportunities for Future Use of Spectrum within VHF Band III (174 to 230 MHz) and in the 1.5 GHz Band (1452 to 1492 MHz[2]) consultation.

## Demand assessment

1.3 The spectrum available for award is 40 MHz (1452 - 1492 MHz). Less than 100 fixed links are still operating in this spectrum band, as well as some PMSE users. These users have been given notification to vacate this band by 31 March 2007, making the band available for alternative use from April 2007.

1.4 This spectrum has particular importance due to the wide range of potential uses that the band could be put to. This includes new services such as mobile multimedia (using standards like DVB-H or DMB) and broadband wireless access (using technologies such as TDD-IP and WiMAX). Terrestrial digital broadcasters (T-DAB) might also be interested in this band, as well as those seeking to provide programme-making and special events (PMSE) services such as digital wireless cameras. Finally, satellite digital radio (S-DAB) services may be deployed in the upper 12.5 MHz of this band (1479.5 – 1492 MHz). Given the wide range and variety of the potential services that could be deployed, and consistent with Ofcom's established policy for spectrum release, technology and service neutrality will be key principles in this award.

1.5 There is a limited amount of other spectrum that may be made available to the market over the coming years that could be used to provide one or more of the services listed above. Ofcom will seek to provide additional information on the availability of other bands before this spectrum band is released for use. In particular, Ofcom's ongoing Digital Dividend Review (DDR) project is examining the options arising from the release of spectrum afforded by the digital switchover programme.

## International constraints

1.6 Several international arrangements are relevant to different parts of this band, most notably:

[1] http://www.ofcom.org.uk/consult/condocs/sfrip/sfip/?a=87101
[2] http://www.ofcom.org.uk/consult/condocs/ra_rau/

- 1452 – 1479.5 MHz: the CEPT Maastricht 2002 Special Arrangement ("the Maastricht Plan") provides an allotment plan for T-DAB. The Maastricht Plan gives the UK the right to deploy T-DAB services in this band, but also requires us to protect T-DAB services in neighbouring countries. These rights do not currently extend to services and technologies other than those that meet the definition of T-DAB (or T-DAB variants including T-DMB and DAB-IP), resulting in limited rights to use other technologies (or to demand interference protection for these).. However the plan does not prevent deployment of other technologies subject to international coordination.

- 1479.5 – 1492 MHz: the ITU Radio Regulations require us to protect reception of registered satellite radio services in neighbouring countries. At least five such satellite networks are notified (or pending notification), resulting in material constraints on terrestrial use in this sub-band across much of the UK.

1.7 As they stand, these international arrangements will impose material constraints on the use of this spectrum band. However, Ofcom considers that not all of these constraints are necessary or justified to achieve the internationally-shared goal of efficient use of the spectrum. Ofcom therefore intends to engage in discussions with the UK's international neighbours, with the aim of agreeing less restrictive arrangements. This would create a more certain framework within which a wider range of technologies and services could be deployed.

1.8 In the light of other initiatives in Europe, Ofcom considers that there is a reasonable chance of success in these discussions. But the outcome plainly cannot be guaranteed, and the timetable for the completion of these discussions is also uncertain.

1.9 However, Ofcom considers that, even if these discussions are not successful, the release of this band would represent a significant opportunity for the deployment of new or expanded services providing significant benefits to citizens and consumers in the UK. New mobile multimedia services could, for example, be deployed within the existing international agreements, using standards such as DMB or DAB-IP that fit within the specifications used in the Maastricht Plan.

1.10 Ofcom considers that, whether or not the existing constraints in the Maastricht Plan are relaxed, it would be possible to use each of the frequency blocks covered by that plan on a UK-wide basis. It would not, in particular, be necessary for use to be based on the pattern of local multiplexes, and frequency re-use, provisionally planned in 2002 (some constraints on geographic coverage within the footprint of the UK may however still arise as a result of incoming or outgoing interference constraints; these are discussed in this document).

## Overview of the key proposals

1.11 Ofcom proposes, subject to the outcome of the current consultation, to award national wireless telegraphy licences to use the spectrum band 1452 – 1492 MHz as soon as practically possible. Ofcom's aim is to award licences by the end of the financial year 2006/07. Ofcom plans to make all 40 MHz available to the market through this process.

1.12 Four options for the packaging of the lower 27.5 MHz (1452 – 1479.5 MHz) are put forward in this consultation. Specifically:

- dividing the spectrum into 16 lots of 1.7 MHz (in line with the Maastricht Plan);
- dividing the spectrum into five lots of 5.1 MHz and one lot of 1.7MHz ;
- dividing the spectrum into varied-sized lots; and
- offering the spectrum as one 27.5 MHz block

1.13 It is proposed that the upper 12.5 MHz (1479.5 – 1492 MHz) be awarded as one spectrum block (due to the requirement to protect potential foreign satellite networks which may be deployed across the entire sub-band);

1.14 It is proposed that the key elements of the licensees' rights and obligations for the spectrum to be auctioned should be as follows:

- The licences should have an indefinite term with a minimum period of 15 years (during which time Ofcom's powers to revoke will be limited);
- The licences should be tradable;
- The licences should be technology and application neutral (though some technical constraints on use may exist as a result of the need to respect international arrangements);
- The licences should contain transmission rights including limits on aggregate field strength at defined points outside the UK (in order to comply with the Maastricht Plan); and
- The licensees should be required to agree criteria and procedures for the mutual coordination of transmitter location between themselves

1.15 It is proposed that the licences would be awarded by auction. Ofcom considers that a simultaneous multiple round auction (SMRA) design is likely to be the most appropriate for the award of this spectrum band.

1.16 An SMRA can be more or less complex, depending on the specific rules created for the award. Ofcom has identified two SMRA formats that may be most suitable for this award:

- an SMRA with augmented switching rules; and
- an SMRA with limited packaging.

1.17 Ofcom plans to study both formats in further detail and consider comments received in response to this consultation prior to deciding on a preferred approach.

## Detailed summary of Ofcom's proposals

1.18 The table below sets out in summary form Ofcom's proposals for this award.

| International and timing | Ofcom proposals |
|---|---|
| Maastricht 2002 | Ofcom will seek more flexibility in the international arrangements |

| | |
|---|---|
| Special Arrangement | through discussions with our international neighbours.<br>If additional flexibility cannot be achieved, Ofcom expects to proceed with the award within the framework set by existing international agreements. |
| Timing of award | All the spectrum between 1452 and 1492MHz will be awarded at the same time and as soon as practically possible. This implies simultaneous award of the top 12.5MHz and the lower 27.5MHz of this spectrum. |
| **Spectrum packaging** | **Ofcom proposals** |
| 1479.5-1492MHz | The upper 12.5MHz (i.e. 1479.5-1492MHz) should be packaged for award as a single block. |
| 1452-1479.5MHz | Four options for the packaging of the lower 27.5 MHz (1452 – 1479.5 MHz) are put forward in this consultation:<br>• dividing the spectrum into 16 lots of 1.7 MHz (in line with the Maastricht Plan);<br>• dividing the spectrum into five lots of 5.1 MHz and one lot of 1.7MHz ;<br>• dividing the spectrum into varied-sized lots; and<br>• offering the spectrum as one 27.5 MHz block. |
| **Wireless Telegraphy rights and obligations** | **Ofcom proposals** |
| Licence term | The licence will have an indefinite duration, with a minimum term of 15 years during which Ofcom's powers to revoke will be limited. Ofcom will have the power to revoke for spectrum management reasons on not less than 5 years' notice after the minimum period, which could lead to the licence being terminated the day after the expiry of the 15 year minimum period or any time thereafter. |
| Licence fees | If there is only one application for spectrum in the band, the fee payable for the licence will be the aggregate reserve price for the spectrum lots that the applicant requests. Otherwise the auction will determine the fee payable. After the expiry of the minimum period, if the licensee continues to hold the licence, there may be additional charges in line with Ofcom's policy on spectrum pricing at that time. |
| Spectrum trading | The licence will be tradable. All types of trade - partial or total; concurrent or outright - will be permitted. |
| Liberalisation | The licences will contain the minimum necessary technical conditions and will not specify either the technology to be used or the services that may be offered. |

| | |
|---|---|
| Technical conditions | These are intended to be the minimum necessary to:<br>a) ensure compliance with international agreements; and<br>b) ensure effective use of the licensed frequencies, controlling interference between different licensed services.<br>The technical conditions will comprise a constraint on use defined by reference to a spectrum mask.<br>Rights to use the frequency will be on a national basis within the defined frequency range of the licence. |
| **Award mechanism and rules** | **Ofcom proposals** |
| Auction format | The auction format will be a simultaneous multiple round auction with specific lots and with either:<br>• augmented switching rules i.e. with rules that facilitate switching between lots; or<br>• limited combinatorial bidding: i.e. the ability to make package bids for triples of lots. |
| Eligibility rules | Each lot in the auction will have an associated number of eligibility points.<br>Bidders ability to make bids for multiple licences would be constrained by their eligibility, which in turn is determined by their bidding activity over multiple rounds |
| Reserve price | Ofcom will set a reserve price above zero for each individual lot. The reserve prices will also determine the initial prices for lots under either auction format. |
| Deposits | Ofcom will set an initial level of deposit per eligibility point. Each bidders' initial eligibility will thus be determined by the level of deposit that they have paid before the auction.<br>A mechanism will be introduced to ensure that bidders increase their deposits in a way that reflects their aggregate bid levels at set points during the auction. |
| Payment terms | Winning bidders will be required to pay 100% of the fee for their licence by a specified time and the licences will only be issued after payment has been received. |
| Transparency | The auction will be fully transparent. Comprehensive information about the number, amount and type of bids on each lot will be released after each round. In addition, bidders will able to monitor the identity of all other bidders and the bids they made. |
| Pace of the auction | Rules will be deployed to give Ofcom flexibility in managing the pace of the auction |

| | |
|---|---|
| Prohibitions on bidder association and collusion | There will be specific rules to prohibit collusion and bidder association. |
| Limits on applying for spectrum | There will be no restrictions on the number or identity of lots that an eligible bidder can bid for, other than as determined by their initial deposits |

*Question: Do stakeholders agree with these proposals for the award of this band or have any other comments on the contents of this document?*

## Next steps

1.19 This consultation closes on 9 June 2006. Ofcom plans to hold a seminar on its proposals for interested parties during the consultation.

1.20 Subject to the outcome of the discussions with international neighbours and the outcome of this consultation, Ofcom expects to publish the following key documents during the course of 2006.

- a short statement on this consultation;
- an Information Memorandum, describing in detail the relevant information for the award such as the award procedure and rules, prospective licence conditions and other information likely to affect use of the band;
- draft regulations setting out the auction rules;
- draft regulations to allow trading of these licences.

1.21 Ofcom will consider any comments it receives on the draft auction regulations before finalising them. The regulations will then be made to allow Ofcom to hold the auction. Before the auction is held Ofcom expects to hold a further "question and answer" seminar for interested parties, in particular on the rules for the auction.

1.22 As noted above, Ofcom is currently progressing work on the release of other spectrum bands, including through the DDR. One issue being considered within the DDR is the timing for potential auction of frequencies in the UHF band. This includes 590-598MHz (channel 36), which it may be possible to release to the market earlier than other frequencies in UHF. Ofcom will consider the relationship between the timing of the auction of the spectrum band discussed in this document, and of the spectrum bands considered in the DDR, as work is taken forward on both projects.

1.23 Ofcom intends to proceed with this award in the first quarter of 2007. This timescale is subject inter alia to the outcome of this consultation and the outcome of discussions with the UK's international neighbours.

## Section 2

# Introduction

2.1 Around Europe and around the world, interest in mobile multimedia and in particular mobile TV is increasing, satellite radio services in the US are seeing rapid take up and growing interest in sporting events is driving demand for portable wireless television cameras. These services all need suitable spectrum. The spectrum band that is the subject of this award potentially gives operators the ability to provide these and other services in the UK.

2.2 This document consults on Ofcom's plans for awarding wireless telegraphy licences with rights to use 40 MHz of spectrum between 1452 and 1492MHz.

2.3 The proposals follow two previous consultations. The most recent of these is Ofcom's Spectrum Framework Review: Implementation Plan (SFR: IP). The SFR:IP was issued on 13 January 2005, and consulted on initial proposals to make a significant number of spectrum bands available to the market over the next few years, including 1452-1492 MHz. That consultation closed on 24 March 2005. The previous consultation was a joint Radiocommunications Agency/Radio Authority consultation, Opportunities for Future Use of Spectrum within VHF Band III (174 to 230 MHz) and in the 1.5 GHz Band (1452 to 1492 MHz) (the RA/RAu consultation). The RA/RAu consultation was published in October 2003 and briefly considered possible uses for this band, alongside a more detailed discussion of VHF Band III. That consultation closed in January 2004. The responses to both those consultations have been taken into account in preparing this consultation, are discussed at various points in the document and summarised in annex 5.

## Ofcom's approach to spectrum management

2.4 The proposals outlined in this consultation build upon those in the SFR:IP and provide detailed information on how Ofcom proposes (subject to the outcome of this consultation) to award wireless telegraphy licences which will permit use of the spectrum band. Its aim is to provide on as comprehensive a description as possible of Ofcom's proposals for the award of wireless telegraphy licences and to inform potential bidders of the proposed spectrum packages and auction mechanisms. It also shows how Ofcom proposes to implement its general approach to spectrum management as it applies to this spectrum band. This general approach has been set out in a number of documents published by Ofcom over the past year, including:

- the Spectrum Framework Review consultation document published in November 2004 ("SFR") and Statement published in June 2005 ("SFR Statement")[3];
- the Spectrum Trading consultation document published in November 2003 ("Trading Consultation Document") and Statement published in August 2004 ("Trading Statement")[4];

[3] http://www.ofcom.org.uk/consult/condocs/sfr
[4] http://www.ofcom.org.uk/consult/condocs/spec_trad/statement/?a=87101

- the Spectrum Liberalisation consultation document published in September 2004 ("Liberalisation Consultation Document") and Statement published in January 2005 ("Liberalisation Statement")[5];

- the SFR: IP and the Interim Statement on the SFR:IP published in July 2005.

2.5 The licence award outlined in this consultation forms part of a wider programme of awards that was set out in the SFR:IP and in the Interim Statement on the SFR:IP. Ofcom expects to publish more detailed documents with specific plans for each award as the programme advances. Ofcom's website lists all publications of the detailed proposals for other awards in this programme.

## Background

2.6 Ofcom's general spectrum policy in the SFR and the SFR:IP sets out Ofcom's spectrum vision which states that:

- Spectrum should be free of technology and usage constraints as far as possible. Policy constraints should only be used where they can be justified;

- It should be simple and transparent for licence holders to change the ownership and use of spectrum; and

- Rights of spectrum users should be clearly defined and users should feel comfortable that they will not be changed without good cause

2.7 Ofcom has set out its approach to spectrum management in the Spectrum Framework Review (SFR). Its central theme is that the management of the radio spectrum can be carried out most effectively if market forces are harnessed to a significantly greater degree than in the past. Ofcom considers that this approach will:

- promote efficient use of the radio spectrum by allowing spectrum to be transferred to, and used by, the user who values it most highly;

- promote competition by increasing the availability of spectrum for use by the most valuable service; and

- facilitate economically valuable innovation as new users enter the market to offer new services.

2.8 The approach is primarily implemented through the development and implementation of three policies:

- **Spectrum Trading** – Allow licensees to buy and sell (and lease and hire) some or all of their spectrum usage rights

- **Spectrum Liberalisation** – Give licensees flexibility to change the use they make of the spectrum they hold

[5] http://www.ofcom.org.uk/consult/condocs/liberalisation

- **Spectrum Awards** – Make unused spectrum available to potential users as quickly as possible, compatible with an orderly process, on a technology and application neutral basis

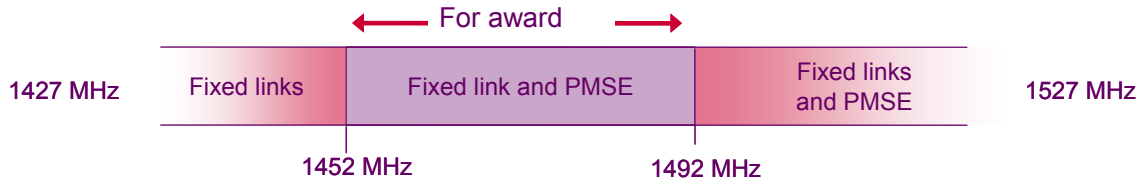
2.9 Ofcom's proposals for the 1452 - 1492 MHz band are designed to contribute to achieving its objectives within the framework of these policies.

## Current use

2.10 The spectrum between 1452 and 1492 MHz is currently being used for fixed links and Programme Making and Special Events (PMSE). WorldSpace operates a satellite DAB system in this band which is receivable in the UK.

2.11 Adjacent uses to the 1452 – 1492 MHz spectrum band are fixed links below 1452 MHz and fixed links and PMSE above 1492 MHz (see Figure 1).

**Figure 1: Current use of 1452-1492MHz and adjacent spectrum**




Source: Ofcom

2.12 There are currently less than 100 fixed links, with around 500 assignments, operating within the spectrum between 1452 and 1492 MHz. These licence holders have been under notice since 1996 that they will be moved to other frequencies[6].

2.13 That said, to reduce the time that the spectrum may lie fallow, Ofcom has decided to allow all remaining fixed link users to stay in this band until such time as access is required by the new licensees. From 30 September 2006 onwards, these users will operate under a six month notice period, with 31 March 2007 as the earliest date at which the band needs to be vacated. A letter again communicating this decision to all fixed links users in 1452-1492 MHz was sent in March 2006.

2.14 In addition, around 10 Programme Making and Special Events (PMSE) users have used this band (located in the sub-band 1488 – 1491 MHz) for short-term assignments in the past five years. JFMG, who license PMSE users on Ofcom's behalf, has been encouraging remaining users of this spectrum to move to the spectrum at 1517-1525 MHz. Notice has been given to all of the remaining PMSE users stating that they can no longer operate in the 1452-1492 MHz band after 31 March 2007.

2.15 The 1452 – 1492 MHz band will therefore be available from 31 March 2007 for alternative uses.

## Potential uses

2.16 The joint RA/RAu consultation looking at the future use of the 1452 – 1492 MHz spectrum band[7] gathered responses on the possible demand for this spectrum band

[6] Strategy for the Future Use of Spectrum in the UK, Radiocommunications Agency, 1996, 1997, 1998 2000, 2002.

to be used for the delivery of different services – specifically soliciting views on demand for T-DAB, data/ multimedia/ broadband services and digital radio/data via satellite. The nine respondents that offered their opinion on this matter broadly held the following views:

- **Data/ multimedia/ broadband services:** Several respondents, including SMG, Crown Castle, GWR Group, and NTL, believed there would be significant demand for the delivery of mobile multimedia services, and/or broadcast data services. Services to mobile devices were mentioned as a particular emerging technology that would require significant blocks of spectrum for full commercial trials. There was support for a flexible approach to the spectrum to accommodate a variety of technologies.

- **T-DAB:** While the Community Media Association, GWR Group, Chrysalis radio and CBC believed there was demand for this spectrum from small-scale local commercial radio broadcasters and/ or community radio, other respondents questioned the suitability of this band for T-DAB given its propagation characteristics (especially when compared to Band III[8]).

- **Satellite services:** Whereas some respondents felt that there was interest in using this spectrum to deliver services, mainly digital radio, via satellite (particularly as an effective way for delivery to rural areas), others took the view that restricting the use of the spectrum to satellite radio would not benefit consumers.

2.17 In order to understand better the full range of possible uses of this spectrum and to inform the proposals for releasing the spectrum to the market, Ofcom engaged independent consultants to carry out a market assessment. The market assessment encompassed a review of possible uses (applications and technologies) of the band, an extensive interview programme with potential users of the band, equipment manufacturers and other stakeholders, and modelling of the likely value of individual uses.

2.18 In this process, a large number of interviewees expressed interest in acquiring usage rights for this spectrum, opening up the possibility of a range of possible uses (in addition to the existing use for fixed links), namely:

- **Mobile multimedia**: most interest in the interview process was generated by the potential for mobile multimedia applications. Several parties suggested that they may be interested in deploying multimedia services using DVB-H (Digital Video Broadcasting – Handheld) or DMB (Digital Multimedia Broadcasting).

- **Broadband wireless access**: interest was also expressed in broadband wireless access services, offering services with mobility capabilities. Technologies that could be used to offer these services include TDD-IP and WiMAX.

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[7] Consultation on future use of spectrum within VHF Band III (174 – 230 MHz) and in the 1.5 GHz Band (1452 – 1492 MHz), 17 October 2003, the Radiocommunications Agency and the Radio Authority, http://www.ofcom.org.uk/consult/condocs/ra_rau/

[8] 174 – 230 MHz

- **Satellite digital radio**: there was interest in using the upper 12.5MHz for offering pan-European satellite digital radio services. Such services might use the S-DAB standard and combine satellite broadcast signal with terrestrial in-fill, particularly in urban areas.

- **PMSE** (Programme-making and special events): little interest was evident in use of the spectrum for point-to-point audio links, but there was some evidence of demand for wireless cameras.

- **T-DAB** (terrestrial digital audio broadcasting): despite the use of these frequencies for T-DAB in other parts of the world, there was little interest in using this spectrum for T-DAB, as the deployment of T-DAB in the UK has made use of VHF Band III, and it appeared likely that there would be sufficient spectrum available in Band III to meet demand at least in the short to medium term.

2.19 The minimum spectrum requirements for each of these technologies vary widely. However the actual amount of spectrum that could be required by a particular user will also vary depending on their specific business plan. Figure 2 is intended to illustrate the minimum spectrum required to deploy different technologies from a technical perspective, and some indication of the potential demand for spectrum in order to deploy a commercial service. The inclusion of a technology or application in this list does not imply any judgement as to level of commercial interest or feasibility.

**Figure 2: Possible spectrum requirements for prospective technologies**

| Service | Technology | Amount of frequency potentially required |
|---|---|---|
| Mobile multimedia | T-DMB | One or more blocks of 1.7 MHz |
| | DVB-H | One or more blocks of 5, 6, 7 or 8 MHz |
| | S-DMB | Up to 25MHz |
| | DAB-IP | One or more blocks of 1.7 MHz |
| | ISDB-T | One or more blocks of 6, 7 or 8 MHz |
| | MediaFLO | One or more blocks of 5, 6, 7 or 8 MHz |
| Mobile audio services | Satellite radio (S-DAB) (with terrestrial infill) | 12.5 MHz (in sub-band 1479.5 – 1492 MHz) (with possible demand for additional spectrum in 1452-1479.5MHz) |
| | Terrestrial radio (T-DAB) | One or more blocks of 1.7 MHz |
| Wireless Broadband | UMTS TDD | One or more blocks of 10 MHz |
| | WiMAX | 3 to 7 blocks of 3.5, 5 or 7 MHz |
| | 802.20 | 1.25, 5 or 10 MHz |

| Service | Technology | Amount of frequency potentially required |
|---|---|---|
| PMSE | Digital radio cameras | One or more blocks of 10 MHz |

Source: Analysys, Mason and Ofcom

## Substitute spectrum

2.20 There are other spectrum bands that can be used to provide similar services to those discussed above. However only a limited amount of additional spectrum is likely to become available to the market in coming years. Other bands that may become available include: frequencies in 470-862MHz (UHF Bands IV and V); frequencies in 209-217MHz (VHF Band III); 2500-2690MHz and 2010-2025MHz.

2.21 Spectrum in UHF is expected to be used for mobile multimedia in other countries (such as Italy). In the UK, spectrum in UHF is likely to become available for release to the market following the switch off of analogue television. Ofcom's Digital Dividend Review (DDR) project is currently examining the options arising from the release of spectrum afforded by the digital switchover programme.

2.22 Some spectrum in UHF between 590 and 598 MHz (channel 36) may become available for release to the market earlier than the rest of the spectrum considered in the DDR project. Further work is required to identify the feasibility and implications of any early release. Ofcom is currently planning to issue a consultation on the DDR project (including 590 - 598 MHz) by the end of 2006. Further details about the DDR can be found on Ofcom's website[9].

2.23 T-DAB services in the UK presently use spectrum in VHF Band III. Ofcom is currently seeking agreement in the Regional Radio Conference (RRC) to use the frequency range 209.2 to 217.5 MHz for additional T-DAB services. This spectrum, ,which comprises four blocks of 1.7MHz each, is intended for use specifically:

- for a further national commercial radio multiplex; and
- to provide further local radio multiplexes, with the primary objective of extending the coverage of local digital radio services to those areas of the UK that are currently not served.

The future use of this spectrum is discussed in Ofcom's statement on Radio - Licensing Policy for VHF Band III, Sub-band 3[10], published in December 2005, and is subject to the outcome of the RRC on international spectrum usage and the vacating of the spectrum by existing users.

2.24 Ofcom has also concluded that all of these multiplex licences should be awarded under the terms of the Broadcasting Act 1996. Under the present regulatory arrangements, which include an order by the Secretary of State limiting the use of multiplex capacity for data services, no more than 20% of the capacity on a digital

[9] http://www.ofcom.org.uk/radiocomms/ddr/
[10] http://www.ofcom.org.uk/consult/condocs/vhf/statement/

radio multiplex may be used for non-programme related services, including data and multimedia services.

2.25 Ofcom's consultation looking at the future licensing of DAB digital radio proposed to start advertising the new multiplexes no earlier than the autumn of 2006, with award expected six to seven months following the advertisement. This consultation closed on 15 March 2006 and Ofcom plans to announce the outcome of that consultation in the coming months.

2.26 Ofcom plans to make spectrum in the 2500-2690MHz and 2010-2025MHz bands available to the market as soon as possible, consistent with an orderly process. This spectrum could potentially be used for a variety of services, possibly including mobile multimedia services. In the SFR:IP, Ofcom proposed to auction the 2500 – 2690 MHz band in 2006-2007 on a technology and application neutral basis, while using a spectrum mask based on the IMT-2000 specification. Ofcom has recently announced the appointment of advisers to take forward work on the award of this band.

2.27 Other bands may also become available that could be used for services that might also be deployed in 1452-1492MHz. These include, for example, 1980-2010MHz, paired with 2170-2200MHz. This spectrum is currently largely unused in the UK. It is the subject of discussions in CEPT and the EU about possible use for Mobile Satellite Services, potentially in conjunction with terrestrial use. It is possible that the spectrum could be used to offer services similar to those that could be supported using 1452-1492MHz. It is also possible that some additional spectrum may become available in part of the band 1492-1690MHz after March 2007. However there are various constraints, including existing users and international arrangements, which affect this spectrum. These mean that it may not be available for release to the market in a similar timescale to the 1452-1492MHz band.

2.28 In general it should be noted that other wireless telegraphy licences granted in future, as part of Ofcom's ongoing award programme, may be used to provide services that could compete with those that may be offered using this spectrum band. For the avoidance of doubt, Ofcom is not proposing to place any limitation as a function of this award process on the scope for it to authorise other persons to use spectrum to offer such services. Such licensing may occur by means of the award of new licences to use spectrum in other bands, by means of decisions as to licence exemptions or via the removal of restrictions on the use of bands that have already been licensed. As set out in the SFR, Ofcom's general policy is to move towards technology and application neutral licensing that provides much greater flexibility for the use of spectrum to respond to demand and to be economically efficient.

## Matters covered in this document

2.29 The aim of this document is to provide a comprehensive description of Ofcom's proposals for the award of the band 1452 – 1492 MHz. This document logically falls into a number of parts.

2.30 The first part provides a background to the award proposals and consists of:

- Section 2 – this Introduction;
- Section 3 – which provides a summary of Ofcom's powers and duties relevant to this award;

- Section 4 – which details Ofcom's objectives for, and general approach to, the award

- Section 5 – which describes various international issues relevant to the spectrum available for award

2.31 The second part provides details of the actual award proposals and consists of:

- Section 6 – which details how Ofcom proposes to package the spectrum band;

- Section 7 – which sets out the proposed auction design and associated rules; and

- Section 8 – which describes the specific conditions that will apply to the licences and other issues relevant to the rights in the licences

2.32 Section 9 sets out the next steps leading up to the award.

2.33 Annexes 1 to 3 set out further information about Ofcom's consultation principles and the process for responding to this consultation.

2.34 Other Annexes provide further background information relevant to the award.

- Annex 4 summarises the consultation questions.

- Annex 5 sets out a summary of relevant responses to the SFR:IP and the joint RA/ RAu consultation on the future use of this spectrum.

- Annex 6 sets out a draft of the licence which will be offered.

- Annex 7 provides a brief summary of other regulation relating to broadcasting and electronic communications networks and services which may be relevant to potential licensees.

- Annex 8 sets out an impact assessment in accordance with Ofcom's statutory requirement.

- Annex 9 provides further detail on possible auction formats

- Annex 10 provides a glossary of key terms.

## Section 3

# Ofcom's duties and functions

3.1 This section provides a brief overview of the main UK and European legislative provisions relevant to wireless telegraphy licensing and to the proposed award process. It does not provide a comprehensive statement of all legal provisions which may be relevant to Ofcom's functions and to the award of wireless telegraphy licences for the use of the 1452 – 1492 MHz band.

## Ofcom's general duties

3.2 Under section 3(1) of the Communications Act 2003 it is the principal duty of Ofcom in carrying out its functions:

> (a) to further the interests of citizens in relation to communications matters; and
>
> (b) to further the interests of consumers in relevant markets, where appropriate by promoting competition.

In doing so, Ofcom is required to secure (under section 3(2)):

> (a) the optimal use for wireless telegraphy of the electro-magnetic spectrum;
>
> (b) the availability throughout the UK of a wide range of services;
>
> (c) the availability throughout the UK of a wide range of TV and radio services which (taken as a whole) are both of high quality and calculated to appeal to a variety of tastes and interests;
>
> (d) the maintenance of a sufficient plurality of providers of different television and radio services;
>
> (e) the application in the case of all television and radio services of standards that provide adequate protection to members of the public from the inclusion of offensive and harmful material, unfair treatment in programmes and unwarranted infringement of privacy;

and to have regard to certain matters which include:

- principles of better regulation (section 3(3));
- the desirability of promoting competition (section 3(4));
- the desirability of encouraging investment and innovation (section 3(4)(d));
- the desirability of encouraging availability and use of broadband services throughout the UK (section 3(4)(e));
- the different needs and interests of persons in different parts of the UK (section 3(4)).

3.3 As the management of the UK radio spectrum is governed by the European Communications Directives, which aim to harmonise the regulation of electronic communications networks and services throughout the European Union, section 4 of the Communications Act 2003 requires Ofcom when carrying out its spectrum functions to act in accordance with the "six community requirements" set out in that section when managing the wireless spectrum in the UK. Of relevance are the following:

(a) The requirement to promote competition (section 4(3));

(b) The requirement to secure that Ofcom's activities contribute to the development of the European internal market (section 4(4));

(c) The requirement to promote the interests of all persons who are citizens of the European Union (section 4(5));

(d) The requirement to act in a technology neutral way (section 4(6));

(e) The requirement to encourage to such extent as appropriate the provision of network access and service interoperability (section 4(7)); and

(f) The requirement to encourage such compliance with international standards as is necessary for (a) facilitating service interoperability; and (b) securing freedom of choice for the customers of communications providers (sections 4(9) and (10)).

## Ofcom's duties when carrying out spectrum functions

3.4 In carrying out its spectrum functions it is the duty of Ofcom (under section 154 of the Communications Act 2003) to have regard in particular to:

(a) the extent to which the spectrum is available for use or further use, for wireless telegraphy;

(b) the demand for use of that spectrum for wireless telegraphy; and

(c) the demand that is likely to arise in future for the use of that spectrum for wireless telegraphy.

It is also the duty of Ofcom to have regard, in particular, to the desirability of promoting:

(a) the efficient management and use of the spectrum for wireless telegraphy;

(b) the economic and other benefits that may arise from the use of wireless telegraphy;

(c) the development of innovative services; and

(d) competition in the provision of electronic communications services.

3.5 Where it appears to Ofcom that any of its duties in section 154 conflict with one or more of its general duties under sections 3 to 6 of the 2003 Act, priority must be given to its duties under those sections.

## Granting wireless telegraphy licences

3.6 Ofcom's legal power to grant wireless telegraphy licences is set out in the Wireless Telegraphy Act of 1949. Section 1(1) of that Act makes it an offence for any person to establish or use any station for wireless telegraphy or to install or use any apparatus for wireless telegraphy except under and in accordance with a licence granted by Ofcom under that section (a wireless telegraphy licence).

3.7 Section 1(2) of that Act gives Ofcom the power to grant wireless telegraphy licences subject to such terms as Ofcom thinks fit.

3.8 However, Ofcom's broad discretion in relation to the terms that can be imposed in a wireless telegraphy licence is subject to the rule that Ofcom must impose only those terms that it is satisfied are objectively justifiable in relation to the networks and services to which they relate, not unduly discriminatory, and proportionate and transparent as to what they are intended to achieve (section 1D(9)).

## Providing for an auction of wireless telegraphy licences

3.9 Under Article 5(2) of the Directive on the authorisation of electronic communications networks and services 2002/20/EC (the "Authorisation Directive"), when granting rights of use of radio frequencies (wireless telegraphy licences in the UK context), Member States must do so through open, transparent and non-discriminatory procedures.

3.10 Under Article 7(2) of the Authorisation Directive where the number of rights of use of radio frequencies needs to be limited, Member States' selection criteria must be objective, transparent, non-discriminatory and proportionate. (Section 164 of the Communications Act 2003 requires Ofcom to make an order setting out the criteria).

3.11 Within that context, Ofcom has power under section 3 of the Wireless Telegraphy Act 1998 (having regard to the desirability of promoting the optimal use of the electro-magnetic spectrum) to make regulations providing that applications for the grant of wireless telegraphy licences must be made in accordance with a procedure which involves the applicants making bids for licences (for example an auction).

3.12 Ofcom has broad powers in section 3(3) to make provision in regulations for the form of the licences and the auction bidding procedure.

## Charging fees for wireless telegraphy licences

3.13 Ofcom also has power, under section 1 of the Wireless Telegraphy Act 1998, to prescribe in regulations fees that are payable in respect of wireless telegraphy licences. Under section 2 Ofcom may prescribe sums which are greater than necessary for the purpose of recovering costs, if it thinks fit in the light (in particular) of the matters to which they are to have regard under section 154 of the Communications Act 2003.

3.14 The fees for most wireless telegraphy licences are set out in such regulations (including those fees which are set by Ofcom in order to incentivise the use of the

spectrum). The current regulations are the Wireless Telegraphy (Licence Charges) Regulations 2005 (SI 2005/1378).

3.15 Under Article 13 of the Authorisation Directive, any fees imposed for rights of use of radio frequencies shall reflect the need to ensure the optimal use of the resources. Such fees must be objectively justifiable, transparent, non-discriminatory and proportionate in relation to their intended purpose (and take into account the objectives set out in Article 8 (Policy objectives and regulatory principles) of Directive 2002/21/EC[11] (the "Framework Directive")).

[11] The Directive of the European Parliament and the Council on a common regulatory framework for electronic communications networks and services (2002/21/EC)

Section 4

# Ofcom's objectives and proposed approach to the award

4.1 This section provides an account of Ofcom's objectives for this spectrum award, and of Ofcom's consideration of certain key issues relating to the award, namely: whether to award licences or to authorise use on a licence-exempt basis; how to award licences, whether by way of auction or otherwise; whether to offer licences on a technology and service neutral basis; and the timing of the award. This section also contains a discussion of certain points raised by respondents to the two previous consultations on the award of this spectrum band.

## Objectives for the award

4.2 The main objective of this award of wireless telegraphy licences is to promote the optimal use of the electro-magnetic spectrum, particularly in the 1452–1492 MHz frequency band. In preparing the proposals designed to secure that objective, Ofcom has had regard, in particular, to the availability of and demand for spectrum and to the desirability of promoting:

- the efficient management and use of the spectrum;
- the economic and other benefits that may arise from use of the spectrum;
- the development of innovative services; and
- competition in the provision of electronic communications services.

4.3 The SFR identifies the use of auctions as the most appropriate means to distribute spectrum that is not currently assigned where demand for the spectrum is likely to exceed supply. It also sets out the view that spectrum should be auctioned in a technology and usage neutral way. We have followed this approach in framing the proposals for the award of this band.

## Choice of assignment mechanism

### Licence exemption

4.4 As noted in the SFR: IP and elsewhere, Ofcom has a duty (in section 1AA of the Wireless Telegraphy Act 1949) to make regulations exempting the use of particular equipment from licensing if it is satisfied that its use for wireless telegraphy is not likely to involve undue interference. Ofcom has considered whether use of equipment in the 1452-1492 MHz band would be suitable for licence exemption.

4.5 The market assessment,has revealed a wide range of potential uses of this band, including satellite digital radio, mobile multimedia, broadband wireless access, PMSE and terrestrial broadcasting (see section 2). Deployment of most of these potential uses on a licence-exempt basis would be likely to result in significant interference, as most of these uses employ transmitters that operate at significant power levels, and as a result would create a large zone of potential interference.

4.6 Ofcom therefore considers that a licence exempt approach would be likely to involve undue interference and would therefore be unlikely to lead to an optimal use of the 1452-1492 MHz band.

## Award through an auction

4.7 Ofcom has considered what mechanism for award of the spectrum is likely to result in the most efficient outcome for the use of the spectrum. Ofcom set out its general view in the Interim Statement on the SFR:IP and in the SFR Statement that an auction mechanism is likely to be Ofcom's preferred tool for assigning licences to use unused spectrum, where demand for the licences is likely to exceed supply. Having considered the particular circumstances of this spectrum band, Ofcom has concluded that an auction mechanism should be preferred.

4.8 Ofcom considers that an auction offers the most open, transparent and non-discriminatory method out of those available for determining who should be granted licences for this band. This is because in auctions, a bidding process is used to award licences to those bidders prepared to pay most for them. Auctions are therefore likely to lead to the spectrum rights being assigned to users that value them most highly, which will generally be those who are likely to use the spectrum most efficiently. By contrast, in Ofcom's view, other assignment mechanisms are unlikely to be as effective in promoting optimal use of the spectrum for this award. Alternative assignment mechanisms include first come first served processes, where licences are assigned to applicants in the order of their application, and comparative selection processes, where licences are assigned to the applicants that, in the regulator's judgement, best satisfy the selection criteria that it has set. A first come first served process would not be appropriate where demand for spectrum is likely to exceed supply - the first applicants may not be those who would make the optimal use of the spectrum and many applicants may come forward at the same time. A comparative selection process involves defining selection criteria and assessing candidates' submissions and so carries the risk of subjective judgements being made and of the spectrum not being awarded to the bidder able to use it to maximum advantage.

4.9 Ofcom considers that this reasoning is relevant to the 1452-1492MHz band as it is to a number of other bands. Moreover, Ofcom considers that the evidence available suggests there is keen interest in acquiring spectrum in this band, and that it is very likely that demand will exceed supply. A well-designed auction process, including appropriate design of licence conditions and packaging, should give the maximum flexibility for the market to determine the use of the spectrum and the identify of the users. This will further reduce the risk of regulatory error and unnecessary intervention inherent in other approaches to assigning spectrum rights.

4.10 Ofcom therefore considers that this spectrum band should be awarded by way of auction. Ofcom's proposal to use an auction as the method for assignment, and Ofcom's other proposals relating to the details of the auction design, are derived from the objectives for the award, and in particular the aim of securing optimal use of the spectrum. It is not Ofcom's objective to raise revenue by means of spectrum auctions nor, given Ofcom's statutory duties, is this a consideration that Ofcom has taken into account.

4.11 Sections 6 and 7 of this document set out Ofcom's detailed proposals for the design of the auction process for the spectrum band.

## Technology and service neutrality

4.12 As set out elsewhere (see in particular the SFR, SFR:IP and Liberalisation Statement) and consistent with its statutory duties, Ofcom's preferred approach is to remove restrictions in existing wireless telegraphy licences that are not proportionate or objectively justified, enabling users to make better use of the spectrum and to deploy the most appropriate services and technologies. Equally, when granting new wireless telegraphy licences Ofcom considers that it should avoid restricting the technology that may be used, or the type of service that may be offered, wherever possible.

4.13 Any restrictions on spectrum use must be justifiable and proportionate. In matters such as the selection of a technology, or service offering, the risks and potential adverse consequences of regulatory error are especially high. This is not least given the present rate of change in the communications sector and the imperfect nature of the information available to the regulator. Regulator-led decisions on the technology to use, or service to offer, can have very large distortive effects on competition and on the efficient use of resources. There is also no need for Ofcom to specify the technology or service to be used provided the essential requirements of interference management are met.

4.14 Ofcom considers that neutrality in these respects is consistent with the Framework Directive, which requires that national regulatory authorities take the utmost account of the desirability of making regulations technologically neutral. As a consequence, Ofcom is required in section 4 of the Communications Act 2003 to meet a number of duties relating to "community requirements". One of these is a requirement to act in a technology neutral way.

4.15 Consistent with this general approach, Ofcom intends to release unused bands to the market with only those technology and usage restrictions that are the minimum necessary for the efficient management of the radio spectrum and the avoidance of interference, and compliance with Ofcom's statutory duties and international obligations.

4.16 Ofcom's technical analysis indicates that it is not necessary to place any technology or usage restrictions on the 1452 – 1492 MHz band (see section 8). In making this spectrum available in a technology neutral way, the licensee will have the freedom to deploy a particular technology if it wishes, but it will not be required to do so. Ofcom considers that this is a proportionate and objectively justifiable approach, which provides the most appropriate means of meeting Ofcom's objectives for the award and its duties under UK and European law. It is not unduly discriminatory as it avoids differential treatment of technologies or persons and is transparent in what it seeks to achieve.

## International arrangements

4.17 In any spectrum award, one factor that needs to be taken into account is whether there are international agreements that relate to the spectrum band in question. In this case, several international arrangements exist that are potentially relevant, in varying ways:

- The ITU International Radio Regulations allocate all 40 MHz of the spectrum on a co-primary basis to fixed services, mobile services, broadcasting and broadcasting-satellite services (with an exclusion for aeronautical mobile);

- An ITU Resolution limits broadcasting-satellite use to the top 25 MHz, i.e. 1467-1492 MHz;

- An arrangement between CEPT administrations made in 2002 ("the Maastricht 2002 Special Arrangement" or "Maastricht Plan") provides for T-DAB use in the bottom 27.5 MHz of the spectrum i.e. 1452 – 1479.5 MHz. This arrangement includes a T-DAB allotment plan for the band; and

- A CEPT Electronic Communications Committee Decision designates the top 12.5MHz, i.e.1479.5 – 1492 MHz, for Satellite Digital Audio Broadcasting in Europe, although the UK has not agreed to implement this.

These arrangements are discussed in more detail in section 5.

4.18 None of these international arrangements prevent this spectrum from being offered on a technology neutral and application neutral basis. The UK has not implemented the above-mentioned ECC Decision and is therefore not bound to designate 1479.5 – 1492 MHz to Satellite Digital Audio Broadcasting. Licensees of course have the freedom to deploy satellite radio if they wish – but they will not be required to do so. Further, the Maastricht 2002 Special Arrangement provides a T-DAB allotment plan for the 1452 – 1479.5 MHz band. Although Ofcom will respect the international coordination agreements as set out in this plan, this does not imply that other technologies are precluded from using this frequency band in the UK – provided the aggregate level of potential interference into neighbouring countries remains within the limits of the plan (see section 8 and annex 6 for more detail on this approach). Finally, the ITU allocation of the band to broadcasting, broadcasting-satellite, mobile and fixed services is very broad and does not prescribe any specific technologies or services (other than a restriction on aeronautical mobile services). A technology and service neutral approach can therefore live within this ITU allocation. Under ITU rules, services may even be deployed outwith allocations in the ITU Radio Regulations, on a non-interference, non-protection basis.

## Technology neutrality

4.19 Ofcom indicated in the SFR:IP its preference to award all 40 MHz of spectrum (1452 – 1492MHz) on a technology and application neutral basis, stating that to do so would be consistent with the need to secure the optimal use of the available spectrum. An account of responses to the SFR:IP as well as relevant responses to RA/RAu consultation on future use of spectrum in the 1.5 GHz Band is given in Annex 4. In the remainder of this section, and in several other places throughout this document, these consultation responses are presented as and when relevant.

4.20 The majority of respondents to this proposal supported Ofcom's technology neutral approach as they felt that it would allow different broadcasting technologies (such as DVB-H and DMB) to be deployed to provide mobile multimedia services. Four satellite-related companies (Alcatel, ESAPREG, Inmarsat and WorldSpace) argued that Ofcom should reserve the upper 12.5 MHz (1479.5 – 1492 MHz) exclusively for the operators of satellite broadcasting services. They also argued that these satellite operators should also be allowed to use this spectrum for terrestrial services complementary to the satellite service. They propose that an exclusive reservation along these lines would promote the development of a pan-European market. ESAPREG and WorldSpace also felt that the 1467 – 1479.5 MHz sub-band should be reserved for use by T-DAB and S-DAB only. Several respondents (e.g. BBC and

NTL Broadcast) further pointed out the suitability of this band for very local radio services.

4.21 As set out above, Ofcom's preferred approach is to award the spectrum on a technology and service neutral basis. The avoidance of such restrictions should increase the opportunities for the market to determine the optimum use of this spectrum band – be it satellite audio broadcasting, mobile multimedia services or local radio services – thereby improving the efficiency of spectrum use. Ofcom's preference is not to choose between some of these services as a regulatory decision, preferring some and excluding others, but to ensure that all of these potential uses can be accommodated in this band. This can be done by adopting a packaging solution that can accommodate the spectrum requirements of as many uses as possible (see section 6), and by making sure that the spectrum mask and its technological constraints are compatible with these uses (see section 8).

4.22 Ofcom does not consider that there is any need to reserve spectrum exclusively for the operators of satellite broadcasting services, with or without the ability for those operators to use the spectrum for complementary terrestrial services. Such a reservation would prevent by law the use of the relevant frequencies for other uses. But those alternative uses might prove to be the more efficient use of the spectrum, either at the point of initial assignment of subsequently. An exclusive reservation of spectrum in favour of one type of user could also have the effect of distorting competition in downstream markets, by giving the users with preferential rights regulatory advantages not available to their rivals. Ofcom considers that this would be an extreme step, requiring a compelling justification, and it could only be taken after very careful consideration of all potentially relevant effects (such as the dynamic and static costs of excluding alternative uses, as well as any potential benefits). Ofcom considers that no such case has been made here.

4.23 Some respondents to the SFR:IP argued that it would be unduly discriminatory if Ofcom were to release spectrum that could be used for mobile applications (such as this band) on a technology and application neutral basis. These comments were made by a number of Mobile Network Operators (MNOs). They argued that technology- and application-neutrality would unduly discriminate against them, as holders of existing 2G and 3G mobile licences, as these licences presently specify the technologies to be employed. Similar points were made about the award of licences that would allow mobile use but might be indefinite in duration (unlike the 2G and 3G licences) or not contain roll-out obligations (unlike the 3G licences).

4.24 Ofcom considers that the proposals set out in this document, including as to technology and application neutrality, licence term and other licence conditions, are proportionate, objectively justified, and transparent, and do not involve undue discrimination against any person. The existing 2G and 3G licences differ from the licence proposed for this spectrum band in a number of respects. The 2G and 3G licences also differ from each other in important respects, including in relation to the conditions under which they were awarded. Given the objective differences between these various licence classes, and the objective justification for its proposals, Ofcom does not consider that there can be any undue discrimination against the existing 2G or 3G licensees, or any other person.

4.25 Ofcom notes two further points in this context. First, Ofcom is not proposing to place any restrictions on the holders of 2G or 3G licences (or for that matter any other person) from competing to acquire licences in this auction. Second, there can be no undue discrimination between different holders of spectrum rights in the 1452-1492MHz (assuming more than one party acquires rights to this spectrum), given the

common process that is envisaged for defining these rights and making them available to the market.

## Sound broadcasting

4.26 Several respondents, such as Digital One, CMA, GWR Group, CBC and Chrysalis Radio, believed that at least some of the 1452-1492 MHz should be reserved exclusively for digital radio broadcasting, particularly for community radio or local commercial radio broadcasters. Some of these respondents argued that the spectrum should be reserved so that Ofcom would provide an option for all analogue radio stations to migrate to digital radio.

4.27 The question of providing additional capacity for radio services that are presently broadcast only in analogue, to secure a migration path to digital broadcasting as well as other related issues is considered in more detail in two recent Ofcom documents. Radio – Preparing for the Future, Phase 2: Implementing the Framework [12] and Radio – Licensing Policy for VHF Band III, Sub-band 3[13].

4.28 These documents set out an analysis of the public policy case for intervening to require three blocks of T-DAB compatible spectrum in VHF Band III, Sub-Band 3 to be made available for further local radio multiplexes. The primary objective of this intervention was to extend the coverage of local digital radio services to those areas of the UK that are currently not served.

4.29 Ofcom does not consider that a further public policy intervention to require spectrum in 1452-1492MHz to be used for further local multiplexes using the T-DAB standard is warranted. This judgement reflects the high cost of deploying T-DAB in this frequency range, compared to the more suitable lower frequencies (such as VHF Band III). It is also relevant that experience elsewhere in Europe in using frequencies in 1452-1492MHz has been of limited success, and much less effective than use of lower frequencies (as in the UK). Moreover, the opportunity cost of displacing other potential services by requiring use of this spectrum for local multiplexes is likely to be very high.

4.30 No local commercial analogue radio station has an automatic right to migrate to a digital platform. However Ofcom is working with the industry to identify further opportunities for migration to digital standards. This includes consideration of other potentially more suitable standards, such as DRM in FM and AM frequencies. In the coming months Ofcom will be carrying out a project that will look at the future shape of the radio industry. This will include looking at the digital options for smaller radio stations.

4.31 In relation to the award of this spectrum band, any potential operator of sound broadcasting will be free to bid for licences, alongside any other party.

## International issues

4.32 Some respondents to the SFR:IP commented on the international dimension of this award.

[12] http://www.ofcom.org.uk/consult/condocs/radio_reviewp2/
[13] http://www.ofcom.org.uk/consult/condocs/vhf/

4.33 NTL Broadcast felt that it was unclear whether alternative technologies would be compatible with the subdivision of the band according to the Maastricht 2002 Arrangement, or with the interference limits used in this Plan. Another respondent felt that there was an absence of clarity regarding the practical application of technology neutral spectrum rights. These issues are addressed in section 5 and later sections of this document.

4.34 Some respondents also argued that there was a case for harmonising the use of this spectrum band. These included the satellite-related companies, which argued that in order to promote the success of S-DAB technology and service in Europe a spectrum band should be reserved exclusively for their services throughout Europe, Some other respondents (NTL Broadcast and Philips) argued that more generally harmonisation could bring benefits such as a larger European market for receivers and international roaming capabilities.

4.35 Ofcom notes that significant effort has already been expended in various international fora to define a common international framework for use of this band. This includes harmonisation measures such as the Maastricht Arrangement, and the various steps taken at the ITU and elsewhere to define a basis for potential satellite use.

4.36 This effort has not however been notably effective in bringing the spectrum into productive use. Indeed, Ofcom considers that as it stands the Maastricht Plan is an impediment to optimal use of the spectrum, because it is insufficiently flexible and overly prescriptive. It is also unclear how the various international steps taken in relation to potential satellite use will lead to the spectrum being brought into productive use, or ensure that the use made is the most efficient of all possible uses.

4.37 Ofcom considers that well-designed and appropriately flexible international arrangements can be helpful in facilitating efficient use of the spectrum. Such measures could include, for example, ensuring that similar bands of spectrum are available across a large geographical area, on a flexible and technology-neutral basis. The availability of more spectrum resource in this way can help to enlarge market opportunities, making it easier for operators and manufacturers to achieve economies of scale. But Ofcom considers that the reservation of particular bands exclusively to particular technologies or services is a highly intrusive measure that can carry very high costs and should only be taken where there is a compelling justification.

## Timing of the award & other matters

### Timing of the award

4.38 Both consultation documents indicated that the auctions could take place in 2006 - 2007. Eight responses related to the timing of the award. While three respondents (Crown Castle, NTL and Philips) urged Ofcom along in assigning this band as soon as possible, others (Intellect, Oak Global, GWR Group and the Wales Broadband Stakeholder Group) did not view this as a priority.

4.39 Ofcom aims to release spectrum as soon as reasonably practicable, where it is not already in use. This spectrum policy also applies to the 1452-1492 MHz band. The demand assessment for this band found significant market interest in this spectrum (see section 2). In particular for some of the services there is likely to be limited amounts of suitable spectrum becoming available in the coming years. As a result making this spectrum available will provide significant benefits.

4.40 Two responses (including one confidential) requested a delay in the implementation of any new application in 1452-1492 MHz, so that NHS ambulance services could continue to use this band until 2009. Ofcom has served notice on fixed link users operating in this band since 1996, ensuring all users are aware that they have to vacate the band by 31 March 2007. However, to reduce the time that this spectrum may lie fallow, Ofcom has communicated with all remaining fixed links users in this band that they may stay in this band until such time as access is required by the new licensee(s). These remaining users will operate under a six month notice period, with 31 March 2007 as the earliest date at which the band may need to be vacated.

## Competition concerns

4.41 Two satellite-related companies (ESAPREG and Inmarsat) argued that satellite and terrestrial services could not compete for access to spectrum in a 'level playing field' in such national awards. They felt that auctions lead to barriers to entry for European satellite-based enterprises, whereas terrestrial-based enterprises offering non-broadcast services benefit from increased access to favourable spectrum previously assigned to the broadcast service. According to these respondents, the unequal treatment of terrestrial and satellite services in national awards should be examined closely from the perspective of ensuring fair competition. These respondents suggested alternatively that some spectrum should be reserved exclusively for satellite operators in a manner that would also allow these operators to use the spectrum for complementary terrestrial services.

4.42 Ofcom, as well as its external consultants, have examined the competition effects related to this award. The Impact Assessment (IA) in Annex 8 includes a consideration of the implications on competition in downstream markets if control of all, or a significant proportion, of the spectrum were to be gained by a limited number of bidders. Also, it considers whether any competition problems would be caused if a successful bidder already held a position of strength in any related markets such that it may have anti-competitive motives for acquiring spectrum. The IA assesses the following types of services that could be offered using this spectrum, and their associated downstream markets:

- Mobile television/ multimedia: this is essentially a new service. Competition law, rather than spectrum policy, can address any potential concerns if one bidder, who is also a large contents right holder, were to acquire all of the available spectrum and use this to attempt to foreclose upstream or downstream competitors.

- High speed data: limited competition concerns as there are a variety of existing providers of high speed data services, whilst more suitable spectrum for such services will become available.

- Broadcast radio: limited scope for a bidder to negatively affect competition given the availability of T-DAB services and the increase of spectrum resources.

4.43 No significant competition concern has been identified in any of these downstream markets. As a consequence, Ofcom believes that it would not be justified preventing any category of bidder from participating in the auction, or restricting the amount of spectrum that any single bidder can acquire. In addition, Ofcom considers that if the spectrum were to be allocated for use of a particular service or technology thereby preventing a category or categories of bidders from participating in the auction, taking such a non-technology neutral approach may introduce distortions to competition.

## Section 5

# International issues

5.1 The subdivision of the radio spectrum into specific frequency bands and the allocation of those bands to various radio services is a process that occurs globally in the ITU, at the European level in CEPT and the EU, and nationally, through regulatory decisions made by Ofcom. There are also bilateral arrangements between the UK and neighbouring countries for the use of particular bands where there is a risk of interference in either direction.

5.2 The fundamental reason for international co-ordination of radio use has, historically, been the risk of harmful interference between use in one jurisdiction and use in another, given that radio emissions do not stop at national borders.

5.3 The existence of an international framework has a number of advantages for users around the world, but also imposes some constraints on national freedom of action. The nature of those constraints varies significantly depending on the particular international body and international agreement that is relevant. The international framework for use of the 1452 – 1492 MHz band is complex.

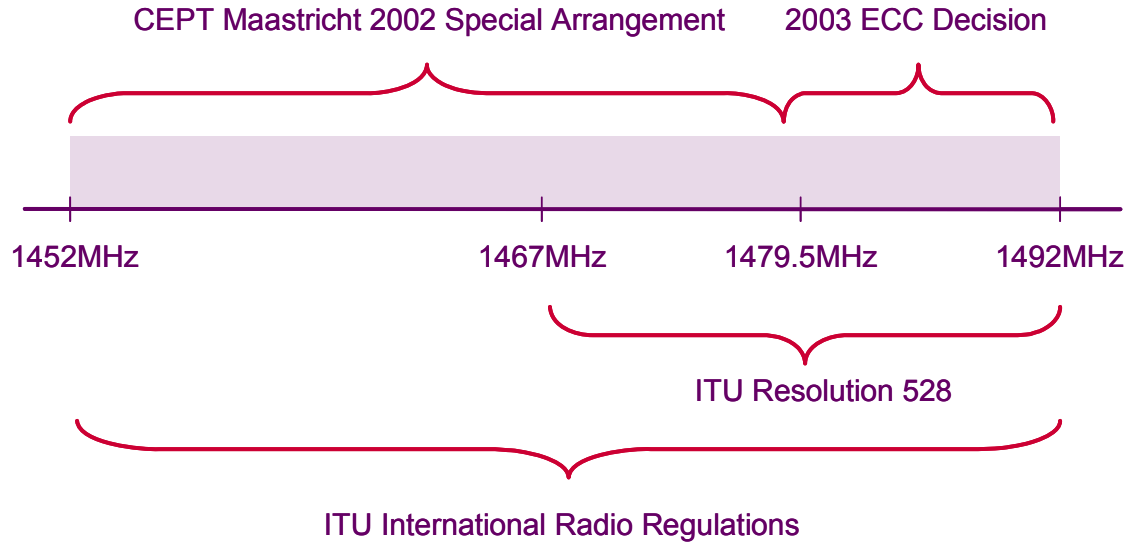
## Existing international arrangements

5.4 Several international arrangements are applicable to different parts of the 1452 – 1492 MHz spectrum band as shown in Figure 3.

- The ITU International Radio Regulations allocate all 40 MHz of the spectrum on a co-primary basis to the fixed services, mobile services (except aeronautical mobile), broadcasting services and broadcasting-satellite services;
- ITU Resolution 528 limits broadcasting-satellite use to the top 25 MHz, i.e. 1467-1492 MHz;
- An arrangement between CEPT administrations made in 2002 to provide for T-DAB in the bottom 27.5 MHz of the spectrum i.e. 1452 – 1479.5 MHz. This arrangement (The Maastricht 2002 Special Arrangement) includes a T-DAB allotment plan for the band; and
- An Electronic Communications Committee Decision (ECC/DEC/(03)02) that designates the top 12.5MHz, i.e.1479.5 – 1492 MHz, for Satellite Digital Audio Broadcasting in Europe, although the UK has not committed to implementing this Decision.

Each of these arrangements is discussed in more detail below.

**Figure 3: International arrangements affecting the 1452-1492MHz spectrum band**




Source: Ofcom

## ITU International Radio Regulations

5.5 The ITU Radio Regulations (ITU-RR) define those uses for specific spectrum bands that will have international recognition under the Radio Regulations. If an operator is awarded a licence by a national authority for a service that does not fall within the ITU-RR, that assignment will have no status under the ITU-RR. This does not mean that the service may not be authorised nationally, or that it may not be provided, but that it will have no rights to protection from interference caused by a service in another jurisdiction that is a signatory to the ITU Treaty. Moreover, if the service that is operating outwith ITU-RR causes interference to an assignment in another country operating in accordance with the Radio Regulations, the station may have to be shut down (even if the assignment in the other country was not registered at the time of initial operation).

5.6 Before 1992 the 1452-1492 MHz band was allocated internationally by the ITU-RR to the fixed and mobile services. In the UK at this point, this spectrum was used for a multiplicity of point-to-point fixed links operated by a variety of private-sector and government users.

5.7 The World Administrative Radio Conference in 1992 (WARC-92) added allocations to the broadcasting and broadcasting-satellite services. These new allocations are limited to digital audio broadcasting.

5.8 As a result under ITU-RR the broadcasting and broadcasting-satellite (limited to digital audio broadcasting), fixed and mobile (except aeronautical mobile) services all have co-primary status in this spectrum. The co-primary status means that any assignment in any of these services, once registered internationally, has precedence over any other later assignment and is entitled to protection from interference from any later assignment.

## ITU Resolution 528

5.9 At the same WARC-92 conference, a resolution was adopted that stipulated that broadcasting-satellite could only be introduced in the upper 25 MHz (1467 – 1492 MHz) until an international conference was convened to plan satellite broadcasting services.

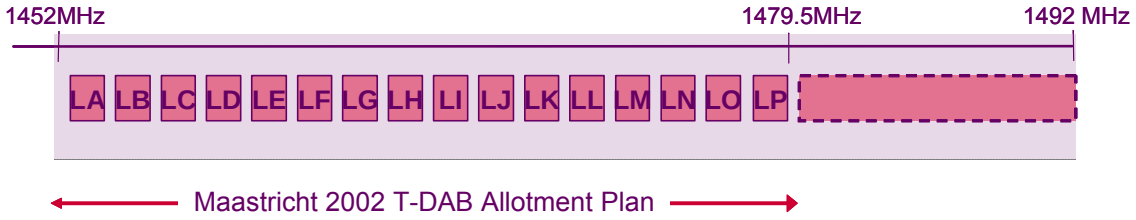
5.10 That planning conference was originally scheduled to take place by 1998 but has not taken place and there are no plans to convene such a conference.

## The CEPT Maastricht 2002 Special Arrangement

5.11 Two European conferences under the aegis of the European Conference of Postal and Telecommunications Administrations (CEPT) have taken place to plan T-DAB across Europe. The first was in 1995 in Wiesbaden to plan T-DAB in Band III (i.e. 174 to 230 MHz) and some frequencies above 1492MHz, the second was in Maastricht in 2002 to plan T-DAB services in part of the spectrum that is the subject of this award.

5.12 This CEPT Maastricht 2002 Special Arrangement provides an allotment plan for T-DAB for the lower 27.5 MHz of this band (i.e. 1452 to 1479.5MHz) as shown in Figure 4.

**Figure 4: Maastricht 2002 T-DAB allotment plan**

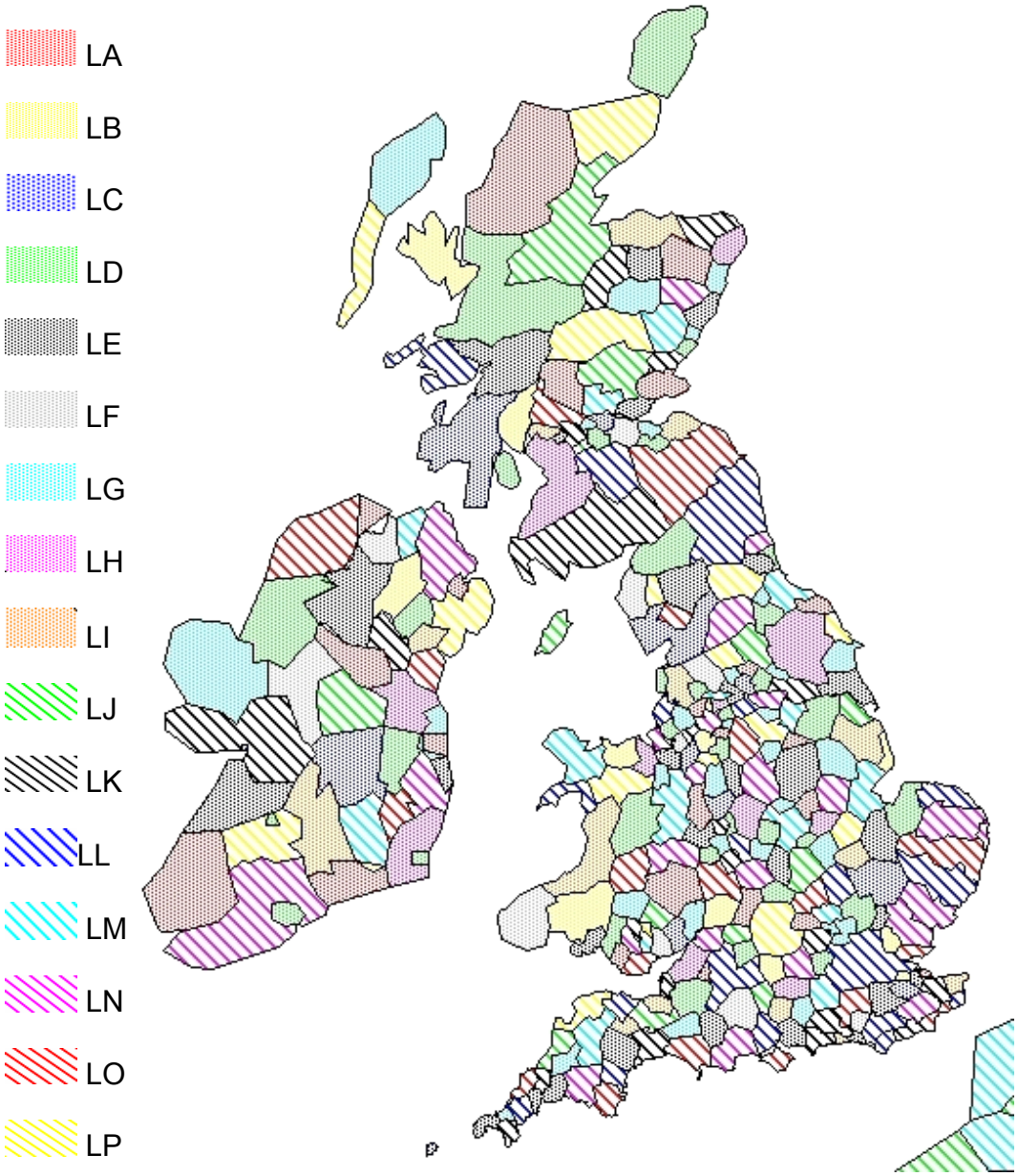



Source: Ofcom

5.13 This plan divides the spectrum into 16 blocks, each used to provide channels in small areas spread across the country, such that each area only has one channel (see Figure 5). Each block is suitable for one T-DAB, service, including the T-DAB variants known as T-DMB and DAB-IP.

5.14 Ofcom considers that, whether or not the existing constraints in the Maastricht Plan are relaxed, it would be possible to use each of the frequency blocks covered by that plan on a UK-wide basis. It would not, in particular, be necessary for use to be based on the pattern of local multiplexes, and frequency re-use, provisionally planned in 2002 (some constraints on geographic coverage within the footprint of the UK may however still arise as a result of incoming or outgoing interference constraints; these are discussed in this document).

**Figure 5: Maastricht 2002 T-DAB allotment plan for the UK**




5.15 The UK is a signatory to this Special Arrangement. This means that under the Special Arrangement the UK has certain rights to use this frequency band, and for that use to be protected from interference from other countries. The other signatories, including all of the UK's neighbours, have similar rights. The Special Arrangement includes modification procedures, so on a national level the UK has some degree of freedom (e.g. on specific network layouts) as long as it respects the constraints of the Special Arrangement. This means that technologies other than T-

DAB could be deployed in this band in the UK as long as the international coordination agreements set out in this plan are respected. Interference into adjacent bands (most notably to broadcasting-satellite services in the spectrum band above 1479.5MHz) also needs to remain within the limits defined in the Plan.

## The ECC decision

5.16 In 2003 ECC Decision (ECC/DEC/(03)02) designated 1479.5 – 1492 MHz for use for satellite digital audio broadcasting systems. This was done in an attempt to keep part of the overall allocation available for satellite broadcasting while balancing this with the need to make adequate spectrum available for T-DAB services.

5.17 The UK has not implemented this decision and is therefore not bound to designate the upper 12.5MHz of this band (1479.5 - 1492MHz) to the broadcasting satellite service (BSS). There are therefore no constraints arising from the ECC Decision on the UK's freedom to use the frequency band for any services whether BSS or not BSS. However, the UK will have to have regard to neighbouring countries that have implemented this ECC Decision (such as France and Ireland) and applied the procedures of the ITU-RR, and ensure that alternative uses in the UK do not cause interference (beyond the permitted limits) to any assignments internationally registered through the ITU, in these countries. Additionally, alternative uses would not receive protection from harmful interference from pre-registered BSS usage in neighbouring countries unless the UK assignments were introduced in accordance with the international frequency table and registered with the ITU

## Satellite filings

5.18 The options for use of the 1479.5 – 1492 MHz sub-band are constrained by the ITU Radio Regulations, which require us to protect internationally registered services, including satellite radio service reception, in neighbouring countries in the upper 12.5 MHz. Although some satellite radio broadcasts can be received in parts of the UK, the UK has not made any specific assignments to broadcasting satellite users in this band. There are however a number of satellite filings by other administrations, at various stages of notification that could impact the UK's ability to use the spectrum.

5.19 A filing has to move through three stages of co-ordination before it is registered into the ITU Master International Frequency Register ("the Master Register"). Once included in the Master Register, a network receives protection against interference from other networks with a later registration date, and other administrations must take the registered filing into account when filing their own assignments.

5.20 One USA assignment has been through all three stages of co-ordination and is recorded in the ITU Master Register (WorldSpace filing) for the full 40MHz (1452 – 1492 MHz). However, WorldSpace are currently only deploying in four small frequency bands in Europe with their AFRISTAR satellite, as indicated by their 'notified frequencies'[14]. The Maastricht Arrangement has involved the setting aside of the relevant provision in the Radio Regulations relating to the 1452-1492MHz band among the signatories to the Maastricht Arrangement. Hence a signatory to the Maastricht Arrangement is not likely to be in a position to claim right of interference protection for any satellite services in the 1452-1479.5MHz band from

[14] The notified frequencies are: 1469 MHz with a 3MHz emission, 1479.5 MHz with a 2.6MHz emission, 1479.5 MHz with a 3MHz emission and 1490 MHz with a 3MHz emission.

services transmitted within the jurisdiction of another signatory to the Maastricht Arrangement.

5.21 Four filings have been submitted by France which relate to European coverage. These filings are at the notification stage and cover 1479.5 – 1492MHz. These filings are junior to the WorldSpace/AfriStar network and France would need to obtain agreement from WorldSpace to begin services. The UK will have to provide protection from interference to these filings within the countries that have granted operational authorisation for each network.

5.22 Furthermore, there are around 120 filings at an advanced publication stage. These filings could move into the notification stage as soon as a formal request for coordination has been made, and coordination with existing networks has completed.

5.23 As a consequence of the ITU Radio Regulations, users of the1452-1492 MHz frequency band will need to take into account the interference protection they will need to give to the current (and any future) filings of satellite operators in the top 12.5MHz. Agreement with such operators on coordination arrangements may be uncertain.

5.24 A further discussion on the risk of interference resulting from these international arrangements is included below.

## Implications of the international arrangements

5.25 If there are no changes to the international arrangements described above then it is still likely that users of this spectrum will be able to use it for a variety of services. Although, the lower 27.5 MHz has been planned for T-DAB use, i.e. for audio broadcasting services, given the multimedia (T-DMB) and packet (DAB-IP) variants that are compatible with T-DAB the use is unlikely to be restricted to sound services. However although this option will allow potential operators to deploy a variety of services it does not allow the full benefits of a more technology and service neutral approach to be realised. Around Europe, there appears to be a desire for spectrum to be made available for a variety of uses, particularly mobile multimedia. As a result there may be opportunities to be able to realise some of those benefits.

5.26 Of all of arrangements described above, the two that are likely to have the most significant potential impact on users of this spectrum are the Maastricht 2002 Plan, and the protection from interference that the UK has to provide to satellite filings that are recorded in the Master Register.

### Potential impact of the Maastricht 2002 Special Arrangement

5.27 The Maastricht 2002 Special Arrangement divides the lower 27.5MHz of this spectrum into 16 blocks to be used for T-DAB that are each roughly 1.7 MHz in size and defines how international interference will be co-ordinated. It allows for some flexibility in transmitter deployment without coordination with neighbouring countries.

5.28 In the light of this, coordination with neighbouring administrations will be required for technologies other than T-DAB to be deployed. The spectrum is split into 1.7 MHz

blocks (including guard bands[15]) which creates particular co-ordination issues for technologies that wish to use greater bandwidths. The Maastricht Plan does not define how international interference should be coordinated in these guard bands. As a result, if someone wishes to launch a service that requires aggregating the spectrum into lots that are larger than 1.7MHz they run the risk that they will be in breach of the Maastricht Plan.

5.29 Ofcom recognises that this uncertainty is undesirable and has therefore considered how best to address it. Options identified include:

- Moving ahead under the current Maastricht Plan.
- Withdrawing from the Maastricht Plan
- Finding more flexibility within the Maastricht Plan through agreement with our international neighbours.

5.30 **Moving ahead under the current Maastricht Plan** leaves the uncertainty on spectrum usage rights with the bidders. This may in practice limit the use of this spectrum to T-DAB and technologies that fit within the technical parameters of T-DAB, such as T-DMB and DAB-IP.

5.31 **Withdrawing from the Maastricht Plan** would not solve the problem. The UK would lose its rights contained in the Arrangement and use of the spectrum would still require international coordination before it could be used with certainty. Negotiating the international agreements that would be required would be likely to be a lengthy process and withdrawal itself is a one year process.

5.32 **Finding more flexibility within the Maastricht Plan through agreement with our international neighbours** could provide a route to increase the flexibility of this spectrum without significant delays. Prior to a technology neutral award, bidders are likely to require a degree of comfort from our international neighbours to be confident of being able to deploy alternative technologies. Working within the framework of the Maastricht Plan to obtain this would seem to be the most likely route to obtaining agreement in a quick and expeditious manner.

5.33 Ofcom's preferred option is to seek additional flexibility within the framework of the Maastricht Plan through agreement with our international neighbours. However it should still be noted that gaining international agreement to use this spectrum in a more flexible manner remains a significant risk. However, there are a number of international developments that will provide a helpful backdrop to the international discussions. Those are:

- The Radio Spectrum Policy Group[16] (RSPG) Opinion on Wireless Access Policy for Electronic Communications Services (WAPECS) adopted in November 2005;
- The RSPG 's decision to develop an opinion on mobile multimedia (by October 2006); and

[15] A guard band is a narrow range of frequencies within which energy is not intentionally transmitted. It is included within a spectrum plan to improve the ability of wanted radiocommunications services using frequencies either side of the guard band to coexist without mutual interference

[16] The Radio Spectrum Policy Group provides opinions, to assist and advise the European Commission on radio spectrum policy issues.

- The proposed approach of CEPT members to the ITU's Regional Radiocommunications Conference (RRC-06) in May - June 2006

5.34 The RSPG Opinion on WAPECS is based on a long term policy goal "towards converged and coherent spectrum regulation, and this would require technological neutrality, service neutrality and coherent authorization mechanisms, taking into account that harmonization may be beneficial from the point of view of inter-operability and roaming capabilities of spectrum". Work is in hand on applying these principles and the RSPG is expected to review progress towards the end of 2006.

5.35 There is a strong desire for multimedia services around Europe, as such the RSPG is preparing an opinion on mobile multimedia services. An interim report is expected in May 2006 with a final opinion in October 2006. Preparation of this opinion is likely to encourage countries to think about how mobile multimedia services can be accommodated in the spectrum, with particular emphasis on broadcasting Bands IV and V and 1452 – 1492 MHz.

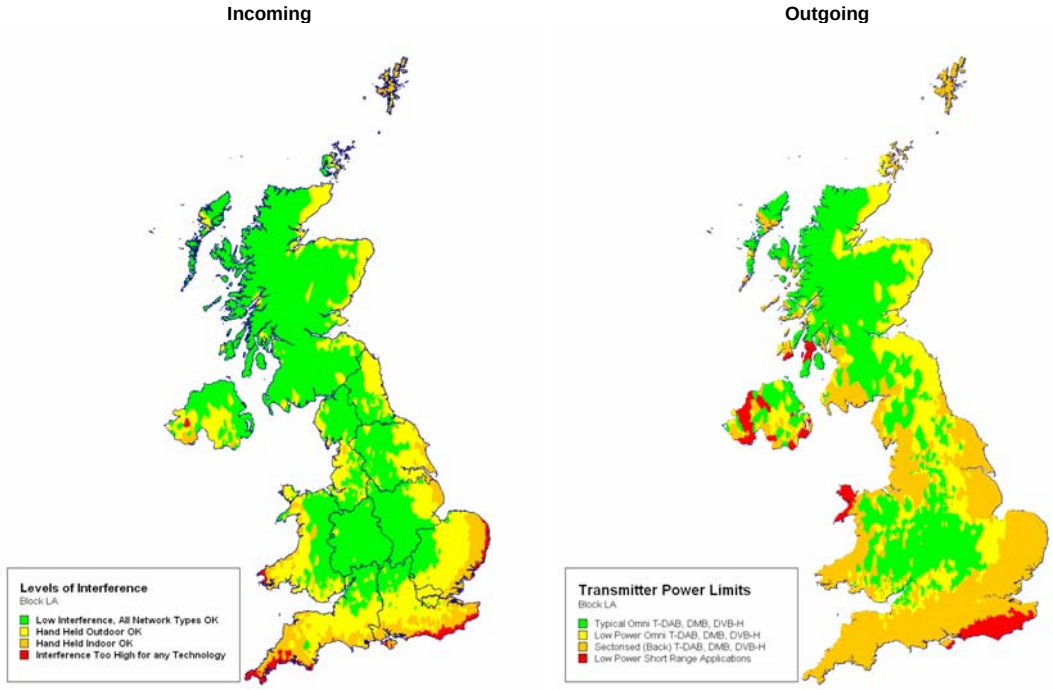
5.36 The RRC-06 is tasked with re-planning broadcasting Bands III (VHF), IV and V (UHF) and does not have any remit to consider the spectrum between 1452 and 1492 MHz. The plan produced by the RRC will be in the form of frequency assignments (or allotments) for digital broadcasting. However Europe will be proposing to the RRC that countries may use such assignments for any purpose so long as that use complies with the spectrum mask for broadcasting and does not demand any more protection from interference than would be offered to broadcasting. This proposal, especially if it is adopted by the RRC, could provide a useful precedent for introducing flexibility in other bands including 1452 -1492 MHz.

*Consultation question: Do you agree with Ofcom's proposed approach to address the international issues resulting from the Maastricht Plan applicable to the 1452 – 1479.5 MHz frequency band in this spectrum?*

5.37 Even if international agreement is achieved to allow more flexibility in the use of this spectrum, to allow readily the deployment of technologies such as DVB-H, use of this spectrum in different countries is likely to involve some element of cross-border interference. Any operator will have to contend with the incoming interference that the Maastricht Plan allows, while not rolling out a network that provides unacceptable outgoing interference. The effect and extent of the incoming and outgoing interference varies between the different spectrum blocks.

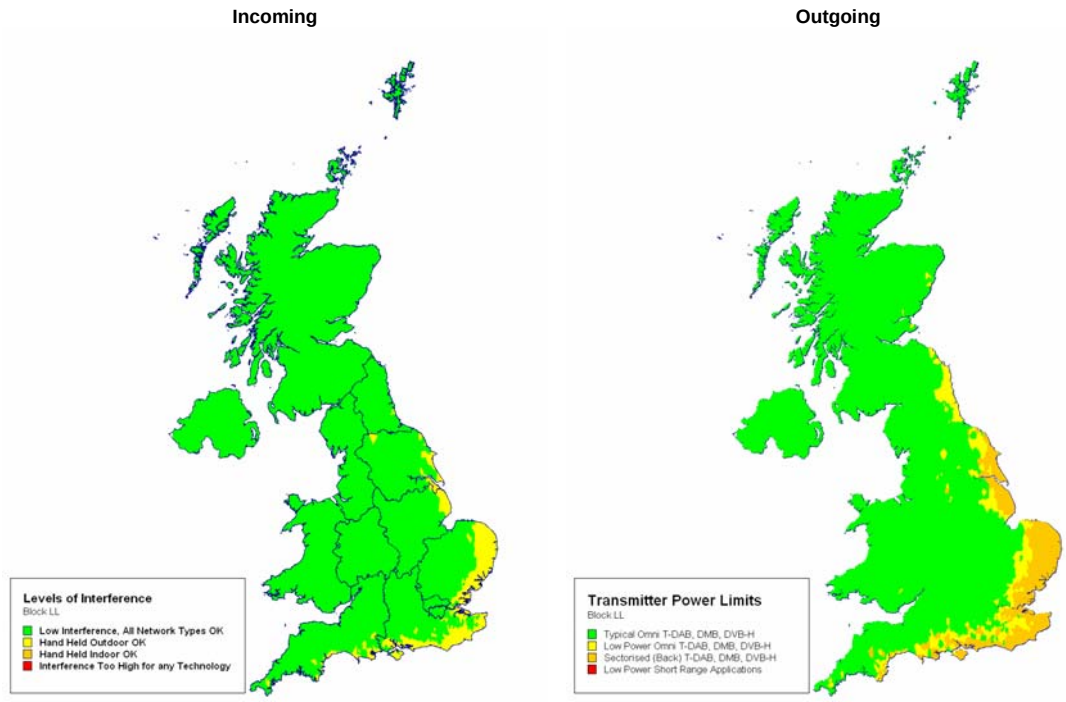
5.38 Figure 6 provides an example of the effect of incoming and outgoing interference to services in one of the blocks that is most affected (block LA), while Figure 7 provides an example in one of the blocks that is least affected (block LL).

**Figure 6: Effect of incoming and outgoing interference in block LA**




Source: Analysys Consulting and Mason Communications

**Figure 7: Effect of incoming and outgoing interference in block LL**




Source: Analysys Consulting and Mason Communications

5.39 Figure 8 below gives an indication of the percentage of the population and area that would be free from the effects of incoming interference from continental T-DAB systems as permitted by the Maastricht 2002 Special Arrangement. For each block it looks at the possible effect on typical networks that can provide coverage for different types of devices.

**Figure 8: Indicative population and area coverage that would be free from incoming interference within the limits permitted by the Maastricht Plan**

| Channel | Interference levels low enough for all network types | | Interference low enough for networks providing coverage for outdoor hand held devices | | Interference low enough for networks providing indoor coverage for hand held devices | |
|---|---|---|---|---|---|---|
| | Population | Area | Population | Area | Population | Area |
| LA | 44.7% | 55.0% | 85.8% | 87.1% | 96.8% | 97.9% |
| LB | 58.4% | 71.4% | 88.8% | 91.2% | 97.6% | 98.9% |
| LC | 53.8% | 67.3% | 88.5% | 91.8% | 98.6% | 99.4% |
| LD | 52.1% | 60.9% | 88.4% | 88.8% | 98.1% | 98.8% |
| LE | 54.3% | 57.9% | 94.0% | 91.3% | 99.3% | 98.1% |
| LF | 66.6% | 73.2% | 91.8% | 93.6% | 98.6% | 99.3% |
| LG | 56.4% | 67.8% | 89.6% | 92.8% | 97.7% | 99.2% |
| LH | 47.2% | 61.4% | 86.2% | 87.6% | 98.2% | 99.1% |
| LI | 86.1% | 86.0% | 99.9% | 99.5% | 100.0% | 100.0% |
| LJ | 51.6% | 63.1% | 87.4% | 91.2% | 96.7% | 98.7% |
| LK | 68.9% | 75.8% | 98.1% | 97.9% | 100.0% | 100.0% |
| LL | 89.7% | 93.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| LM | 58.7% | 67.5% | 89.2% | 91.0% | 95.4% | 98.0% |
| LN | 86.1% | 86.0% | 99.9% | 99.5% | 100.0% | 100.0% |
| LO | 74.2% | 72.7% | 96.0% | 96.0% | 99.6% | 99.6% |
| LP | 90.1% | 88.4% | 100.0% | 99.7% | 100.0% | 100.0% |

Source: Analysys Consulting and Mason Communications

5.40 Figure 9 below gives an indication of the percentage of the population and area that could be covered without causing outgoing interference to continental T-DAB systems (beyond that permitted by the Maastricht 2002 Special Arrangement). For each block it looks at the possible effect on different types of typical networks.

**Figure 9: Indicative population and area coverage that would be permitted without causing outgoing interference in breach of the Maastricht Plan**

| Channel | T-DAB, DMB, DVB-H transmitter type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low Power Short Range Applications | | Sectorised (back) and tri-sectored antennas for WiMAX and UMTS TDD | | Low power omni-directional | | Typical omni directional | |
| | Population | Area | Population | Area | Population | Area | Population | Area |
| LA | 100% | 100% | 94.7% | 95.9% | 44.9% | 58.3% | 28.2% | 39.4% |
| LB | 100% | 100% | 93.6% | 96.3% | 56.9% | 70.2% | 46.1% | 59.7% |
| LC | 100% | 100% | 93.0% | 95.3% | 51.3% | 68.2% | 36.0% | 50.8% |
| LD | 100% | 100% | 95.2% | 96.5% | 50.1% | 63.9% | 34.3% | 45.1% |
| LE | 100% | 100% | 92.8% | 94.8% | 50.7% | 63.3% | 32.0% | 42.4% |
| LF | 100% | 100% | 93.2% | 96.0% | 70.2% | 75.9% | 48.9% | 62.2% |
| LG | 100% | 100% | 90.9% | 93.7% | 42.7% | 57.6% | 25.2% | 38.3% |

| Channel | T-DAB, DMB, DVB-H transmitter type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low Power Short Range Applications | | Sectorised (back) and tri-sectored antennas for WiMAX and UMTS TDD | | Low power omni-directional | | Typical omni directional | |
| | Population | Area | Population | Area | Population | Area | Population | Area |
| LH | 100% | 100% | 87.6% | 90.9% | 43.8% | 59.4% | 30.3% | 46.2% |
| LI | 100% | 100% | 98.7% | 99.9% | 58.7% | 70.9% | 44.3% | 58.7% |
| LJ | 100% | 100% | 95.8% | 97.8% | 58.8% | 71.7% | 42.3% | 54.3% |
| LK | 100% | 100% | 98.6% | 99.4% | 64.2% | 74.2% | 44.4% | 60.8% |
| LL | 100% | 100% | 99.0% | 100.0% | 86.9% | 91.3% | 79.0% | 86.4% |
| LM | 100% | 100% | 88.5% | 92.6% | 60.7% | 71.3% | 45.4% | 56.6% |
| LN | 100% | 100% | 97.7% | 98.8% | 57.1% | 71.5% | 40.1% | 52.4% |
| LO | 100% | 100% | 98.3% | 98.9% | 73.7% | 77.0% | 25.2% | 62.4% |
| LP | 100% | 100% | 99.0% | 100.0% | 88.8% | 89.9% | 77.5% | 77.8% |

Source: Analysys Consulting and Mason Communications

5.41 In general the current analysis suggests that outgoing interference is likely to be the limiting factor when designing a T-DAB, DMB or DVB-H broadcast network within the UK, whilst incoming interference is likely to be the limiting factor for duplex WiMAX and UMTS TDD networks, due to the interference received at the network base station.

5.42 It should be noted that these results are only an indicative outcome based on one possible network rollout. There are a number of ways that an operator could achieve different coverage e.g. through a combination of changing the network density, the power and the height of the transmitters. Indicative maps for all the blocks similar to those above and further analysis on this and the satellite filings is available in the report from Analysys Consulting and Mason Communications, *International interference analysis for future use of 1452-1492 MHz range*, which is available on the Ofcom website.

## Potential impact of the satellite filings

5.43 The satellite filings in the top 12.5MHz of this spectrum pose a risk for potential licence holders in the UK, as, for those territories in the agreed service area of the satellite network, licensees will have to provide protection from interference to existing and potentially to future satellite networks which have complied with the international procedures resulting in their assignments being included in the Master Register. While it is possible that satellite operators will not deploy across the entire spectrum, they have the priority rights to deploy in all or any part of the 12.5MHz.

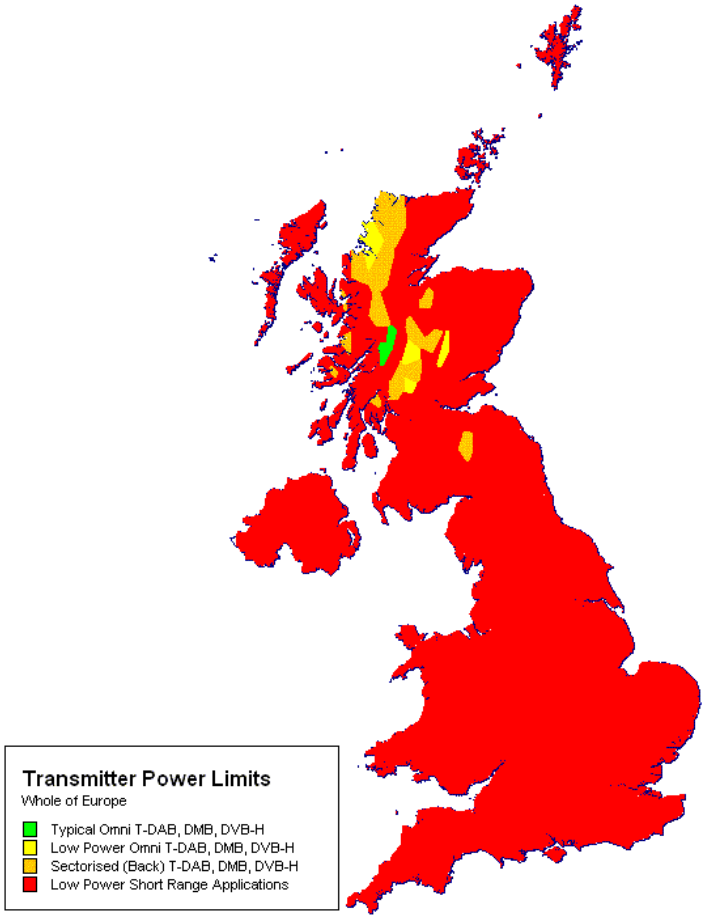
5.44 However it is also possible that the satellite services that have filed to use this spectrum will not be deployed. There are a variety of reasons (for example difficulties in raising funding), that could mean that an operator that has a filing for satellite services in this spectrum may choose not to launch. Even if they did wish to launch there is the opportunity for a UK licence holder to carry out bilateral negotiations with the satellite operator in order to be able to introduce non-satellite services.

5.45 As a result of the UK's obligation to protect satellite service reception of the filings against interference, terrestrial use of the top 12.5 MHz in the UK is likely to be severely constrained (an illustration of the possible total effect is in Figure 10).

5.46 As can be seen in the table at Figure 11 if the UK has to provide protection for satellite radio services in all of the continental neighbours listed below then, excluding low power, short range applications, no service seems likely to be able to cover more than 0.1% of the UK population. However, it may not be the case that all of these countries will wish to use this spectrum for this purpose.

5.47 This analysis looks at the effects of concessions to continental S-DAB users assuming that the protection limits defined in the Maastricht 2002 Special Arrangement are applied. It may be that the actual effects will not be as severe.

**Figure 10: UK area potentially affected by concessions to S-DAB users in continental countries**




Source: Analysys Consulting and Mason Communications

5.48 The extent of the constraints on use in the UK will vary depending on the country to which the UK has to offer protection for S-DAB services and on the services that are deployed in the UK. This is summarised in Figure 11 below which looks at the possible effect on UK coverage for different services that may result from protecting various countries satellite services.

**Figure 11: Percentage of UK's population and areas not affected by a requirement to protect non-UK S-DAB users in the top 12.5MHz**

| Country | T-DAB, DMB, DVB-H transmitter type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Low Power Short Range Applications | | Sectorised (back) and tri-sectored antennas for WiMAX and UMTS TDD | | Low power omni-directional | | Typical omni directional | |
| | Population | Area | Population | Area | Population | Area | Population | Area |
| Belgium | 100% | 100% | 39.2% | 58.4% | 24.7% | 46.1% | 19.2% | 40.0% |
| Germany | 100% | 100% | 44.5% | 59.3% | 24.9% | 43.0% | 17.1% | 35.1% |
| France | 100% | 100% | 33.5% | 51.2% | 15.8% | 38.0% | 11.5% | 32.3% |
| The Netherlands | 100% | 100% | 29.2% | 46.7% | 13.3% | 33.8% | 8.8% | 27.5% |
| The Republic of Ireland | 100% | 100% | 30.3% | 28.5% | 7.4% | 14.0% | 2.5% | 8.7% |
| Luxemburg | 100% | 100% | 98.1% | 98.9% | 88.2% | 91.0% | 76.1% | 83.0% |
| Norway | 100% | 100% | 72.4% | 62.6% | 54.7% | 47.6% | 34.3% | 38.8% |
| TOTAL | 100% | 100% | 0.1% | 4.9% | 0.0% | 1.1% | 0.0% | 0.7% |

Source: Analysys Consulting and Mason Communications

5.49 In addition, if continental countries claim protection for S-DAB services in Block LQ use of block LP (in the lower 27.5MHz) could be severely restricted due to adjacent channel interference and there could be an effect on block LO.

5.50 In the light of these restrictions there are several options for the award of the upper 12.5MHz:

- Simultaneous award now;
- Pan-EU award of upper 12.5MHz; or
- Separate award

5.51 **Simultaneous award now.** Both the upper 12.5 MHz and the lower 27.5 MHz (i.e. all available 40 MHz of 1452-1492 MHz) could be awarded as soon as possible. Such an approach would allow bidders to reflect the complementarity and substitutability of upper 12.5 MHz and lower 27.5 MHz blocks, leading to a more efficient outcome in the award. Such a simultaneous award would be quicker than the alternatives, and would give the market certainty about access to the top12.5MHz in the UK. It would result in spectrum for both satellite and terrestrial use being available at the same time, and allow parties interested in use of the top 12.5MHz to acquire spectrum in the lower 27.5MHz at the same time. This may be particularly relevant if (for example) a potential S-DAB operator also wants access to additional spectrum for terrestrial capacity.

5.52 In this option use of the upper 12.5 MHz is likely to be constrained by restricted terrestrial rights as a result of the need to avoid interference to satellite networks recorded in the Master Register. However, it would allow any party acquiring rights to the top 12.5MHz to use the spectrum for terrestrial services provided sufficient protection could be provided to satellite services outside the UK. This might be

achieved, for example, by deploying complementary satellite/terrestrial services, that achieve real-time co-ordination.

5.53 There might also be some increase in the complexity of the award process if both sub-bands are awarded at the same time.

5.54 **Pan-European award of upper 12.5MHz.** In the consultation responses a group of satellite-related companies voiced their concern over the regulatory uncertainty they will be faced with if each country has their individual award procedures. They argued that the resulting procedures would be complex, expensive and difficult to manage, inhibiting the development of international satellite systems. In principle, an award across a larger geographic zone (such as the EU) could be organised for the upper 12.5MHz. In such an award, externalities caused by different countries awarding the spectrum for potentially different uses would be taken into account. Spectrum could be more valuable if it is used for the same application across borders (due to coordination). Under this approach, there would be no need to reserve the spectrum for satellite use. Indeed, the wider geographic scope for the award would allow a wider range of services to access the spectrum, as the interference constraints identified above would be internalised within the award.

5.55 If such an approach could be implemented quickly, and under a framework that allowed the market to determine the optimum use of this valuable resource, this could be an efficient approach for releasing the spectrum for use. However, such an approach has not been carried out before and has risks associated with it – as well as possible significant delays. This assumes that a pan-European award would be acceptable to Member States and that it could be organised. There are doubts about the feasibility and acceptability of such an approach from the political and institutional point of view. Furthermore, it may take a lengthy process to gain international agreement on a technology and service neutral approach.

5.56 Moreover, under this approach, the award processes would not be able to reflect any complementarity or substitutability between the top 12.5 MHz and the bottom 27.5 MHz in the UK.

5.57 **Separate award.** The award for the upper 12.5 MHz could be separated from the award of the lower 27.5 MHz, and held at a different date on a UK-only basis. There are however no obvious advantages to this approach, as it would prevent bidders from reflecting the complementarity and substitutability of upper 12.5 MHz and lower 27.5 MHz blocks. This approach would also carry none of the advantages of an award process with a larger geographic scope.

5.58 Ofcom has a strong preference for a simultaneous award as soon as practically possible. The potential concerns with this option may be mitigated by Ofcom. For example, by attempting to define the usage rights more clearly prior to the award, through negotiations with our neighbouring countries (such as Ireland) on interference coordination. Also, auction design can focus on keeping the increased complexity that would result from a simultaneous award of the award process to a minimum for bidders.

5.59 Through their response to the SFR:IP, a group of satellite-related companies voiced their concern over the regulatory uncertainty they will exist if each country holds individual award procedures. They argued that the resulting procedures would be complex, expensive and difficult to manage, inhibiting the development of international satellite systems. They also argued that the spectrum should be

reserved solely for satellite use. There are, however, many markets in which companies' economic position is improved if they can acquire the rights to operate in multiple jurisdictions, as this enables them to realise larger economies of scale. There also many markets in which participants need to co-ordinate the acquisition of rights in different jurisdictions to optimise profitability. Ofcom does not propose to preclude use of this spectrum for satellite services in the UK. Operators of such services will be free to compete to acquire rights to the top 12.5MHz alongside other parties, through a transparent and non-discriminatory assignment process. They will also be free to acquire rights to use spectrum in other jurisdictions under whatever rules and procedures are adopted there.

5.60 The likely constraints on use of this spectrum have already been identified, and are likely to put severe restrictions on use of the spectrum for terrestrial services (at least those independent of satellite use). However, in Ofcom's view, to go further and preclude possible stand-alone terrestrial use is unnecessary and lacks objective justification. This approach could sterilise use of the spectrum for many years if satellite services are not, in fact, developed and deployed, or are commercially unsuccessful.

5.61 Ofcom also considers that, given the potentially significant delays and risks associated with awarding the spectrum through some new multinational process (such as a pan-European award), this is not the optimal solution. An approach on these lines would also make it difficult the realise the benefits of complementarity and substitutability with the other 27.5MHz of spectrum.

*Consultation question: do you agree with Ofcom's proposed approach to award of all the spectrum between 1452 and 1492MHz at the same time and as soon as practically possible (i.e. a simultaneous award of the top 12.5MHz and the lower 27.5MHz of this spectrum)?*

## Section 6

# Spectrum packaging

6.1 In this section, Ofcom describes its proposals and rationale for the packaging of the rights and obligations to be granted under the wireless telegraphy licences available.

6.2 Ofcom's wider principles for spectrum management, as set out in particular in the SFR and SFR:IP, suggest that, in general, decisions on how spectrum is used should be left to the market rather than determined by the regulator. However, spectrum needs to be 'packaged' in some way in order for Ofcom to make it available to the market. It is important that this is done in a way that facilitates efficient use.

6.3 In order to achieve this, Ofcom needs to have an understanding of the most likely uses of the spectrum, and to consider how this can be reflected in the packages offered to the market.

6.4 The proposals below have been prepared in light of the objectives identified for the award and in light of Ofcom's statutory duties. They take into account all the relevant evidence that is available to Ofcom, including the outcome of the consultation on the SFR:IP as well as the findings from the market assessment.

## Overview of proposals outlined in the SFR: IP

6.5 In the SFR: IP Ofcom offered an initial packaging option for the 40MHz of spectrum that is available for award. Ofcom proposed to auction the 12.5 MHz identified by the ITU for satellite broadcasting (1479.5 – 1492MHz) as a single licence, subject to constraints to protect reception of those satellite services in neighbouring countries. The remaining 27.5 MHz (1452 – 1479.5MHz) was proposed to be auctioned as more than one sub-band, enabling the establishment of a competitive environment in the provision of a range of services.

## Geographical coverage

6.6 Ofcom's proposal is to award this spectrum on a UK-wide basis. Very limited interest has been expressed in using this spectrum to provide services other than for the UK as a whole. Only two SFR:IP responses commented on this aspect of the award; whereas BT believes national licences are most appropriate, BAA would prefer local licences. Further evidence on market preference for national or regional licences was sought by the market assessment. During the course of a detailed interview programme, carried out as part of the market assessment, the preference from participants was for nationwide spectrum. Although some radio and multimedia providers may offer regional services, these would be part of a national portfolio.

6.7 In general it is more spectrally efficient to allocate spectrum across the UK as a whole rather than at a more granular level. This is due to the need to leave spectrum unused between different geographical services in order to avoid interference. In contrast, an operator offering the same services across the UK would not need to leave any gaps in its coverage so would be able to use the available spectrum more efficiently. Northern Ireland is different in this respect from other parts of the UK in that it shares a land border with the Republic of Ireland but not with the rest of the UK. This issue has however been successfully addressed in relation to other

services and other spectrum bands through close bilateral co-ordination between respective spectrum administrations and operators.

6.8 In addition, for satellite services (one of the potential users of this spectrum) it would not be realistic for services to be offered at a regional level. If a prospective satellite operator did not win spectrum covering all of the UK, they would have to rely on the secondary market to complete their coverage. However, the secondary market may not be sufficiently mature to support this approach – leading to possible delays in services being available for consumers. Moreover, relying on the secondary market may increase complexity due to the possible need to negotiate with multiple spectrum right holders in order to secure sufficient spectrum to complete their coverage. A further consideration is that relying on the secondary market could take a significant amount of time, with the associated costs from delay that this would entail.

6.9 On the other hand, if a bidder is interested in offering a portfolio of regional services only, they would be able to purchase spectrum for that purpose and if desired, sell-on unused spectrum on the secondary market.

6.10 Ofcom therefore considers, talking all these considerations into account, that the spectrum should be offered on a UK-wide basis.

## Spectrum requirements

6.11 In deciding what packaging approach is most appropriate for this band, Ofcom needs to take into account the range of technologies that may be deployed as well as their frequency requirements. In the consultation responses, there was a mixed view on the required spectrum endowment. Various respondents to the consultations each requested a different sized spectrum package:

- Digital One proposed 1.5 MHz frequency blocks, suitable for T-DAB and enabling harmonisation with the rest of Europe;
- BBC suggested compatible blocks of 5, 6, 7 or 8 MHz for DVB-H;
- BT proposed a maximum of two licences in the lower 28 MHz to enable broadband;
- Crown Castle proposed a 5 MHz band plan to enable the delivery of multimedia services using DVB-H; and
- ESOA and GVF suggested releasing all 40 MHz as a single block.

6.12 Although there is a variety of different technologies that could be deployed in this band and the amounts of frequency they require vary widely (see section 2), these different technologies are broadly compatible in that use of the band by one technology would not preclude the use of adjacent spectrum by a different technology (albeit there may be a need for a guard band between the technologies). Therefore, it is feasible that a combination of these technologies could eventually be deployed in this band.

## Compatibility with other uses

6.13 It is necessary to consider whether the value of specific blocks within 1452-1492 MHz could vary as a result of the type of technology deployed either within the UK

band or in adjacent spectrum. If there were significant variations then the packaging options would also have an impact on auction design. For example, if there is demand for both small and large amounts of contiguous spectrum and individual lots are therefore made relatively small, then the auction design will need to take into account potential aggregation risks for bidders seeking the larger amounts of spectrum.

6.14 One consideration is that potential users may have a preference for contiguous spectrum. If the spectrum is to be used for S-DAB services, this type of user is likely to prefer specific spectrum at 1479.5 – 1492 MHz, in order to be compatible with likely uses elsewhere in Europe. All of the other technologies could in principle be deployed anywhere within the available spectrum, although there are the issues relating to compatibility with potential overseas satellite digital radio operators in the upper 12.5 MHz as described in Section 5 above.

6.15 T-DAB, DMB, DVB-H and digital camera technologies could all be deployed in adjacent spectrum using combinations of 1.7 MHz blocks without causing undue interference (to services operating within the Maastricht Plan). The main reason for this being that the allocations under the Maastricht Plan include guard bands within the 1.7 MHz allocations. However, if the spectrum were to be used to deploy broadband wireless technologies in spectrum adjacent to digital radio and multimedia technologies then there would need to be additional separation between technologies. Further, if satellite digital radio is deployed in the lower part of the upper 12.5 MHz then there would need to be power restrictions on adjacent terrestrial services to prevent interference with the satellite signal.

## Packaging options

6.16 Ofcom's aim in packaging spectrum is to divide the spectrum in such a way that makes it feasible for diverse range of potential users to bid for a package which can accommodate the technology of their choice. Devising different packaging options involves Ofcom assessing the most likely technologies to be deployed in the band and consequently packaging the available spectrum in lots depending on the requirements of the technologies. Although potential users will have the ability to aggregate or disaggregate spectrum packages after the initial award, and to change use within the terms of their licences, attempting to assign spectrum efficiently through the initial award process is in keeping with Ofcom's statutory duties.

6.17 Due to considerable differences in regulatory constraints within the 1452 – 1492MHz spectrum band, Ofcom believes that there may not be one preferred packaging option that applies to all 40MHz of available spectrum. As outlined in the SFR:IP and in section 5, the two sub-bands within the 1452 – 1492 MHz band are subject to different international agreements. Most pertinently, the upper 12.5 MHz of this band has been designated for S-DAB services, whereas the Maastricht Plan allocates the lowest 27.5 MHz to T-DAB. These differing regulatory conditions are likely to impact the value of frequencies in these sub-bands for different bidders considering deploying different technologies. Therefore, it may be appropriate to have different packaging proposals for these different sub-bands.

### Packaging options for the lower 27.5 MHz

6.18 In principle, there are numerous ways in which the 27.5MHz of spectrum available between 1452-1479.5MHz could be packaged. To facilitate a useful discussion,

Ofcom assess four broad options for packaging the lower 27.5 MHz of the available spectrum, namely:

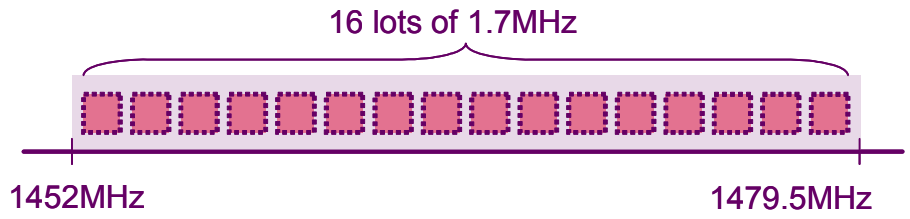
- Option A: package in 1.7 MHz lots
- Option B: package in 5.1 MHz lots
- Option C: package in varied-sized lots
- Option D: package as one 27.5 MHz lot

The discussion that follows assumes that the UK is successful in securing international agreement to a more flexible approach to implementation of the Maastricht Plan. In the event that this is not the case, the considerations relevant to individual options may be subject to change

## Option A: package in 1.7 MHz lots

6.19 Ofcom could package the spectrum in lots of approximately 1.7 MHz (see Figure 12), with 1.7 MHz being the lowest common denominator of spectrum requirements across all the technologies and consistent with the allocation from the Maastricht Plan. With this approach to packaging it would be possible for bidders to achieve a wide range of other combinations of spectrum by amalgamating these blocks. For example, three contiguous lots of 1.7 MHz could be combined into one 5.1 MHz block, the suitable amount of frequency for a single channel for a number of the candidate technologies.

**Figure 12: Option A: package in 1.7MHz lots**




Source: Ofcom

6.20 As this option can accommodate in the primary award process all of the technologies identified in the demand assessment, to the extent that different bidders successfully bid for different blocks of 1.7 MHz lots for competing applications, competition in downstream markets will be promoted. Furthermore, as noted above, 1.7 MHz blocks are in line with the allotment plan in the Maastricht Plan, offering a framework for international interference coordination, however individual 1.7 MHz lots have different interference constraints based on the allotment plan set out in this international agreement. Dividing the spectrum into lots of this size makes these differences between lots explicit, and aids the market in finding optimum combinations of lots.

6.21 A benefit of this packaging option is that a wide variety of award outcomes are possible. As an example, the award outcome in Figure 13 below is one illustrative outcome. Here several bidders have successfully acquired individual 1.7 MHz lots (potentially for deployment of T-DAB and T-DMB services), whereas another bidder has aggregated a contiguous spectrum block of 8.5 MHz (5 * 1.7 MHz lots – potentially for the deployment of an 8MHz channel mobile multimedia service) and another bidder has compiled a contiguous 10.2MHz block (6 * 1.7MHz lots – potentially for the deployment of a broadband wireless service, assuming adjacent channel provisions are adequate between the services).

**Figure 13: Illustrative outcome from award using Option A**


Source: Ofcom

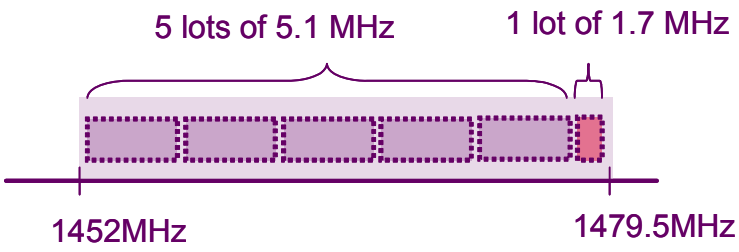
6.22 A disadvantage of this packaging option is the complexity of the resulting award process (compared to offering the spectrum as a fewer number of lots), since 16 different lots are on offer between 1452 – 1479.5 MHz.

6.23 Furthermore, to the extent that packages of aggregated lots are not explicitly available, those users requiring larger spectrum packages run an aggregation risk in the award process. For example, a bidder looking to aggregate three 1.7 MHz lots into a 5.1 MHz package might only successfully win two contiguous lots after being out-bid on the third lot. This creates the risk of sub-optimal outcomes: although these might be resolved in a secondary market, this may be less desirable than achieving an efficient outcome in the primary process, given search and transaction costs.

Option B: package in 5.1 MHz lots

6.24 As another packaging option, the band could be divided into five 5.1 MHz blocks (and one remaining 1.7 MHz lot). The 5.1 MHz lots consist of three 1.7 MHz lots, pre-compiled by Ofcom and as illustrated in Figure 14 below.

**Figure 14: Option B: package in 5.1MHz blocks**




Source: Ofcom

6.25 An illustrative outcome of this packaging option is shown in Figure 15. In this illustration, one bidder has successfully acquired two contiguous 5.1 MHz blocks to compile a 10MHz block while other bidders have acquired one or more 5.1MHz blocks and one bidder has acquired the single 1.7MHz block.

**Figure 15: Illustrative outcome from the award using Option B**


Source: Ofcom

6.26 This approach removes the aggregation risk for users looking to acquire spectrum blocks of 5.1 MHz, as they can now directly bid for these packages. Therefore, this approach would be suitable for DVB-H and other applications seeking to use contiguous 5.1 MHz spectrum blocks. A further advantage is that decreasing the number packages that bidders can bid for would reduce the complexity of the award process.

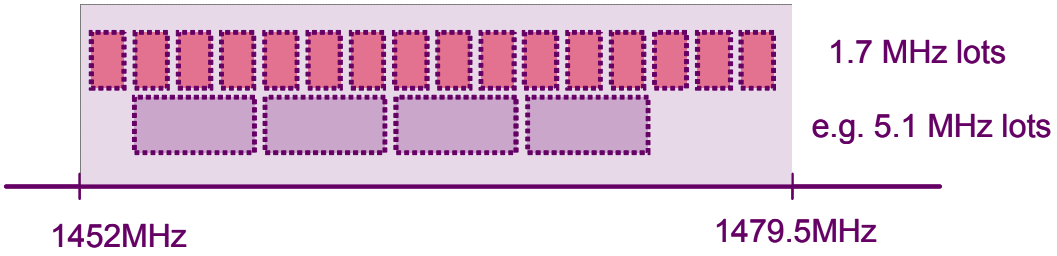
6.27 However, this packaging option also has associated disadvantages. For example, a bidder with plans for a mobile multimedia service might have built a business plan around a service requiring 6, 7 or 8 MHz channels, instead of 5.1MHz. Similarly, bidders interested in acquiring spectrum in blocks of 1.7 MHz (even if interested in acquiring multiple contiguous blocks) would be forced to bid for blocks of 5.1 MHz. The result could be an inefficient (sub-optimal) spectrum allocation, whereby bidders would be relying on the secondary market to resolve their spectrum needs.

6.28 A further disadvantage of this approach revolves around the pre-compiling of spectrum packages by Ofcom. The combination of spectrum, which could be considered to be the 'obvious answer', as illustrated above, may in fact not be the most efficient packaging of the available spectrum. As the geographical interference constraints of individual 1.7 MHz lots differ (as set out in the Maastricht Plan), pre-aggregating lots in larger spectrum packages involves Ofcom making assumptions and judgements about optimum deployments and market valuations. It is Ofcom's view that such decisions are best left to market participants, whose knowledge of these technologies and potential deployments makes them better placed to make judgements about how to package up the available spectrum.

## Option C: package in varied-sized lots

6.29 A wide range of packaging solutions can be devised, using spectrum blocks of varying sizes. For example, it would be possible to divide the 27.5MHz of available spectrum into several lots of differing sizes, such as a combination of 1.7MHz lots, 5.1MHz lots (aggregating three 1.7MHz lots), and 8.5 MHz lots (aggregating five 1.7MHz lots). Figure 16 shows an example where bidders can choose to bid for 1.7MHz blocks and 5.1MHz blocks.

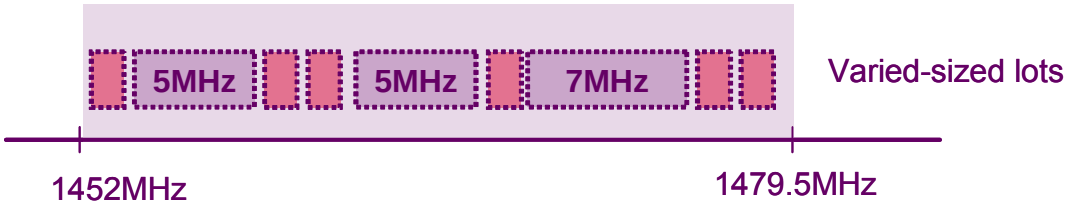
**Figure 16: Option C: package in varied sized lots**




Source: Ofcom

6.30 Figure 17 below illustrates a possible outcome where several 1.7MHz lots and 5.1MHz lots are made available. The auction allowed the 1.7MHz and 5.1MHz blocks to be interspersed and complied. In the illustration one bidder has complied a 6.8MHz block (1*5.1MHz and 1*1.7MHz block, while two others have acquired 5.1 MHz blocks and the other bidders have acquired one or more 1.7MHz blocks.

**Figure 17: Illustrative outcome from award using Option C**




Source: Ofcom

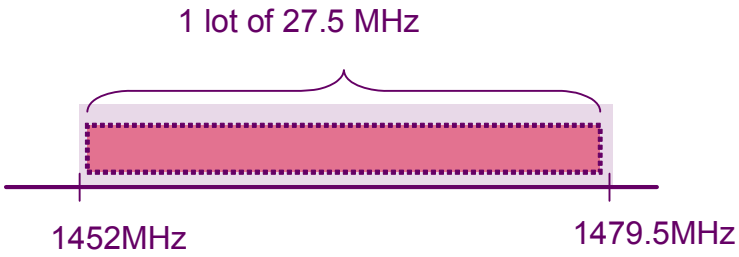
6.31 This packaging option holds the same advantages as mentioned under option B (package in 5.1 MHz lots), namely a diminished aggregation risk for users looking to acquire spectrum blocks in the sizes that the blocks are made available. Furthermore, relative to option B and depending on the exact division of the band into the different sized lots, a greater number of bidders may be given a fair chance to participate in this auction, as bidders requiring (multiples of) 1.7MHz lots and bidders requiring other sized lots can both be accommodated. Therefore, compared to option B, there is scope for a greater variety of downstream uses (which may or may not be more economically efficient), as there is greater opportunity for bidders seeking to adopt technologies with different spectrum requirements to successfully participate in the award process.

6.32 However, the division of the spectrum in varied-sized lots would involve considerable judgement on the part of Ofcom, with Ofcom having to make judgements in terms of which technologies can ideally be deployed where in the spectrum, and how much demand there would be for each technology. As interference constraints of individual lots differ (due to the interference coordination as set out in the Maastricht Plan), pre-compiling lots in various larger spectrum packages also involves Ofcom making assumptions about optimal deployments and market valuations. It is Ofcom's view that such decisions are best left to market participants, whose knowledge of these technologies and potential deployments makes them better placed to make judgements about how to package up the available spectrum. Furthermore, this approach would not be consistent with Ofcom's approach of technology neutrality, as choice of package size may be advantaging particular technologies in particular parts of the band for no objective reason.

Option D: package as one 27.5 MHz lot

6.33 Ofcom could make the spectrum available as one lot of 27.5MHz as shown in Figure 18.

**Figure 18: Illustration of Option D**




Source: Ofcom

6.34 This option would enable one bidder to purchase the entire spectrum block and subsequently deploy across all, or part, of the spectrum while having the ability to sell unwanted frequencies in the secondary market. Offering the spectrum as one block minimises involvement from Ofcom, as the regulator will not need to second-guess potential uses and consequently package spectrum in blocks suitable for these potential uses. Also, the resulting auction can be relatively quick and simple.

6.35 However, there are serious downsides associated with this packaging option. Making spectrum available to the market in one large block excludes from the auction many potential users who only require part of the spectrum. As seen in the assessment of market demand, most potential bidders are looking to deploy technologies that could require much smaller frequency lots. A one lot packaging option where the efficient allocation would be for several users to acquire the spectrum would therefore rely on an efficient secondary spectrum market, where this spectrum can be divided further and sold on to other uses. However, as there will likely be some inefficiency in a secondary market (e.g. incomplete information or transaction costs), and because the need for (immediate) secondary trades only arises when there is an inefficient primary allocation, Ofcom's statutory duties imply that it should aim to achieve efficient outcomes in the primary assignment.

6.36 There is significant evidence in academic literature to support Ofcom's concern. In their academic paper on bilateral bargaining inefficiencies, Myerson and Satterthwaite[17] argue that a bilateral trade may fail, even when it would have been efficient to trade, due to incomplete information. Furthermore, Diamond[18] observed that secondary markets may suffer frictions in bringing together buyers & sellers due to search costs – especially if the market is thin. This also has implications for the secondary spectrum market. In the spectrum area, Milgrom[19] was the first to identify the need to get a primary assignment as efficient as possible, because secondary markets are not fully efficient. Given these inefficiencies, there is a risk (and an

[17] Myerson, R. and Satterthwaite, M. (1983) 'Efficient Mechanisms for Bilateral Trading', Journal of Economic Theory, 29, 265 - 281
[18] Diamond, P. (1982), 'Aggregate demand management in search equilibrium', Journal of Political Economy 90(5), 881-894
[19] Milgrom, P. (2004) 'Putting Auction Theory to Work', Cambridge University Press, Chapter 1

opportunity cost) that outcomes that might deliver greater overall benefits if they were achieved in a primary award may be precluded if there was a reliance on the achieving them in a thin secondary market.

6.37 A further consideration is that if an efficient allocation would have led to multiple successful bidders, competition in downstream markets and service variety is unlikely to be promoted under this approach, as only one bidder can acquire the spectrum.

## Overview of packaging options for lower 27.5MHz

6.38 Ofcom has identified and assessed four possible packaging options for the lower 27.5 MHz. Figure 19 below gives an overview of these packaging options, together with their respective advantages and disadvantages.

**Figure 19: Summary of the advantages and disadvantages of the four possible packaging options**

| | Advantages | Disadvantages |
|---|---|---|
| **Option A: package in 1.7 MHz lots** | Promotes competition<br><br>Different interference constraints between lots are made explicit<br><br>Market can determine optimum aggregation<br><br>Maximum accommodation of alternative uses | Aggregation risk for users requiring larger amounts of spectrum *(may be mitigated through appropriate auction design)*<br><br>Sub-optimal outcomes would need to be resolved in the secondary market<br><br>Larger number of lots tend to add complexity to the award process |
| **Option B: package in 5.1 MHz lots** | Removes aggregation risk for users requiring (multiple of) 5.1 MHz lots<br><br>Less complex award process (fewer lots) | Unsatisfactory for users not seeking (multiples of) 5.1 MHz. These users would need to rely on secondary trading which may involve high transaction costs<br><br>Risk of regulatory failure through picking the sub-optimal package size<br><br>Potentially inconsistent with approach of technology neutrality, as choice of package size may favour certain technologies |
| **Option C: package in varied-sized lots** | May removes aggregation risks for users requiring particular amounts of spectrum<br><br>Potentially allows a greater variety of uses (than options B and D) and reduced aggregation risk than option A | Larger number of lots tend to add complexity to the award process, though this can be mitigated through the auction design |
| **Option D: package in one 27.5 MHz lot** | Quick and simple award process<br><br>Minimal involvement from Ofcom | Spectrum may be allocated inefficiently and relies on an efficient secondary market (which at present is unlikely)<br><br>Potentially restricts the development of competition and variety of applications |

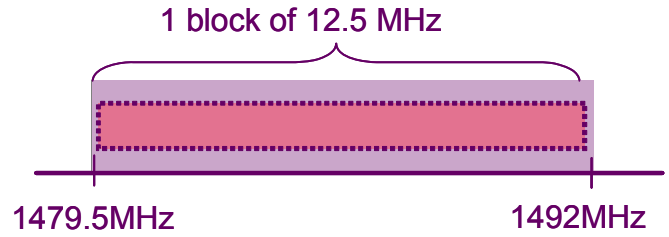
6.39 Although these four broad spectrum packaging options have been identified and assessed by Ofcom, variants are possible. For example, Section 7 discusses how it may be possible to allow the market to choose between alternative packages without creating undue aggregation risks for bidders by using combinatorial bidding

*Consultation question: What are your views on the appropriate packaging for the lower 27.5 MHz of this spectrum?*

## Packaging options for the upper 12.5MHz

6.40 In principle, the same packaging options can be used for dividing the upper 12.5 MHz into spectrum lots (i.e. 1.7 MHz lots, 5.1 MHz lots, varied-sized lots and one 12.5 MHz lot) each with their own relative advantages and disadvantages. However, as opposed to the lower 27.5MHz, it may not be as appropriate to package the upper 12.5MHz sub-band in smaller lots. It is Ofcom's view that the uncertainty regarding satellite service deployments in the upper 12.5 MHz, together with the requirement on UK operators to provide interference protection to overseas deployments, means this sub-band would likely be most efficiently used if it were awarded as one block (see Figure 20).

**Figure 20: Allocate lower 12.5MHz as a single Block**




Source: Ofcom

6.41 As described in section 5 several administrations have filed with the ITU for registration of satellite services in the Master Register. Once filings are included in the Master Register, the networks of these operators can claim interference protection from other networks. In particular, five filings relate to European coverage, and cover the entire1479.5 – 1492MHz band. It is not clear from these filings which frequencies will actually be deployed, and how they will be deployed (i.e. satellite transmission vs. terrestrial in-fill). Furthermore, deployments may change over time as operators launch new networks or amend existing ones.

6.42 The requirement to provide interference protection to satellite reception of these filed networks has serious implications for the bidders in the 1452-1492 MHz auction. At the time of bidding for the spectrum, it will not be possible for the bidders to know exactly where in the upper 12.5MHz spectrum block satellite digital radio services will be deployed. As bidders cannot be certain about (future) interference received from, or more importantly, interference protection that they will be required to give to overseas operators within specific parts of the sub-band, awarding this sub-band in smaller lots would mean that bidders would face substantial uncertainty in valuing these smaller lots.

6.43 A further consideration is that over time it is possible that the overseas satellite operator will seek to change its spectrum use within the upper 12.5 MHz. If this were to occur, a successful bidder in the UK which did not initially interfere with the overseas satellite operator, may have to change its service provision in order to provide protection if the overseas satellite operator were to change its spectrum use.

6.44 Consequently, it is Ofcom's view that assigning this sub-band as one lot (leaving coordination with overseas satellite operators to the winning bidder) is more likely to lead to an efficient allocation of the available spectrum. Bidders for this one block would need to take into account the uncertainty with regards to overseas satellite deployment, and consider the risks associated with the need to negotiate with these overseas satellite operators.

6.45 The award of this 12.5 MHz sub-band as one lot is also suitable for satellite digital radio operators.

*Consultation question: Do you agree that the upper 12.5 MHz of available spectrum should be awarded as one lot?*

## Section 7

# Auction Format

7.1 Ofcom has set out in section 4 its view that an auction is the most appropriate way of awarding this spectrum. This section sets out the particular auction design which Ofcom proposes to use for the auction of licences for the use of the 1452-1492 MHz band and the following section sets out the more detailed rules. Ofcom has developed these proposals with advice from its independent auction advisers.

7.2 In awarding spectrum, Ofcom's aim is to ensure that so far as possible it facilitates the achievement of the award objectives outlined at section 4. In general, assuming no market failures, how much someone is willing to pay for spectrum is likely to be the best guide to who can use the resource most efficiently. An auction can be a robust way to elicit this information, and Ofcom considers that in general it is likely to be superior to alternative mechanisms such as beauty contests or assigning on a 'first come first served' basis, as discussed in section 4.

7.3 Policy makers have a number of choices at their disposal in defining how the auction should be designed. They have to set both the format of the auction and design the rules for running the auction and deciding on the winners. The choice of auction rules will often depend upon the format chosen. The format of the auction covers issues such as whether:

- the bidders can see each others bids (called an open auction) or whether each bid is secret (sealed bid auction);
- bidders can bid for all lots at the same time or for one lot after the other (simultaneous vs. sequential bidding);
- bidders bid for one item, or combinations of items (known as combinatorial or package bidding).

7.4 The remainder of this section examines some practical concerns in deciding upon an auction design, followed by a discussion on the key choices in selecting an auction format. Two potential auction formats for the award of the 1452 – 1492 MHz band are set out briefly at the end of this section. A more detailed account of these auction formats, can be found in annex 9. Finally, this section ends with an account of some general auction rules associated with these auctions.

## Practical concerns in auction design

7.5 An auction may produce more or less efficient outcomes depending on the details of the auction design and the context within which the auction takes place. The economic literature on auctions suggests that in auction design, as in other areas of regulatory policy, it is especially important to address issues such as encouraging participation in the auction, and reducing the potential for collusive behaviour. Some examples of issues to be taken into account in auction design are as follows:

- There may be asymmetries between potential bidders in the auction, as a result of differences in their current market position and the information available to them about the market opportunity offered by the spectrum, or because of differential access to finance (possibly as a result of capital market inefficiency). This may

encourage perceptions that some bidders (e.g. incumbent operators) are 'strong' and others (e.g. prospective entrants) are 'weak', even if in some cases, a 'weak' bidder might have the strongest business case. Where asymmetries are significant, weak bidders may be reluctant to invest time and effort in entering the auction, with the consequence that the auction may be less competitive and effective than it might have been. Auction theory and practice has demonstrated that open, multi-round auctions tend to discourage entry by 'weak bidders', who fear that they will simply be overbid until they lose. By contrast, the use of sealed bids and/or restrictions on transparency can help to ease the impact of asymmetries, as 'weak' bidders perceive themselves to have a better chance of winning. This may encourage competition within the auction.

- Some auction designs may be vulnerable to strategic behaviour by bidders attempting to influence the auction outcome in their favour. For example, (especially in auctions with pricing rules other than pay what you bid) it may sometimes be possible for strong bidders to collude, tacitly or otherwise, to fix the number of licences or influence the price that they pay. Similarly, in multiple round auctions, it is sometimes possible for bidders to use their bids to signal their intentions to each other, creating potential scope for tacit collusion to share resources or to restrict purchase prices.

7.6 A further potential problem that requires consideration when designing the format of an auction is the situation where bidders have a high degree of common value uncertainty on licences, such that they are potentially exposed to the problem of 'the winner's curse'. This arises because those bidders who over-estimate the value of licences in a common value setting are likely to win. Rational bidders should respond to this problem by reducing their bids relative to their best estimates of value. Nevertheless, the common value uncertainty faced by bidders can result in problems, either because differences in the assessment of common value may swamp small differences in the true value across bidders or else because winner's curse affects weak bidders more greatly than strong bidders, exacerbating their disadvantages. Common value uncertainty can be eased by using open, multi-round auctions and high transparency, as bidders can learn from the bidding behaviour of competitors.

## Key choices in selecting the auction format

7.7 There are a number of different auction formats available, which may be suitable for the award of multiple lots of spectrum frequencies. In selecting the appropriate format for this auction, it is helpful to consider four key choices in design:

- Simultaneous or sequential sale of lots;
- Single round (sealed bid) or multiple rounds (ascending bids);
- Generic or specific lots;
- Package (combinatorial) bidding.

7.8 With the support of independent auction advisers, Ofcom has come to the conclusion that using a simultaneous, multiple round process is the most appropriate approach for this specific award, rather than sequential or single round formats. We also believe that it is appropriate to use specific lots rather than generic lots. However, the

arguments for and against using package bidding in the auction are more finely balanced.

## Simultaneous or sequential sale of lots

7.9 If the spectrum is awarded as multiple lots (see section 6 on packaging proposal) these can be sold either simultaneously (all at the same time) or sequentially (one after the other). An important consideration for this award is the substitutability and complementarity of the different spectrum lots. For most categories of bidders (with the exception of satellite operators identified as being primarily interested in a single spectrum lot for the upper 12.5MHz), multiple lots in this band would potentially be close substitutes. This means that bidders' preferences between lots will be significantly affected by the relative prices of individual lots. Further, the demand assessment identified that most bidders are likely to bid for multiple lots, some on a contiguous basis. This means that lots are also complementary.

7.10 The effect of this substitutability and complementarity of the different spectrum lots is that most bidders are potentially exposed to both substitution and aggregation risks. Substitution risk refers to the risk that a bidder may win one lot (or group of lots) when, at the prevailing prices, it would have preferred to win another lot (or group of lots instead) instead. Aggregation risk denotes the risk that a bidder may win a lot (or lots) but fail to win complementary lots.

7.11 Sequential auctions create severe difficulties for bidders where lots are either substitutes or complements. In a sequential auction bidders must bid for one lot without knowing what the price of other substitute lots will be (e.g. substitution risk) or whether they will be successful in winning complementary lots (e.g. aggregation risk). By contrast, a simultaneous approach can allow bidders to manage aggregation and substitution risk across lots.

7.12 These substitution and complementarity issues are present throughout the whole of the available 40 MHz spectrum. However, the substitution risks between the upper 12.5 MHz and the lots in the lower 27.5 MHz could be less than the substitution risks between the spectrum lots within the lower 27.5 MHz. This is because of the international constraints that are placed on the use of the spectrum in the upper 12.5 MHz block, which means that the spectrum in the upper 12.5 MHz is less directly substitutable for the spectrum in the lower 27.5 MHz.

## Single round (sealed bid) or multiple rounds (ascending bids)

7.13 Both single round, sealed bid and multiple round, ascending bid auction formats are commonly used for assigning radio spectrum. Sealed bids are often favoured for their simplicity and because, where there are significant bidder asymmetries and related concerns about the level of competition in the auction, they can encourage participation. However, in the absence of concerns about competition, multiple round auctions are considered to produce more efficient outcomes as bidders can learn from observing the behaviour of competitors over the course of the auction. Ofcom proposes to award the 1452 – 1492 MHz spectrum through a multiple round process, as opposed to a single round sealed bid format, for the following reasons:

- In situations of common value uncertainty, the outcome of the auction will be enhanced if bidders are able to observe the behaviour of their rivals over the course of multiple rounds. Many of the technologies that could be deployed in this band are for provision of new services, so there is significant value uncertainty. At

the same time, there may be bidders targeting very similar downstream markets, so they will have a high degree of common value. Hence, bidders may benefit greatly from being able to observe how their competitors shift demand – including both total demand and demand for specific lots – in response to prices.

- As discussed above, most bidders will face significant substitution and aggregation risks. If the auction does not enable bidders to respond to relative prices, lots might not be distributed to the bidders with the highest value, resulting in inefficient allocation. For example, bidders may end up paying a high price for some lots when substitute lots could have been purchased at a lower price. Alternatively, in terms of complementarities, bidders may fail to acquire sufficient contiguous lots, or they may bid conservatively, which might lead to them inefficiently failing to win a licence (i.e. risk of unsold of lots). By allowing bidders to shift between lots and adjust their demand in response to changes in relative prices, these risks can be addressed.

7.14 Although multiple round auctions are generally more complex to participate in than sealed bid contests, the benefits of simplicity are not so great that this could justify using a significantly less efficient auction format. Ofcom will ensure that bidders are well informed about the auction design and its procedures prior to the award, through bidder seminars.

7.15 It is also relevant to consider that while the mechanics of participating in a multiple round auction are generally more complex for bidders than participating in a single round sealed bid auction, in other respects a single round sealed bid auction can be more complex for bidders. This is particularly so where it is difficult for bidders to calculate the value of the spectrum that is available. As noted above, in a sealed bid auction, there is no opportunity for bidders to learn through the auction process. This means that in a sealed bid auction, bidders will potentially have to invest much more time and resource to calculate their willingness to pay for the available spectrum.

## Generic or specific lots

7.16 The multiple lots available for award could be sold either on a generic or specific basis. With specific lots, bidders place bids for lots at specific frequencies. By contrast, with generic lots, bidders simply specify the number of lots that they want. The actual frequencies that they are awarded are allocated in a follow-up process.

7.17 The main advantage of the generic approach lies in the simplicity of the process for bidders; bidders only have to express the number of lots they want at a particular price. Ofcom then organises a follow-up process to actually allocate specific spectrum to winning bidders. Ofcom can do this in such a way that contiguous spectrum can be guaranteed. However, in such a generic approach bidders cannot express a preference between lots. It is assumed that there are no significant differences in value between lots, so all lots are close substitutes.

7.18 Although multiple lots in the lower 27.5 MHz sub-band could be considered close substitutes for some bidders, Ofcom does not believe offering them as generic lots will be acceptable to all bidders. This is due to differences between lots' usage rights, relating to interference constraints as set out in the Maastricht Plan (see section 5). Furthermore, the market is more familiar with an approach with specific lots, and bidders may not be comfortable bidding for generic lots without knowing which specific frequencies they will be assigned. Using specific lots does add to the complexity of the auction process. However, Ofcom believes that this additional

complexity is necessary to satisfy bidder requirements to express preferences between different lots.

## Package (combinatorial) bidding

7.19 Allowing package bidding can enhance the efficiency of an auction. In an auction with package bidding, bidders submit mutually exclusive bids for combinations of lots, rather than making multiple bids on individual lots. Package bidding can improve the efficiency of SMRA formats in the specific circumstance when *"(a) there are strong complementarities among licences for some bidders, and (b) the pattern of those complementarities varies for different bidders"*[20]. Because of the potential different downstream applications that the available spectrum could support, package bidding is potentially relevant to this auction given that bidders are likely to have demands for different numbers of contiguous lots and different bidders are likely to have demand for different specific lot(s).

7.20 Package bidding can improve the efficiency of an auction outcome, as it can address undesirable outcomes such as:

- Stranded lots (i.e. aggregation risk); where bidders are left with unwanted lots at the end of the auction (due to a failure to win bids on other lots that were needed in combination with these). This is an inefficient outcome as there may be another bidder that would have been happy to buy these lots at a slightly lower price, but had exited the auction.

- Unsold lots; where lots are left unsold due to a sudden 'step change' in demand. This is an inefficient outcome as there may be a bidder that would have been willing to buy these unsold lots, albeit at a lower price.

7.21 Package bidding can reduce aggregation risks for bidders. This should encourage participation by bidders with different patterns of complementarities, resulting in more efficient outcomes

7.22 However, these benefits should be weighed against the drawbacks of allowing package bidding. Generally, package bidding makes the auction more complex and less transparent, especially if bids for every possible combination of lots are allowed. These drawbacks can be eased by (a) restricting the bidders to certain combinations of spectrum and (b) limiting the number of package bids that bidders can make in one round.

## Alternative SMRA formats

7.23 In the previous section we concluded that the auction format should be a simultaneous, multiple round format with specific lots. However, auction designs with and without limited packaging options could be made to work. Based on these choices, there are two auction formats that Ofcom considers could be appropriate for the award of the 1452 – 1492 MHz band:

- SMRA with augmented switching rules

- SMRA with limited package bidding

[20] Public Notice DA 00-1486, US Federal Communications Commission, July 3 2000

7.24 Both of these formats relate mostly to the award of the lower 27.5 MHz. As set out in section 6, Ofcom proposes to award the upper 12.5MHz as one spectrum package. This relatively large spectrum package can be incorporated into the auction under either of the proposed SMRA formats. The rest of this section and annex 9 incorporate explanations of how this could work.

### SMRA with augmented switching rules

7.25 This SMRA format features augmented switching rules to enhance flexibility for bidders seeking combinations of lots. Under such switching rules, bidders that are current high bidders on a lot may *withdraw their demand* but only if they *make a new bid on another lot* on which they are not the current high bidder. This makes switching between lots significantly more fluid, as withdrawals are not penalised provided that there are corresponding new bids.

7.26 The addition of such switching rules reduces bidder exposure to substitution and aggregation risks. This is because it becomes much easier for a bidder wishing to aggregate lots to move between blocks in response to relative price movements. The inclusion of such switching rules should therefore produce a more efficient outcome than a standard SMRA. However, in the absence of package bidding, this auction format cannot entirely eliminate aggregation risks. In this auction, these risks may impact particularly on those bidders seeking to aggregate lots for applications requiring larger amounts of spectrum.

### SMRA with limited package bidding

7.27 This format is a combinatorial SMRA – but with only a limited set of packages available. If this auction format were to be used, Ofcom would propose allowing bidders to make package bids for groups of three adjacent lots (5.1 MHz), which we call ‘triples’, as well as for single lots of 1.7 MHz. An example of a bid form is given in Figure 21 below, to indicate the bid-options available to bidders (whereby A-P relate to single 1.7 MHz lots in the lower 27.5 MHz whereas lot Q stands for the upper 12.5 MHz spectrum block). This limited set of packages greatly reduces the complexity of the auction relative to a full combinatorial SMRA. With the standard SMRA, all bids are non-exclusive and must be on different lots (i.e. all of the bids made by one bidder can be accepted).

**Figure 21: Illustrative example of bid form for SMRA with limited combinatorial bidding**

| Lot | High bidder | Type of bid | Current Price | Bids for single lots | | Bids for triples | |
|---|---|---|---|---|---|---|---|
| A | Tom | Triple | £ xxx | £ xxx ^ | | | |
| B | Tom | Triple | £ xxx | £ xxx ^ | ABC | £ xxx | ^ |
| C | Tom | Triple | £ xxx | £ xxx ^ | BCD | £ xxx | ^ |
| D | Dick | Single | £ xxx | £ xxx ^ | CDE | £ xxx | ^ |
| E | Dick | Single | £ xxx | £ xxx ^ | DEF | £ xxx | ^ |
| F | Peter | Triple | £ xxx | £ xxx ^ | EFG | £ xxx | ^ |
| G | Peter | Triple | £ xxx | £ xxx ^ | FGH | £ xxx | ^ |
| H | Peter | Triple | £ xxx | £ xxx ^ | GHI | £ xxx | ^ |
| I | Emma | Triple | £ xxx | £ xxx ^ | HIJ | £ xxx | ^ |
| J | Emma | Triple | £ xxx | £ xxx ^ | IJK | £ xxx | ^ |
| K | Emma | Triple | £ xxx | £ xxx ^ | JKL | £ xxx | ^ |
| L | Emma | Triple | £ xxx | £ xxx ^ | KLM | £ xxx | ^ |
| M | Emma | Triple | £ xxx | £ xxx ^ | LMN | £ xxx | ^ |
| N | Emma | Triple | £ xxx | £ xxx ^ | MNO | £ xxx | ^ |
| O | Ofcom | None | £ xxx | £ xxx ^ | NOP | £ xxx | ^ |
| P | Dick | Single | £ xxx | £ xxx ^ | | | |
| Q | Jo | Single | £ xxx | £ xxx ^ | | | |

Notes: Simple menu bidding – to make a bid for a single lot or three adjacent lots, bidders select from a drop down menu containing a limited number of bid amount options.

Source: DotEcon

7.28 This format reduces the aggregation risk for applications needing 5 MHz lots or other combinations of spectrum in excess of 5 MHz, relative to the SMRA with enhanced switching. Although (unlike a full combinatorial auction) this format does not address fully aggregation risks for bidders seeking amounts of spectrum greater than 5 MHz, Ofcom considers that remaining aggregation risks should be at a manageable level, given that having contiguous spectrum in quantities larger than 5MHz seems less

critical to prospective business cases for use of this spectrum (see demand assessment in section 2).

7.29 The main drawback of this format is that it may be more challenging to implement, although actual bidding should be reasonably straightforward for bidders. The introduction of package bidding means that it is necessary to introduce a mathematical algorithm to determine the highest bids for each lot at the end of each round. There would also need to be more complex rules on determining the price levels for individual lots in each round, given the possibility that high bids on some lots may be for triples.

7.30 On the other hand, one simplification in this format is that it is not necessary to implement rules on bid switching and withdrawals, as the introduction of package bidding diminishes the risk of stranded licences.

### Conclusion

7.31 Neither of these formats appears clearly superior to the other in awarding the 1452 – 1492 MHz band – i.e. each format has its own advantages and disadvantages. Ofcom plans to study both formats in further detail and consider comments received in response to this consultation prior to deciding which one is preferable. A more detailed description of each of these auction designs can be found in annex 9.

## Auction rules

7.32 The following auction rules are broadly common to both auction formats, although there may be some minor variation in the way they are implemented. For illustration purposes only, we assume an award whereby spectrum is packaged in 1.7 MHz blocks in the lower sub-band (1452 – 1479.5 MHz) and as one 12.5 MHz in the upper band (1479.5 – 1492 MHz). The auction rules required for other packaging solutions would be very similar to the ones described here.

### Eligibility rules

7.33 Each lot in the auction would have an associated number of eligibility points. Ofcom proposes to assign one eligibility point per lot A-P, as they have very similar spectrum endowment (1.7 MHz). Lot Q (the 12.5 MHz lot) is considerably larger in terms of spectrum endowment, so it is appropriate to assign it a higher level of eligibility points. Ofcom anticipates assigning more than one eligibility point to this lot.

7.34 Bidders ability to make bids for multiple licences would be constrained by their eligibility, which in turn is determined by their bidding activity over multiple rounds.

7.35 Ofcom may decide to set an activity requirement of 100% throughout the auction. Alternatively, it may decide to use activity requirements that become progressively more onerous as prices become closer to final prices. This is the approach used in many previous SMRAs, which set activity requirements in **stages**.

7.36 In this case, for each stage of the auction, Ofcom would set an activity requirement between 0% and 100%. Call this *X*. Bidders would need to exhibit activity of at least *X*% of their eligibility in order to maintain their current level of eligibility. Otherwise their eligibility would be reduced.

7.37 Specifically, suppose that eligibility at the start of a round was *E*. Then the bidder would need to have activity of at least *X*E*. If *X*E* is not an integer, this is rounded

*down*. If the level of activity (A) is less than the activity requirement (AR), eligibility in the next round is reduced in proportion to the shortfall, i.e. eligibility is *E*A/AR* rounded up to the nearest whole integer.

7.38 The value of X is typically increased in steps up to 100% as activity in the auction drops off. For example, a typical SMRA might have three stages, with X= 60%, 75% and 100%.

7.39 The advantage of using stages is that it allows more fluid switching between licences, as bidders do not necessarily need to bid on all of the licences that they might ultimately need until late in the auction when prices are more informative.

## Reserve prices

7.40 Ofcom intends to set a reserve price above zero for each individual lot. The reserve prices would also determine the initial prices for lots under either auction format. For this award, the primary reasons for setting a reserve price above zero are:

- to ensure that the auction only attracts serious bidders; and
- to speed up the auction process, if possible, by avoiding having many auction rounds at prices per lot where there is substantial excess demand for all lots.

7.41 Considering first the motive to attract only serious bidders, this would point to setting a reserve price at a low but non-trivial level. For small spectrum lots in other auctions (the 1781.7MHz and 412MHz awards), Ofcom has proposed a reserve price of £50,000 per lot.

7.42 However, unlike the 1781.7MHz and 412MHz awards, this auction will use a multiple round rather than sealed bid process. Thus, instead of a single round in which all prices are determined, prices may rise only gradually on a round-by-round basis. Therefore there is a potentially strong case for setting a reserve price above £50,000 per lot (e.g. £250,000 per lot) for these lots, provided that Ofcom can be reasonably confident of attracting demand for all lots at the higher prices.

7.43 Lot Q in the upper 12.5 MHz has a much larger spectrum endowment. Therefore, it is appropriate to set a higher reserve price for this lot. Ofcom has identified two possible approaches for setting the reserve price for lot Q relative to lots A-P:

- Setting the reserve price for lot Q on the basis of relative spectrum endowment, which would imply a reserve price approximately seven times that of the 1.7 MHz lots.
- Setting the reserve price on the basis of the relative number of eligibility points per lot.

## Deposits and payment terms

7.44 Ofcom proposes setting an initial level of deposit per eligibility point. Each bidder's initial eligibility would thus be determined by the level of deposit that they have paid before the auction. For example, consider the case where lots A-P are each assigned 1 eligibility point, and lot Q is assigned, say, 3 eligibility points. Hence, if the initial deposit was set at £50,000 per lot, then a bidder wishing to start the auction

with eligibility to bid for all available lots, would need to submit a deposit of £950,000 for 19 eligibility points (16*£50,000 + 1*£150,000).

7.45 Given the possibility that bids in the auction could rise to many times the original reserve prices, it is apparent that the initial deposits could during the course of the auction become too small a proportion of bids to act as an adequate deterrent to default. Therefore, Ofcom proposes to introduce a mechanism to ensure that bidders increase their deposits in a way that reflects their aggregate bid levels at set points during the auction.

7.46 Winning bidders would be required to pay 100% of the fee for their licence by a specified time and the licences would only be issued after payment has been received. Further, if a bidder defaults on payment for the licence it would forfeit its deposit and may remain liable for the outstanding balance, and of course it would not be granted a licence.

## Transparency

7.47 Ofcom proposes that the auction would be fully transparent. Comprehensive information about the number, amount and type of bids on each lot would be released after each round. In addition, bidders would also be able to monitor the identity of all other bidders and the bids they made. Bidders would also receive information about each bidder's initial eligibility and changes in eligibility on a round-by-round basis.

7.48 Full transparency is appropriate to alleviate common value uncertainty and reduce the risk of a fragmented assignment.

## Managing the pace of the auction

7.49 If there is significant excess demand for the spectrum at the reserve prices, it is possible that the auction could proceed for many rounds over many days. It is therefore desirable to deploy rules that can give the auctioneer flexibility in managing the pace of the auction such that the auction can proceed as quickly as possible without jeopardising efficiency. There are a variety of tools that can be used to influence the pace of the auction:

- Reserve prices. Setting a relatively high starting price for lots could avoid running many unnecessary rounds at prices well below the market clearing level. However, it is essential that starting prices are not set so high that they choke off demand so that lots go unsold.

- Bid increments. Large bid increments can be used to accelerate the pace of the auction, but they should not be so large that they lead to an inefficient assignment at the margins. Ofcom's provisional proposal is to retain flexibility to set increments between 5% and 100%, and to alter them up or down in different rounds, subject to providing bidders with at least one round notice of any change.

- Round length. Round lengths need only be as long as is necessary to allow bidders to input, check and submit their bids. As with bid increments, Ofcom proposes giving the auctioneer full flexibility to determine the length of a round, for example in a range from 5 minutes up to 1 hour per round. Early in the auction, when bidders are getting used to the system and may have many new bids to submit each round, longer round lengths may be required. However, later in the

auction, when there may be very few new bids or price changes in each round, short rounds may be feasible.

- Round frequency. Ofcom would retain flexibility to set the timetable for rounds on a day-by-day basis. As activity in the auction slows, it may be possible to increase the number of rounds per day and decrease the time gap between rounds. However, in setting the timetable, Ofcom would take into account the need to provide bidders with some predictability as to the pace of the auction, so that they can plan ahead for likely price increases and resulting changes in deposit requirements.

- Waivers. Waivers allow a bidder to submit bids below its activity requirement without sacrificing eligibility in the next round. Ofcom's provisional proposal is that bidders should be granted three waivers each at the beginning of the auction. Further, the auctioneer would have discretion to grant additional waivers to all bidders during the auction. Waivers could be deployed deliberately by bidders or would be deployed automatically in the event that a bidder, for whatever reason, failed to submit any bids in a round. This should protect against the risk of bidders failing to submit bids on time, for example due to technical failure.

- Discretionary powers. Ofcom would retain discretionary powers to temporarily suspend the auction, abandon a round and restart the auction from the end of the previous round, or declare a 'last and final round'. These powers are primarily needed to guard against exceptional technical problems.

## Participation rules and penalties

7.50 Ofcom is not proposing to place any restrictions on the number or identity of lots that an eligible bidder can bid for, other than as determined by their initial deposits. Rules to prohibit collusion and bidder association will be particularly important given that this is a multiple round auction, and penalties will need to an adequate deterrent to such behaviour. Ofcom has not yet determined the rules in this area.

## Electronic bidding

7.51 Ofcom envisages that the auction would be run electronically over the public Internet or private network, using a secure system. Bespoke software would be designed to provide a bidder interface and to process bids.

Section 8

# Regulatory conditions, rights and obligations

8.1 This section sets out the proposed technical and regulatory conditions specific to the wireless telegraphy licences that Ofcom proposes to award for use of the 1452 - 1492 MHz band. The underlying principle has been to keep restrictions on the use of the band to the minimum necessary for efficient use of the spectrum and the avoidance of undue interference. This is consistent with Ofcom's preferred approach for technology and service neutrality, enabling users to make better use of the spectrum and to introduce a wider range of services and technologies (see section 4). Responses to the SFR:IP relevant to licence conditions are also addressed at Annex 5.

8.2 As has been described in section 5, the international arrangements that apply to the sub-band 1452-1479.5 MHz are different to those that apply to the sub-band 1479.5-1492 MHz. As a result, some of the technical licence conditions that will apply vary between the two sub-bands and these are described below. After a description of the respective technical licence terms in each sub-band, this section also sets out the more general licence terms (tenure in minimum term, spectrum trading and liberalised use).

8.3 A draft licence including the proposed licence conditions including further details on the transmission rights can be found in annex 6.

## 1452 – 1479.5 MHz: Allowable Technical Characteristics of the Service

8.4 The licence is based on rights to transmit within the specified frequency ranges subject to compliance with the technical conditions detailed in annex 6. These conditions are predominantly international and explicit within the frequencies licensed, and of a part-technical, part-procedural nature in respect of frequencies adjacent to those licensed. The conditions are based on controlling the technical consequences of transmissions for other spectrum users rather than being intrinsic to the transmissions themselves.

8.5 The conditions of these licences will not restrict use to broadcasting or any other application. However, since this band is allocated internationally to broadcasting (albeit with flexibility), there is no intrinsic limit to the allowable radiated power from any given transmitter, nor the height at which radiating antennas may be sited. However, effective limits will accrue from:

- the external constraints described in Section 5 and Annex 6, notably international limits derived from the Maastricht 2002 Special Arrangement, and the controls on adjacent-channel interference within the UK
- the design principles of networks deployed by licensees, to avoid interference between different transmitters using the same and adjacent frequencies.

8.6 As described in section 5, the UK's access to the frequency range 1452 to 1479.5 MHz is affected by an arrangement made at Maastricht in 2002 by the CEPT administrations. This arrangement and the associated Plan is available at the

website of the Plan Management Body, the ERO[21]. This is the basis of the technical conditions proposed in annex 6 which are constructed to allow for maximum flexibility of implementation by using international rights to the maximum extent, should licensees need/wish to do this. Part 1 of the Maastricht Plan (allotments originally established before 2002) refers to French allotments which are subject to a special arrangement between the UK and France and is not relevant to this licensing process. It governed the procedures needed to protect private fixed link services in the UK, which will not be using the band after March 2007.

8.7 As described in Section 5, the Maastricht 2002 Special Arrangement is an 'allotment plan'. The plan allows for defined rights of implementation, but with significant flexibility about how these rights are used, notably in respect of where transmitters are placed. The Plan consists of defined geographical areas to each of which rights are attributed to use one of 16 standard frequencies (termed 'frequency blocks') from the range 1452 to 1479.5 MHz. Each of the 16 blocks is separated by a guard band. Figure 5 in Section 5 illustrates the allotments in the UK. Each country which is a signatory to the Special Arrangement is similarly split into a number of allotments.

8.8 The Special Arrangement sets the rules which govern procedures and criteria for implementing transmitters without the need for explicit coordination between countries. Proposed implementation beyond these defined rights requires coordination between countries, with no presumption of acceptance by the countries with which coordination is sought. The following provides an outline of the procedure for deciding if coordination is necessary:

- A series of test points is associated with each allotment; this is a combination of:
  - the corners of all other allotments sharing the same frequency;
  - a locus of points generated by the geometry of the allotment and the predicted decay of signal strength from a standard hypothetical reference network of transmitters.
- The cumulative field strength of the proposed real network of transmitters is calculated at each test point
- if this cumulative field strength exceeds a certain threshold then coordination is needed with the those countries touched by the test point concerned or who lie along a line from the test point to a point where the threshold is reached (i.e. if the network is too powerful it potentially affects additional countries).

8.9 It should be stressed that the above is a high level outline of the procedure, the Special Arrangement sets out the full description.

8.10 As indicated, Ofcom is not proposing to restrict use of the spectrum to transmissions which fall exactly within the spectrum blocks defined by the Maastricht 2002 Special Arrangement. This raises two issues:

- how to deal with systems with a bandwidth narrower than a Maastricht block; and
- how to deal with systems with a bandwidth wider than a Maastricht block.

[21] http://www.ero.dk/Maastricht-e

8.11 For a narrower bandwidth system, Ofcom proposes use of a spectrum mask concept: the aggregate of all transmissions within the T-DAB bandwidth should fall within a T-DAB spectrum mask. The field strength threshold used as the trigger for international coordination under Maastricht would be scaled in proportion to the ratio of the system bandwidth and the Maastricht block width. For example: if a system utilises 100 kHz channels the threshold would be reduced by the equivalent of 10 x log (100/1500) = - 12 dB. So, if the threshold defined by Maastricht is 41 dBμV/m then the equivalent threshold for coordination would be 29 dBμV/m. Ofcom will need to secure the agreement of neighbouring countries to this approach, in order to avoid that each transmitter, even of a narrower bandwidth, is treated as being of the full T-DAB bandwidth.

8.12 For a wider bandwidth system Ofcom proposes that the field strength calculation is based on the transmission power across each 1.5 MHz Maastricht block. This means that the actual profile of the transmitted power within its nominal bandwidth needs to be considered rather than necessarily assuming that it is evenly distributed across this bandwidth.

8.13 Each transmitter will need to be attributed to an allotment area, but there is no intrinsic requirement for it to lie within it, provided the test point criteria are satisfied.

## 1452-1479.5 MHz: Out-of-Block Spectrum Emission Mask

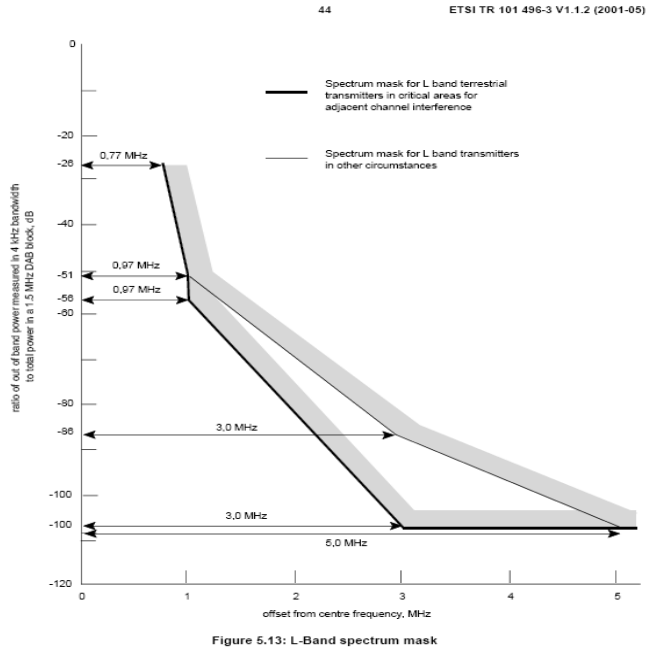
8.14 The application of a common spectrum mask to each transmitter, irrespective of its radiated power, enables its characteristics to be predictable in frequency management. This will avoid a disproportionate burden on other spectrum users in adjacent frequencies in assessing the impact of new transmitters, within the frequency clearance processes.[22]

8.15 Ofcom is not proposing to specify a maximum radiated transmission power, since (a) such a provision is not generally applied in broadcasting bands, and (b) the impact of out-of-band emissions is highly contextual (i.e. how close to the site is the potential adjacent/out-of-band incompatibility?). Nor is Ofcom proposing an equivalent outcome-based provision for an absolute out-of-band field strength within a specified bandwidth. Any realistic transmission for the broadcasting-topology networks which are one of the candidate users of this band would require powers in excess of the maxima which would avoid the potential for adjacent-channel interference. This also implies that alternative measures to a blanket power limit would be necessary.

8.16 The spectrum mask for a given T-DAB channel is specified in the Maastricht Plan. Figure 22 below is taken from the T-DAB specification. Licensees will be expected to implement the 'critical' mask, although the standard variant may be implemented by mutual agreement with the licensee with rights to the adjacent frequency (as discussed further below). Where a licensee holds a licence covering two or more adjacent frequency blocks, the mask from a given transmitter will only apply at the lower edge of the lowest frequency, and the highest edge of the highest one.

[22] This refers to: the site clearance process applied to all transmitters above certain metrics of significance [17 dBW e.r.p.; above 30m aerial height above ground]; the exemption to this for lower power transmitters; and the processes which would be agreed between licensees within the 1452-1492MHz Band to control adjacent-channel interference.

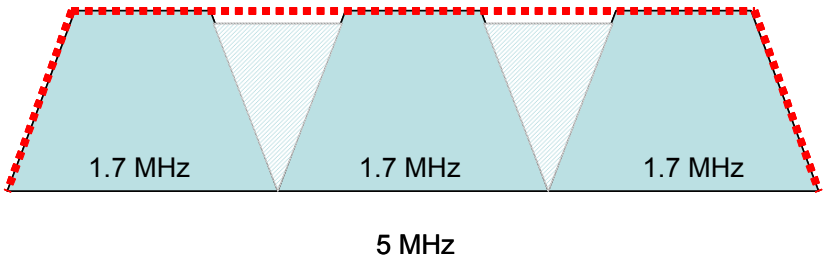
**Figure 22: Standard T-DAB Channel Spectrum Mask**




Source: ETSI

8.17 It should be noted that implementation of technologies with wider bandwidths than the blocks defined in the Maastricht 2002 Special Arrangement is possible but that the conditions of use of the spectrum that falls within the guard bands is not specified (see Figure 23). This means that for the guard bands the Maastricht Plan does not confer any protection from interference caused by use in other countries, and the right of implementation is not clarified within the Maastricht Plan.

**Figure 23: Spectrum mask for three aggregated lots**

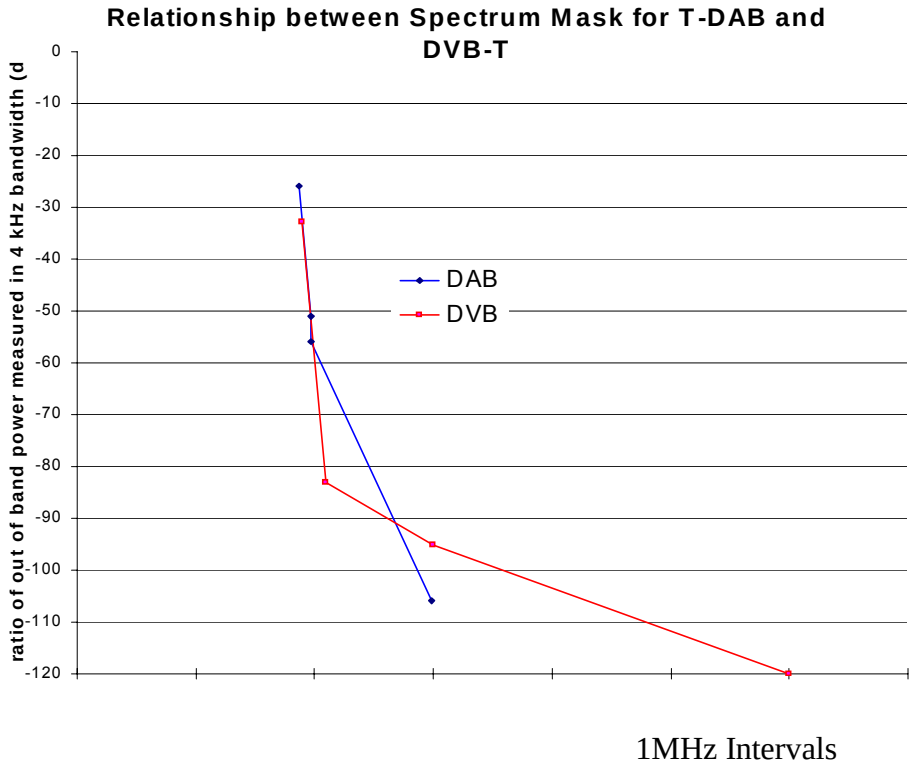



Spectrum mask for three aggregated lots

Source:Ofcom

8.18 One example of a technology requiring a wider bandwidth is a DVB variant with a 5MHz bandwidth. This would require three contiguous T-DAB frequency blocks. There is a slight difference in the shape of the spectrum mask between the two systems (see Figure 24 below), and in this case additional filtering (compared with the usual DVB mask) is likely to be needed.

**Figure 24: Comparison of the band-edge masks of DAB and DVB**




Source: Ofcom

## 1452-1479.5 MHz: Engineering coordination of transmitter location between users

8.19 The implementation of a new service on an adjacent channel[23] and in the same geographical area as an existing service, risks causing a zone of interference to the existing service around the transmitter of the new service. The new service is effectively 'punching a hole' in the coverage of the existing service. The extent of this 'zone of interference' can range over a significant amount of spectrum either side of the transmitting network.

8.20 Several technical solutions are available that can help licensees deal with this adjacent channel interference problem, such as:

- Deploying receivers that have better receiver characteristics;
- Turning down the power of interfering signal;
- Turning up the power of originating signal;
- Engineering coordination of transmitter sites; or

[23] the extent of adjacency which is relevant will depend on the characteristics of the 'victim' system and its receivers; for example with T-DAB, five or more adjacent blocks can be relevant.

- Deploying compensating transmitters for the effected service.

8.21 Each of these solutions places different constraints on the licensee's ability to implement a transmission network.

8.22 There are several regulatory mechanisms available to Ofcom to deal with this adjacent channel interference problem. Such regulatory mechanisms can range from:

- No regulations;
- Industry-defined code of practice;
- Ofcom-imposed engineering coordination process; or
- Independent third party coordinates.

8.23 There is also a choice between an emphasis on pre-implementation coordination or approval, and post-hoc reaction procedures to notification/complaint of interference. The latter would put the burden of risk and predictive analysis onto the party causing the interference

8.24 **No regulations**. No regulation is not a particularly attractive option. It would allow a free for all where licensees could install transmitters without regard to their effect on the coverage of existing systems. It is likely that the effect of 'punching holes' in the service area of existing system described above would be a real and growing problem. Without a mechanism in place to exchange information it is unlikely that licensees could effetely mitigate against the problem.

8.25 **Industry-defined code of practice**. It could be argued that if this was a real problem, it would be likely that licensees would voluntarily develop a procedure to coordinate amongst themselves. Such an industry developed coordination procedure (or code of practice) may well be able to resolve the problem. However, it would only take one licensee to fail to cooperate for the system to fall apart. Without at least the threat of regulatory action if the industry developed code of practice fails to work effectively there may be little the other licensees can do to make an uncooperative licensee cooperate.

8.26 **Ofcom-imposed engineering coordination process**. Were Ofcom to impose a coordination procedure it is unlikely that it could develop one that was as effective as something that industry could design for itself. It is likely that Ofcom would fall back on a relatively unsophisticated approach such as a first in priority system where the licensee who rolls out a service in a particular area first would have priority over subsequently installed systems. These subsequently installed systems would effectively have to protect existing installed systems.

8.27 **Independent third party coordinates.** A process where a third party is responsible for coordination may provide a workable solution but there are still questions about who this third party will be? What power will they have to compel licensees to abide by their decisions and how they are funded?

8.28 Ofcom proposes to impose on the licensees within the scope of this award a general obligation to mutually coordinate their transmitters on a best endeavours basis and to negotiate in good faith where interference occurs.

8.29 In principle, Ofcom proposes to allow licensees to manage the engineering coordination process amongst themselves. There may be a need for licensees to exchange information on the location and characteristics of transmitters and to come to arrangements on siting of transmitters and power levels, etc. Exactly what information is exchanged (if any) and how this is managed should be left up to the industry to agree. The arrangement relating to this engineering coordination should be formalised by the establishment of an industry Code of Practice.

8.30 Ofcom proposes to require all licensees to agree such a Code of Practice within 6 months after the licences are awarded. The Code should deal with the procedural and technical issues with managing engineering coordination. This Code of Practice will need to set out clearly defined principles which will allow the licensees and Ofcom to judge whether an individual licensee is complying with the Code.

8.31 The objective of the Code should be to promote efficient use of the Spectrum Bands so that, as far as possible, systems are deployed in a manner that will allow services to be deployed alongside each other (e.g. in neighbouring spectrum). In developing the Code, Ofcom would expect that, as a minimum, the following principles should be considered:

- Efficient frequency use of the spectrum;
- Possible conditions on limiting transmission powers to that just necessary to effectively provide service;
- Selection of sites in a manner that will minimise the probability of mutual interference; and
- Identifying the type of information that needs to be communicated between licensees and the arrangements for its exchange.

8.32 Mitigation techniques such as automatic power control and dynamic frequency selection may be suitable for certain applications and may be considered for inclusion in the Code of Practice, particularly where they can be implemented on a technology neutral basis.

8.33 Licensees should be aware that the Code, and the activities of the licensees in connection with engineering coordination, need to comply with the requirements of competition law and any other relevant legal requirements.

8.34 The proposed licence will also give Ofcom the power to impose an engineering coordination procedure if necessary (e.g. where licensees either fail to agree the Code or where it is clear that the objective sought by the Code is not being achieved either through lack of cooperation or shortcomings in the Code itself).

8.35 As a matter of policy, Ofcom will not have a role in resolving individual engineering coordination disputes. Ofcom will only become directly involved where the objectives sought by the Code of Practice are clearly not being secured. Such involvement will be limited to the imposition by Ofcom of a Code of Practice setting out a relevant engineering coordination procedure rather than the micro-management of individual coordination requests. Where a licensee fails to abide by a Code of Practice that has been imposed by Ofcom, this will be treated like any other breach of licence conditions

*Consultation question: Do you agree with the proposals for an industry code of practice on engineering coordination to control adjacent-channel interference?*

## Summary of technical licence terms: 1452-1479.5 MHz

8.36 The main technical conditions in the draft licence in this frequency range are based on four requirements.

- Limits will apply to the aggregate field strength which may be produced (within a specified frequency bandwidth) at specified locations outside the UK by the transmitters established under the licence.
- No individual technical system will be specified, but adherence will be required to a spectrum mask. This mask will be based on the T-DAB (digital radio) standard and a standard channelling plan. Where a licensee holds licences for adjacent T-DAB channels, transmissions can span all of those channels, including in the guard bands between them, subject to international co-ordination.
- Undue interference must be avoided to services using adjacent channels, e.g. by interference to mobile receivers using one channel near to transmitter sites using adjacent channels. Therefore, licensees will be under an obligation to create and agree a code of practice on engineering coordination
- The usual procedures of site clearance at each transmitter site will apply. This is to give other radiocommunications users the chance to anticipate and object to potential local incompatibilities in the vicinity of a transmitter; however, low power transmissions (below 50W e.r.p., do not require site clearance).

8.37 In relation to the second of these conditions, the present European agreement for use of this frequency range does not define rights of implementation, nor of protection from interference in the guard bands between T-DAB channels; the agreement did not anticipate use of the band by systems of wider bandwidth than DAB. Ofcom proposes to attempt to establish bilateral agreements with countries neighbouring the UK to clarify the position prior to the auction, in order to increase the technological neutrality of the process. It will not be practicable to commence this dialogue until the late summer/early autumn of 2006, and the process may take several months[24].

8.38 Further details of the transmission rights and the technical analysis on which they are based are set out in annex 6.

## Summary of technical licence terms: 1479.5-1492 MHz

8.39 The main technical conditions attached to this licence are similar in principle to those in the range 1452 to 1479.5 MHz.

- Limits will apply to the aggregate field strength which may be produced (within a specified frequency bandwidth) at specified locations outside the UK by the transmitters established under the licence.

[24] The administrations of neighbouring countries are preoccupied with a major broadcasting conference, the 'RRC06' until then. The RRC 06 does not affect the L-Band, but it may set a precedent with respect to the principle of combining rights to adjacent DAB channels.

- No individual technical system will be specified, but generic limits will apply to emissions into adjacent bands.

- More specific limits and conditions may need to be applied to ensure that undue interference is avoided to services using adjacent channels, e.g. by interference to mobile receivers using one channel near to transmitter sites using adjacent channels.

- The usual procedures of site clearance at each transmitter site will apply. This is to give other radiocommunications users the chance to anticipate and object to potential local incompatibilities in the vicinity of a transmitter; however, low power transmissions (below 50W e.r.p., do not require site clearance).

8.40 However, the principal considerations in designing use of spectrum within this frequency range are that

- the UK currently has no defined rights of terrestrial transmission within this range, transmission rights are in practice limited by the requirements to protect satellite sound broadcast reception in neighbouring countries;

- a satellite service provider holding a licence for use of this spectrum range within the UK may seek protection of its service within the UK from interference from terrestrial transmitters in neighbouring countries to the extent that the satellite service is registered and able to demand protection within the ITU framework; and

- a satellite service provider holding a licence for use of this spectrum range within the UK will have to take into consideration the possible impact on its service within the UK of interference from terrestrial transmitters operating in the band 1452-1479.5 MHz.

8.41 The protection requirements of neighbouring countries' registered (though not yet in service) satellite broadcast systems can be assessed from the system-individual filings made to the International Telecommunications Union. It should also be noted that a US filed satellite, AFRIBSS is notified and is operating in the band with coverage in the UK and neighbouring countries. This implies a need for detailed and bespoke calculations related to the system which a prospective applicant for the UK licence in this frequency range would wish to implement. However, the practical consequence of this is expected to limit the ability to implement broadcast network implementation topologies (see section 5) across much of the UK.

8.42 The Maastricht Plan makes assumptions regarding the receive field strength for the satellite signal based on one particular system; it may be convenient to use this as an approximate basis for establishing the technical constraints required to protect satellite receivers. However, it must be recognised that there is no agreement regarding the type of equipment used to receive the broadcast satellite signals and the interference criteria are those that are set by the characteristics registered in the ITU filing and the relevant recommendations on protection and interference. Reference sources for these, along with filing information and known satellite operators are provided in Annex 6.

8.43 If a licence holder is the cause of interference to an ITU registered satellite network, he must cease the transmission causing interference irrespective of holding a licence that allows for the transmission.

## Non technical licence terms

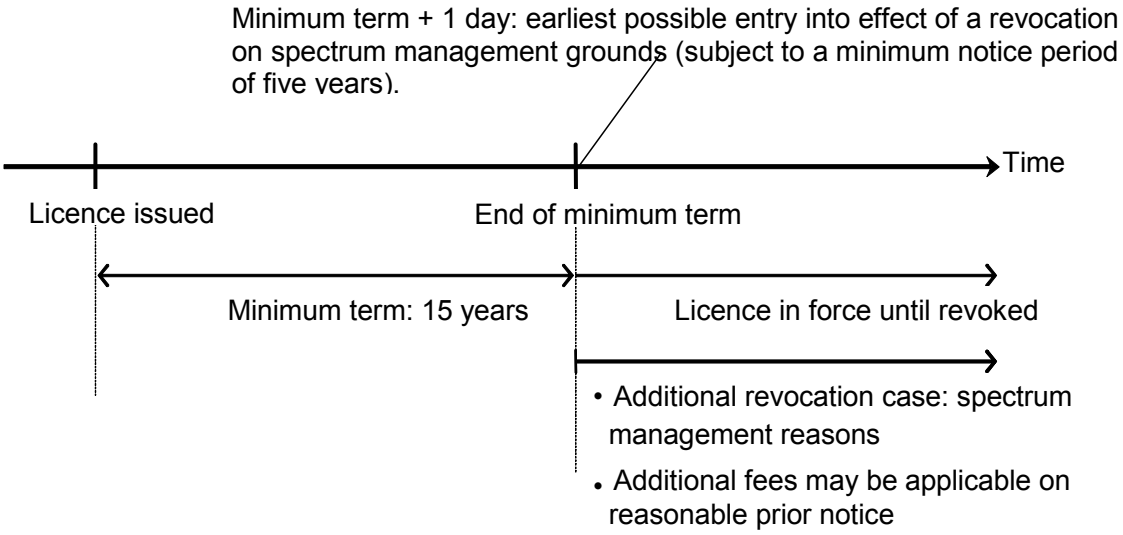
8.44 It was proposed in the SFR:IP that new licences to be awarded by auction should generally have an indefinite term with a minimum period. During the minimum period the grounds for revocation by Ofcom would not include a general right to revoke for spectrum management reasons. After the end of the minimum term, the grounds for revocation by Ofcom would include such a right, subject to a minimum notice period of five years. Ofcom also proposed that notice of revocation for spectrum management reasons could be given so that the licence ended the day after the expiry of the minimum term. Revocation will still be subject to the provision; where it is necessary or expedient for Ofcom to revoke the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under section 5 or section 156 of the Communications Act 2003

8.45 The aim of these proposals was to provide licensees with a minimum period during which they would have high security of tenure, and grounds for revocation would be limited to a narrowly defined set of conditions. The period of the minimum term should be linked to a reasonable view of the period required to earn a return on the investment anticipated for efficient use(s) of the spectrum. The aim of proposing an indefinite duration was to give the licensee the opportunity to continue operating its business beyond the minimum term. However, during this period Ofcom would be able to recover the spectrum by serving a notice of revocation in a similar manner to many other spectrum licences, if this step was justified on spectrum management grounds.

8.46 Consistent with the Interim Statement on the SFR:IP, Ofcom proposes to take the following approach to the award of the 1452 – 1492 MHz band:

- The licences will have an indefinite duration.
- The licences will have a minimum term of 15 years.
- The licences may be revoked before the expiry of the minimum term on the limited grounds set out below.
- The licences may be revoked from any point after the expiry of the minimum term on the grounds set out below. They may be revoked for spectrum management reasons subject to Ofcom giving five years notice. Notice of revocation may be issued during the minimum term, for revocation to take effect after expiry of the minimum term.

**Figure 25: Graphical illustration of the licence term**




Source: Ofcom

## Tenure during the minimum term

8.47 The proposed minimum term is designed to provide licensees with a high security of tenure for investment planning purposes. During that period, Ofcom will not be able to revoke licences for spectrum management reasons and will only be able to do so in the particular circumstances described below.

8.48 To determine the length of the minimum term, Ofcom has considered the relevant period that provides a reasonable chance for the businesses that might be most likely to operate in the bands to make a return on their investment. This is based on assessments of-

- initial fixed costs and operating costs to exploiting the spectrum;
- the time needed to roll out an operational service;
- projected rates of uptake of services and associated revenues.

8.49 Ofcom's standard approach to licence duration is to issue indefinite usage rights with a guaranteed minimum term. This would appear to be appropriate in this case. Based on the modelling of the business cases for deploying various technologies in this band, a minimum term of 15 years would be appropriate.

8.50 During this minimum term the licence may only be revoked for the following reasons:

- with the consent of the licensee;
- for non-payment or late payment of the relevant licence fee;
- if there has been a breach of any of the terms of the licence;
- if the licensee has not complied with any requirement of any relevant trading regulations;

- if the licensee has not complied with the auction regulations under which the licence was awarded, including any financial provisions including guarantees;

- in accordance with section 4(5) of the Wireless Telegraphy Act 1998. That section provides that notwithstanding any terms or provisions in a WT Act licence which restrict the exercise by Ofcom of its power to revoke licences, Ofcom may at any time, by notice in writing, revoke or vary licence terms if it appears to be requisite or necessary or expedient to do so in the interests of national security, or for the purposes of complying with a Community obligation of the UK or with any international agreement or arrangements to which the UK is party; and

- if it appears requisite or necessary or expedient to do so for the purpose of complying with a Direction by the Secretary of State to Ofcom under section 5 or section 156 of the Communications Act 2003.

## After the minimum term

8.51 When the minimum term has expired, the licence will remain in force and continue to be held by the licensee. Two additional conditions will then also apply:

- one providing an additional power for Ofcom to revoke the licence on spectrum management grounds as described above; and

- one allowing Ofcom to apply annual licence fees.

8.52 Whether an annual licence fee is applied after the expiry of the period of the minimum term will depend on Ofcom's general approach to fees for the use of spectrum at that time and how that general approach relates to these licences. Such fees could be set at a level to recover a share of the costs of regulation; it may alternatively be based on Administrative Incentive Pricing (AIP). This provision will allow for the potential application of AIP to the licensed use of the spectrum after the end of the minimum term if this is appropriate in the context of Ofcom's statutory duties. AIP presently plays an important role in incentivising efficient spectrum management, and Ofcom has stated that it expects to continue applying AIP after introducing spectrum trading in order to promote efficient use of the spectrum.

8.53 Ofcom does not consider that it is necessary or appropriate to specify now the level of the annual licence fees, if any, that may be applied to the 1452 – 1492 MHz band after the end of the minimum term. Ofcom would expect to bring forward proposals on this matter to a timescale that gave the licensee reasonable notice of any relevant fees before they became payable.

8.54 Ofcom believes that it is necessary to include these additional licence conditions in relation to the licence period after the minimum term because of the need for the regulator to be able to intervene if required to promote efficient use of the spectrum. Ofcom has a high degree of confidence that the auction, including the payment of the auction fee, will secure efficient use of the spectrum during the minimum term. However, it is less clear that this objective will be met after the minimum term, or indeed for the entire indefinite duration of the licence. The longer the period over which the regulator is required to look forward, the greater the uncertainty that exists. At present, the ability to revoke licences on spectrum management grounds, and the ability to charge fees (including to promote optimal use of the spectrum) are important mechanisms in the regulator's toolkit. Ofcom considers that it is proportionate and objectively justifiable to include provisions allowing the regulator to

take these steps after the end of the minimum term of these licences. Ofcom also considers that the inclusion of these provisions is transparent as to what it seeks to achieve and does not unduly discriminate against any person.

8.55 It is important to note that Ofcom would expect to give prior notice at the time of any specific proposal to use the power of revocation and variation, or the charging of fees, and to consult as appropriate.

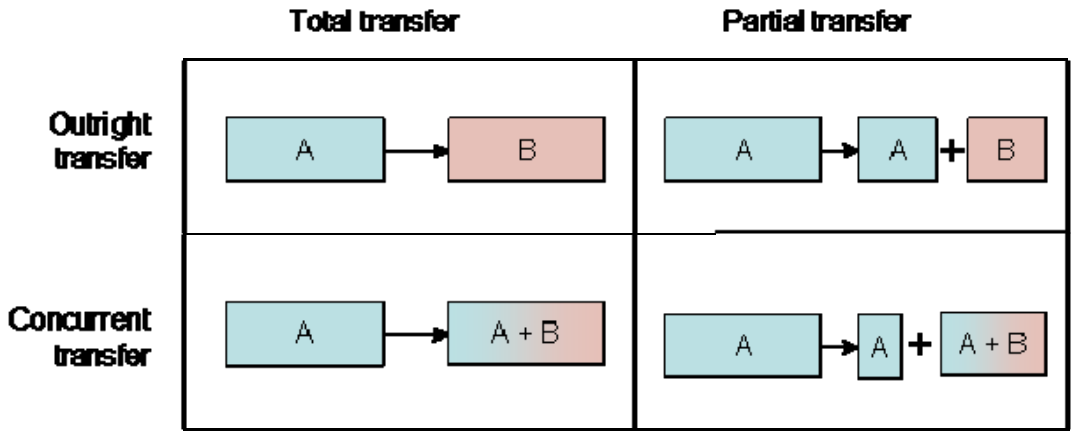
## Spectrum trading

8.56 Ofcom has started the implementation of spectrum trading for selected licence classes in 2004, through the Wireless Telegraphy (Spectrum Trading) Regulations 2004[25]. The changes, described in the Spectrum Trading Statement, published in August 2004, introduced the possibility for licensees in specific classes to carry out:

- outright total transfers, i.e. transfers of all of the rights and obligations arising under a licence to a third party.
- concurrent total transfers, i.e. transfers (of all of the rights and obligations arising under a licence) to a third party which result in a concurrent holding of those rights and obligations by the transferor and the transferee(s);
- outright partial transfers, i.e. outright transfers of some of the rights and obligations arising under a licence to a third party; and
- concurrent partial transfers, i.e. transfers of some of the rights and obligations arising under a licence to a third party which results in a concurrent holding of those partial rights and obligations by the transferor and the transferee(s).

8.57 Figure 26 illustrates some possible types of transfers.

**Figure 26: Illustration of some possible types of transfer**




[25] Statutory Instrument 2004 No. 3154

8.58 In the case of the 1452 – 1492 MHz band, Ofcom proposes to amend the Wireless Telegraphy (Spectrum Trading) Regulations to allow all of these types of transfer.

## Liberalised use of the band and spectrum quality benchmarks

8.59 In January 2005, Ofcom published a statement on spectrum liberalisation, describing changes in the way licensees of particular licence classes can use the spectrum. These changes, programmed for the year 2005, are being implemented in stages to facilitate the optimal use of the spectrum. The full statement and associated documents can be found at: http://www.ofcom.org.uk/consult/condocs/liberalisation/ and http://www.ofcom.org.uk/radiocomms/ifi/trading/libguide/.

8.60 The spectrum liberalisation process described in the statement includes changes to three licensing sectors in 2005 – Business Radio, Fixed Wireless Access and Fixed Links – and the use of two mechanisms for liberalisation of spectrum use – through individual licence variation, following a request by a licensee, or through a generic licence change applied by Ofcom. The licence proposed for award in the 1452 – 1492 MHz band will bear conditions similar in principle, in terms of technology neutrality and possible change of use, to those that Ofcom would aim to introduce through a generic change to existing licences in a given class or sector. As a result, Ofcom proposes to pursue the approach of liberalising spectrum use in this band – allowing spectrum trading and reconfiguration.

8.61 In the SFR:IP, Ofcom indicated its plan to award the 1452 – 1492 MHz band without restrictions as to service provision or technology other than the power limit. The spectrum mask specified to that effect, described in the draft licence in annex 6 allows licensees in this band to transmit while minimising the risk of causing interference to adjacent licensed users. Licensees will be free to deploy the technologies of their choice and change their use of the spectrum or these technologies within the spectrum mask, without requiring Ofcom's approval.

8.62 In order to give prospective licensees some guidance as to the likelihood of interference from adjacent band users, annex 6 describes the relevant technical characteristics of the adjacent spectrum users. This information can be construed as defining the elements of a Spectrum Quality Benchmark (SQB) as described in the Liberalisation Statement. In other spectrum bands where trading and liberalisation have been implemented, SQBs are used to define the standard of spectrum quality that licensees can expect to experience and are based on current spectrum planning assumptions. SQBs are used in assessing requests for licence variations and investigating and resolving interference complaints.

8.63 Any change by a licensee in the band that would depart from its respective licence conditions (e.g. power level and out-of-block emission mask) will be subject to prior approval by Ofcom. The same will apply to any change by licensees in adjacent bands that would depart from the conditions in those licences. Ofcom will consider any requests for change on their merits at the time.

## Summary of licence terms applicable to all of this band

8.64 The main non-technical conditions in the draft licence are:

- Licence term – minimum term of 15 years, with an indefinite term thereafter, subject to revocation on 5 years' notice (potentially subject to AIP);

- Tradability – the licences will be tradable;
- Liberalisation – the licences will contain the minimum necessary technical conditions and will not specify either equipment or services.

8.65 The licence fee for the minimum term will be determined by the auction.

8.66 The licence will permit use within the United Kingdom.

8.67 Ofcom believes that all of the proposed conditions meet the statutory requirements, set out in section 3, in particular the requirements only to impose terms that are objectively justified, non-discriminatory, proportionate and transparent.

8.68 In setting these terms, Ofcom has taken into account the available technical and economic evidence on the likely use of the band and believes that these terms represent the minimum necessary to ensure efficient use of the radio spectrum and therefore they are objectively justified. The term preserves Ofcom's discretion on notice to revoke the licence for spectrum management reasons, after the minimum term, if it becomes necessary to do so. The proposed provisions on licence fees are objectively justified because they will either be determined by the bidders themselves in the auction (see section 7 for auction details) or if, as indicated above, following the expiry of the minimum term other licence fees are payable, these will be justified to ensure continued efficient use of the band or to recover a share of the regulatory costs.

8.69 Ofcom also believes that these licence conditions are proportionate since they are, in Ofcom's view based on the evidence available, the minimum set of restrictions which are required to promote efficient use of the band and the other objectives relevant to this award process. The proposed licence terms are also transparent in that they are clear as to the purpose in each case and they are set out in the draft licence which is included in annex 6.

8.70 Ofcom has also considered carefully whether the proposed licence terms will discriminate unduly against any other person, including existing licensees in other spectrum. Ofcom has concluded that the proposals do not involve undue discrimination.

## Section 9

# Next steps and timetable

This section sets out the next steps for the award, subject to the present consultation.

## Analysis of responses

9.1 Ofcom will analyse all responses it receives by the closing date for this consultation of 9 June 2006 and consider them against its statutory duties in finalising the award process.

## Publication of a draft information memorandum and draft auction regulations

9.2 Ofcom will publish an Information Memorandum for the award. This will be designed to give bidders as much information as necessary for them to decide whether to enter the auction and how they would prepare for participation. It may be modified or complemented by the publication of updates and answers to specific questions.

9.3 Regulations will provide the legal basis for the auction and contain detailed and comprehensive rules and procedures for its running. The regulations are made by means of a statutory instrument. They must be published in draft with a minimum of 28 days allowed for comments. When all comments have been considered and necessary amendments made the regulations are made in final form; they come into force 21 days after being laid before Parliament.

9.4 According to Ofcom's provisional timetable, both the Information Memorandum and the draft regulations should be published at the same time towards the end of 2006. The final version of the regulations would then be laid before Parliament, to allow the auction to take place in early 2007.

## Other regulations and documents for publication

9.5 As part of the preparations for this award and before prospective bidders are invited to consider participating in the award process, Ofcom will publish new regulatory documents and amend existing regulations to incorporate the conclusions of this consultation where appropriate.

9.6 This will include:

- amending the spectrum trading regulations (Statutory Instrument 2004 No. 3154) before the award process to cover the 1452 – 1492 MHz band;
- publishing an interface requirement for the band before the award process to reflect the technical conditions to be adopted for the licences;
- amending the order limiting the number of licences for certain categories (Statutory Instruments 2003 No. 1902) at the next relevant regular update;
- amending the UK Frequency Allocation Table at the next relevant regular update and UK Frequency Allocation Plan after the award to include the new assignment for the band.

## Events and communications on the award

9.7 Ofcom intends to give a presentation during the consultation period to stakeholders interested in this award to publicise and explain the details.

9.8 There are likely to be further events to assist potential bidders in understanding the auction rules before the auction takes place.

## Annex 1

# Responding to this consultation

## How to respond

Ofcom invites written views and comments on the issues raised in this document, to be made by 5pm on 9 June 2006

Ofcom strongly prefers to receive responses as e-mail attachments, in Microsoft Word format, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 2), among other things to indicate whether or not there are confidentiality issues. The cover sheet can be downloaded from the 'Consultations' section of our website.

Please can you send your response to anirban.roy@ofcom.org.uk

Responses may alternatively be posted or faxed to the address below, marked with the title of the consultation.

Anirban Roy
Policy Manager
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7981 3990

Note that we do not need a hard copy in addition to an electronic version. Also note that Ofcom will not routinely acknowledge receipt of responses.

It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 3. It would also help if you can explain why you hold your views, and how Ofcom's proposals would impact on you.

## Further information

If you have any want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact on Anirban Roy on 020 7981 4677.

## Confidentiality

Ofcom thinks it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt (when respondents confirm on their response cover sheer that this is acceptable).

All comments will be treated as non-confidential unless respondents specify that part or all of the response is confidential and should not be disclosed. Please place any confidential parts of a response in a separate annex, so that non-confidential parts may be published along with the respondent's identity.

Ofcom reserves its power to disclose any information it receives where this is required to facilitate the carrying out of its statutory functions. Ofcom will exercise due regard to the confidentiality of information supplied.

Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use, to meet its legal requirements. Ofcom's approach on intellectual property rights is explained further on its website, at www.ofcom.org.uk/about_ofcom/gov_accountability/disclaimer.

## Next steps

Following the end of the consultation period, Ofcom intends to publish a statement in the autumn of 2006.

Please note that you can register to get automatic notifications of when Ofcom documents are published, at http://www.ofcom.org.uk/static/subscribe/select_list.htm.

Ofcom's consultation processes

Ofcom is keen to make responding to consultations easy, and has published some consultation principles (see Annex 2) which it seeks to follow, including on the length of consultations.

If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk. We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, whose views are less likely to be obtained in a formal consultation.

If you would like to discuss these issues, or Ofcom's consultation processes more generally, you can alternatively contact Vicki Nash, Director, Scotland, who is Ofcom's consultation champion:

Vicki Nash
Ofcom
Sutherland House
149 St Vincent Street
G2 5NW Glasgow

Tel: 0141 229 7401
Fax: 0141 229 7433

E-mail: vicki.nash@ofcom.org.uk

## Annex 2

# Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

### Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

### During the consultation

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened version for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will normally allow ten weeks for responses to consultations on issues of general interest.

A2.6 There will be a person within Ofcom who will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. This individual (who we call the consultation champion) will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why. This may be because a particular issue is urgent. If we need to reduce the amount of time we have set aside for a consultation, we will let those concerned know beforehand that this is a 'red flag consultation' which needs their urgent attention.

### After the consultation

A2.8 We will look at each response carefully and with an open mind. We will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

## Annex 3

# Consultation response cover sheet

A3.1 In the interests of transparency, we will publish all consultation responses in full on our website, www.ofcom.org.uk, unless a respondent specifies that all or part of their response is confidential. We will also refer to the contents of a response when explaining our decision, without disclosing the specific information that you wish to remain confidential.

A3.2 We have produced a cover sheet for responses (see below) and would be very grateful if you could send one with your response. This will speed up our processing of responses, and help to maintain confidentiality by allowing you to state very clearly what you don't want to be published. We will keep your completed cover sheets confidential.

A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their cover sheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.

A3.4 We strongly prefer to receive responses in the form of a Microsoft Word attachment to an email. Our website therefore includes an electronic copy of this cover sheet, which you can download from the 'Consultations' section of our website.

A3.5 Please put any confidential parts of your response in a separate annex to your response, so that they are clearly identified. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only so that we don't have to edit your response.

## Cover sheet for response to an Ofcom consultation

### BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

### CONFIDENTIALITY

What do you want Ofcom to keep confidential?

| | | | |
|---|---|---|---|
| Nothing | ☐ | Name/contact details/job title | ☐ |
| Whole response | ☐ | Organisation | ☐ |
| Part of the response | ☐ | If there is no separate annex, which parts? | |

If you want part of your response, your name or your organisation to be confidential, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

### DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response. It can be published in full on Ofcom's website, unless otherwise specified on this cover sheet, and I authorise Ofcom to make use of the information in this response to meet its legal requirements. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here. ☐

Name Signed (if hard copy)

## Annex 4

# Summary of consultation questions

Our key proposals for this consultation are outlined in the executive summary and described in more detail throughout the document. We would welcome views on any aspect of this document by 9 June 2006, in particular on the following questions

*Do stakeholders agree with these proposals for the award of this band or have any other comments on the contents of this document?*

*Do you agree with Ofcom's proposed approach to address the international issues resulting from the Maastricht Plan applicable to the 1452 – 1479.5 MHz frequency band in this spectrum?*

*Do you agree with Ofcom's proposed approach to award of all the spectrum between 1452 and 1492MHz at the same time and as soon as practically possible (i.e. a simultaneous award of the top 12.5MHz and the lower 27.5MHz of this spectrum)?*

*What are your views on the preferred packaging option for the lower 27.5 MHz of this spectrum?*

*Do you agree the upper 12.5 MHz of available spectrum should be awarded as one lot?*

*Do you agree with the proposals for an industry code of practice on engineering coordination to control adjacent-channel interference?*

## Annex 5

# Summary of consultation responses relevant to the award

A5.1 This annex sets out a summary of the responses made to the Spectrum Framework Review: Implementation Plan as well as the responses made to the RA/RAu 'Consultation on future use of spectrum within VHF Band III (174 to 230 MHz) and in the 1.5 GHz Band (1452 – 1492 MHz)', which are relevant to the spectrum award discussed in this document. This annex should be read in conjunction with the rest of the document, where some of these issues are discussed in more detail.

A5.2 The full text of the responses can be found on the consultation section of the Ofcom website at www.ofcom.org.uk. Twenty-eight respondents provided comments on the proposals for the award as stated in the SFR: IP, whereas nine respondents answered the questions regarding 1.5 GHz (Questions 8 – 11) in the RA/RAu spectrum consultation. One respondent requested confidentiality for this part of their response. The views of this respondent have been taken into account, but their response has not been published on the Ofcom website.

## Timing of the award

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Lack of urgency in addressing the potential in this band | Crown Castle and Philips believe there is a lack of urgency in addressing the potential of 1452-1452 MHz. They suggest this band is made available for mobile multimedia applications as soon as possible, encouraging market initiatives prior to analogue switch-over. NTL also believes that an early migration of the current fixed link operators should be facilitated wherever possible. | Where spectrum is not already in use in the market, Ofcom aims to release it as soon as reasonably practicable. This spectrum policy applies to 1452-1492 MHz.<br><br>Therefore, Ofcom is working towards an award of this spectrum at the earliest possible date – as soon as all outstanding issues have been resolved. Ofcom believes market initiatives are encouraged by making this band available for mobile multimedia applications as one of a variety of possible uses. |
| This band is not viewed as a priority | Intellect, Oak Global and the Wales Broadband Stakeholder Group do not believe spectrum in this band is a priority for auction. Furthermore, GWR Group is concerned that an early introduction of L-Band could de-stabilise DAB penetration. | Where spectrum is not already in use in the market, Ofcom aims to release it as soon as reasonably practicable. This spectrum policy applies to the 1452-1492 MHz.<br><br>The market demand assessment found evidence of current interest in this spectrum from a variety of uses and users (see section 2). Ofcom therefore believes it to be appropriate to proceed with the award as proposed. |

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Make final proposals after RRC 2006 | O2 suggested Ofcom finalises its proposals following the 2006 Regional Radio Conference, to ensure these proposals complement those relating to Bands III, IV and V. | Although it is not a prerequisite, under current proposals, this award is scheduled to take place after the RRC 2006 so results from the conference will be available to the participants of the award. |
| Request delay for some fixed links services | Two respondents requested that Ofcom delay the implementation date for any new applications on 1452-1492 MHz and permit continued use for some services until 2009. | Rather than granting some services rights for continued use of the band, Ofcom has decided to allow all remaining fixed link users (including the ambulance services) to stay in this band until such time as access is required by the new licensee(s). From 30 September 2006 onwards, these users may continue to operate until Ofcom gives them notice to cease operations, which will be at least six months before the band needs to be vacated, with 31 March 2007 as the earliest possible date at which the band needs to be vacated. This decision has been communicated to the remaining users. |

## Service and technology neutrality

| Issue raised | Comments | Ofcom's response |
|---|---|---|
| Designate 1479.5-1492 MHz for broadcasting satellite services and retain 1467-1479.5 MHz for satellite and terrestrial digital radio services | Alcatel, ESAPREG, Inmarsat and WorldSpace believe 1479.5-1492 MHz should be designated for broadcasting satellite services and complementary terrestrial services. The respondents hold that the success of S-DAB systems is conditioned on the possibility to access a single pan-European market – and this band is the only ITU allocation available worldwide between 1- 3GHz. If the band becomes inaccessible in the UK, satellite business may be prevented to develop at European level.<br><br>Furthermore, ESAPREG and WorldSpace believe that 1467-1479.5 MHz should be retained for T-DAB and S-DAB and complementary terrestrial services, as required by the UK's international agreements. | Ofcom preference is to award the spectrum on a technology and service neutral basis. The avoidance of such restrictions should increase the opportunities for the market to determine the optimum use of the spectrum, thereby improving the efficiency of spectrum use.<br><br>In this approach, Ofcom will need to take into account its duty to promote the European internal market but this is only one duty which needs to be taken into account alongside others, such as our duty to avoid unnecessary restrictions in the licences which limit the potential uses of the spectrum.<br><br>Ofcom is committed to honouring its international obligations and will protect interference to users in other countries as detailed under these agreements (see section 5). Within the UK, Ofcom will ensure that the technical spectrum usage rights defined by Ofcom (see section 8) are compatible with S-DAB, so that this use can be accommodated. |

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Harmonise bands to ensure a mass market for devices | Both NTL Broadcast and Philips felt that there would be benefits from the harmonisation for devices: a pan-European market for receivers using the same technology and spectrum can ensure a mass market for devices. | Ofcom preference is to award the spectrum on a technology and service neutral basis. The avoidance of such restrictions should increase the opportunities for the market to determine the optimum use of the spectrum, thereby improving the efficiency of spectrum use.<br><br>Arguments for mass market devices (requiring use of spectrum bands to be harmonised to reach economies of scale in their production) will be reflected in an operator's valuation of the spectrum band in question. |
| Harmonise bands to achieve international roaming capabilities | The Digital TV Group felt that services to mobile and handheld receivers using DVB-H require alternative bands in order to achieve international roaming capability. Two bands, within the range of 400-700MHz and 1400-1700MHz, would satisfy the requirement. | Ofcom preference is to award the spectrum on a technology and service neutral basis. The avoidance of unnecessary restrictions should increase the opportunities for the market to determine the optimum use of the spectrum, thereby improving the efficiency of spectrum use.<br><br>Arguments for international roaming capabilities (requiring use of spectrum bands to be harmonised) will be reflected in an operator's valuation of the spectrum band in question. |

| Issue raised | Comments | Ofcom's response |
|---|---|---|
| Allow different broadcasting technologies to be used | Ten respondents believed this band should be made available for mobile multi-media applications. A range of new technologies, such as DMB and DVB-H, should be allowed to be used. | This point of view is in line with Ofcom's preference to award spectrum on a technology and service neutral basis. The avoidance of such restrictions should increase the opportunities for the market to determine the optimum use of the spectrum, including potentially a range of new multi-media technologies. |
| Reserve spectrum for DAB digital radio | A variety of respondents, including CMA, GWR Group, Chrysalis radio, CBC and Digital One, believe that available spectrum in this band should be reserved for T-DAB – particularly to ensure access for community radio or local commercial broadcasters. Some of these respondents argue that spectrum needs to be reserved so that all (AM/FM) radio stations have an option for migration to DAB digital radio provided by Ofcom. They believe it would be unacceptable if some stations are orphaned in analogue. | Whilst no commercial analogue radio station has an automatic right to migrate to a digital platform Ofcom is working with the industry to identify further opportunities for digital migration. In the coming months Ofcom will be carrying out a project that will look at the future shape of the radio industry. This will include looking at the digital options for smaller radio stations. Ofcom has previously noted that while spectrum in the 1452-1492MHz band could be used to carry local radio services using T-DAB technology this is a costly option compared to other frequencies (such as AM and FM, potentially using DRM technology). In other parts of Europe where T-DAB has been deployed in 1452-1492MHz take-up has been relatively poor. In relation to this award, should any radio station wish to broadcast on this spectrum, then this option is open as long as they acquire a licence.<br><br>The question of providing additional capacity for radio |

| Issue raised | Comments | Ofcom's response |
|---|---|---|
| | | services that are presently broadcast only in analogue, to secure a migration path to digital broadcasting as well as other related issues is considered in more detail in two recent Ofcom documents. *Radio – Preparing for the Future, Phase 2: Implementing the Framework* and *Radio – Licensing Policy for VHF Band III, Sub-band 3*. |

| Issue raised | Comments | Ofcom's response |
|---|---|---|
| Suitability of 1452-1492MHz for very local radio services | A variety of respondents felt that 1452-1492MHz is suitable for services targeted at small geographical areas, such as local radio services. NTL Broadcast encourages Ofcom to do a review of technologies for the delivery of very local radio so the appropriate spectrum and technology can be found. | In the coming months Ofcom will be carrying out a project that will look at the future shape of the radio industry. This will include looking at the digital options for smaller radio stations.<br><br>The question of additional spectrum for smaller radio services, as well as other related issues is considered in more detail in two recent Ofcom documents. *Radio – Preparing for the Future, Phase 2: Implementing the Framework* and *Radio – Licensing Policy for VHF Band III, Sub-band 3* |
| Concern on compatibility of alternative technologies | NTL Broadcast was its uncertain about the compatibility of alternative technologies with the subdivision in the Maastricht Plan, or with the interference limits used in the plan. | The document defines the spectrum mask and its technological constraints for potential uses of this band. In its assessment Ofcom has taken into account the Maastricht Plan and the interference limits used in it.<br><br>This document also lays out Ofcom's proposals to find more flexibility within the Maastricht Plan through agreement with our international neighbours. |

## Spectrum packaging

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Mixed views on ideal spectrum packages | Four respondents offer their opinion on ideal frequency blocks sizes, each suggesting a different spectrum package:<br><br>Digital One proposes 1.5 MHz frequency blocks, suitable for DAB and enabling harmonisation with the rest of Europe;<br><br>BBC suggests compatible blocks of 5, 6, 7 or 8 MHz for DVB-H;<br><br>BT argues no more than 2 licences could be created out of the lower 28 MHz as broadband services need sufficiently large blocks;<br><br>Crown Castle proposes reassignment of the spectrum into 5 MHz blocks to enable multimedia services using DVB-H;<br><br>ESOA and GVF advise the whole 40 MHz is released as one single block. | The mixture of views from respondents needs to be taken into account in Ofcom's spectrum packaging proposals (see section 6). Some of the packaging options put forward by Ofcom can accommodate this mixture of needs in the market. |
| Preference for UK-wide or local licences | Although BT believes national licences are most appropriate because of the interference range at these frequencies, BAA would prefer local licences. | Ofcom proposes to award UK-wide licences, with the possibility to create regional or local licences – after the award – through the division of existing licences and spectrum trading (see section 6). Such an approach can accommodate both preferences. |

## Award process

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Auctions lead to regulatory uncertainty for satellite services (1479.5 – 1492 MHz) | Alcatel, ESAPREG, Inmarsat and WorldSpace voice their concern over the regulatory uncertainty they will be faced with if each country has their individual award procedures. They claim to have a strong need for certainty with respect to conditions for access to spectrum due to the high upfront capital investment requirements. Furthermore, the acquisition of different rights results in time consuming and costly procedures, inhibiting the development of satellite systems. | Ofcom has put forward for consultation several options on how to move forward with the award of the 1479.5 – 1492 MHz, see section 5.<br><br>Ofcom does not propose to award this spectrum though a pan-European award, as such an approach is likely to have significant risks and delays associated with it as well as the other disadvantages identified in section 5.<br><br>Instead, Ofcom proposes to award this band in a UK-wide auction, as soon as practically possible. We aim to minimise regulatory uncertainty for participants by communicating our policy clearly and adopting it consistently. |
| Competition concerns in auction award | ESAPREG and Inmarsat are concerned that satellite and terrestrial services cannot compete for access to spectrum in a 'level playing field'. They hold that auctions lead to barriers to entry for European satellite-based enterprises, whereas terrestrial-based enterprises benefit from increased access to favourable spectrum. | Ofcom, nor its independent advisers, have identified any material competition concerns for this award (see section 5).<br><br>However with regard to this concern, Ofcom invites respondents to give their view on the proposed approach of the top 12.5 MHz (1479.5 – 1492 MHz) through a consultation question in section 5. |

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Fees for spectrum should be cost-based | Alcatel and ESAPREG believe that fees for spectrum should not exceed administrative costs incurred in the assignment. | Administrative cost-based fees do not reflect the market value of spectrum and hence do not provide adequate incentives for efficient use of this resource. Ofcom believes auctions are the most appropriate means to release spectrum, where demand is likely to exceed supply. The fee payable for the licence is determined through the award, and is therefore better reflective of the true opportunity cost of using spectrum.<br><br>After the expiry of the minimum period, if the licensee continues to hold the licence, there may be additional charges in line with Ofcom's policy on spectrum pricing at that time (see section 8). |

## Spectrum rights

| Issue raised | Comments | Ofcom's Response |
|---|---|---|
| Lack of clarity on spectrum rights | Orange noted that it is not able to comment on the proposals due to the absence of any clarity regarding the practical application of technology neutral spectrum rights. | Section 8 of this document holds further details on the application of technology neutral spectrum rights, describing the spectrum mask and its constraints as defined for licensees in this band. |
| Concern on RSA | Inmarsat comments that they remain sceptical about the benefits of RSA, whilst ESOA and GVF are highly concerned about the proposals without indication on how RSA will be implemented. The latter respondents presume that a consultation will be made before RSA is being used as a spectrum management concept. | Ofcom is still gathering information and has not yet made any decision as to whether, or in which bands, to introduce RSA for satellite services. A further detailed consultation on RSA will be held before any such decision is made. |

## Annex 6

# Draft Licence template

Please note that the following template licence represents Ofcom's current thinking and may well change as Ofcom's thinking develops and after consideration of responses to this consultation.

**Wireless Telegraphy Acts 1949 and 1998**

**Office of Communications (Ofcom)**

**LICENCE FOR THE USE OF THE SPECTRUM BAND 14xx – 14xx MHz**

Licence no. **[Insert Licence Number]**

Date of first issue: **[Insert Date]**

**1.** The Office of Communications (Ofcom) grants this licence to

**[Insert Licensee's Name and Company Registration Number (if a company)]**

("the Licensee")

**[Insert Registered Company Address]**

**Xxxxxxxxxxx**

**Xxxxxxxxxxx**

**Xxxxxxxxxxx**

**Xxxxxxx**

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in the schedule(s) (herein after together called "the Radio Equipment") subject to the terms set out below.

## Licence Term

**2.** This Licence shall continue in force until revoked by Ofcom in accordance with paragraph 3 below or surrendered by the Licensee.

## Licence Revocation and Variation

**3.** Where Ofcom exercises its power to revoke or vary the Licence in accordance with section 1(4) of the Wireless Telegraphy Act 1949, the Licensee shall be notified in writing.

**4.** Pursuant to section 4 of the Wireless Telegraphy Act 1998 (the "1998 Act") Ofcom may not revoke this Licence under section 1(4) of the Wireless Telegraphy Act 1949 except:

(a) at the request, or with the consent, of the Licensee;

(b) in accordance with paragraphs 8 and 9 ;

(c) if there has been a material breach of any of the terms of the Licence;

(d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of regulations made by Ofcom under the powers conferred by section 168(1) and (3) of the Communications Act 2003[26] ;

(e) if, in relation to the Licensee, any of the events listed in regulation 32 of the Wireless Telegraphy (Licence Award) Regulations 2006 occurred prior to the grant of this Licence where the occurrence of the event materially affected the outcome of the award process under these regulations;

(f) in accordance with section 4(5) of the 1998 Act;

(g) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under section 5 or section 156 of the Communications Act 2003; or

(h) for reasons related to the management of the radio spectrum, provided that in such case:

(i) this power to revoke may only be exercised after at least five (5) year's notice is given in writing to the Licensee; and

(ii) such notice must expire after fifteen (15) years from the date of first issue of this Licence.

**5.** For the avoidance of doubt, and without prejudice to paragraphs 3 and 4 above, Ofcom may only revoke this Licence in accordance with section 1E of the Wireless Telegraphy Act 1949.

## Changes

**6.** This Licence may not be transferred.[27]

**7.** The Licensee must give immediate notice to Ofcom in writing of any change to the Licensee's name and address from that recorded on the Licence.

[26] These are regulations on spectrum trading.

[27] However rights and obligations arising by virtue of this wireless telegraphy licence may be transferred in accordance with regulations made by Ofcom under powers conferred by section 168(1) and (3) of the Communications Act 2003. See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

## Fees

**8.** The Licensee shall pay to Ofcom the fee(s), in cash and without set-off or counter-claim, described in Schedule 2 of this Licence, on the date(s) also described therein, failing which Ofcom may revoke this Licence. In accordance with section 4A of the Wireless Telegraphy Act 1998 any such fee is recoverable by Ofcom.

**9.** On or after the expiry of ten years from the date of issue of this Licence the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under section 1 and 2(2) of the Wireless Telegraphy Act 1998, failing which Ofcom may revoke this Licence.

**10.** The Licensee shall also pay interest to Ofcom on any amount which is due under the terms of this Licence or provided for in any regulations made by Ofcom under section 1 and 2(2) of the Wireless Telegraphy Act 1998 from the date such amount falls due until the date of payment, calculated with reference to the Bank of England base rate from time to time. In accordance with section 4A of the Wireless Telegraphy Act 1998 any such amount and any such interest is recoverable by Ofcom.

**11.** If the Licence is surrendered or revoked, no refund, whether in whole or in part of any amount which is due under the terms of this Licence or provided for in any regulations made by Ofcom under section 1 and 2(2) of the Wireless Telegraphy Act 1998 will be made, except at the absolute discretion of Ofcom in accordance with regulation 36 of the Wireless Telegraphy (Licence Award) Regulations 2006.

## Radio Equipment Use

**12.** The Licensee must ensure that the Radio Equipment is constructed, established, installed and used only in accordance with the provisions specified in Schedule 1 of this Licence. Any proposal to amend any detail specified in Schedule 1 of this licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.

**13.** The Licensee must ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.

## Access and Inspection

**14.** The Licensee shall permit any person authorised by Ofcom:

(a) to have access to the Radio Equipment; and

(b) to inspect this Licence and to inspect, examine and test the Radio Equipment,

at any and all reasonable times or, when in the opinion of that person an urgent situation exists, at any time to ensure the Radio Equipment is being used in accordance with the terms of this Licence.

## Modification, Restriction and Closedown

**15.** A person authorised by Ofcom may require the Radio Equipment, or any part thereof, to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:

(a) a material breach of this Licence has occurred; and/or

(b) the use of the Radio Equipment is causing or contributing to undue interference to the use of other authorised radio equipment.

**16.** Ofcom may require the Radio Equipment to be modified or restricted in use, or temporarily closed down either immediately or on the expiry of such period as may be specified in the event of a national or local state of emergency being declared. Ofcom may only exercise this power after a written notice is served on the Licensee or a general notice applicable to holders of a named class of Licence is published.

## Geographical Boundaries

**17.** This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

## Interpretation

**18.** In this Licence:

(a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of stations and installation and use of apparatus for wireless telegraphy as specified in section 1 of the Wireless Telegraphy Act 1949; and

(b) the expressions "undue interference", “station for wireless telegraphy” and “apparatus for wireless telegraphy” shall be construed in accordance with section 19 of the Wireless Telegraphy Act 1949;

**19.** The schedules to this Licence form part of this Licence together with any subsequent schedules which Ofcom may issue as a variation to this Licence at a later date.

**20.** The Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

## Issued by Ofcom

Signed by

## For the Office of Communications

SCHEDULE 1 TO LICENCE NUMBER: **[Insert Licence Number]**

Licence Category: **Licence for the Use of the Spectrum band 14xx-14xx MHz**

This schedule forms part of licence no **[Insert Licence Number]**, issued to **[Insert Licensee's name]**, on **[Insert Date]**.

## 1. Description of Radio Equipment Licensed

In this Licence, the Radio Equipment means any station for wireless telegraphy or apparatus for wireless telegraphy.

## 2. Interface Requirements for the Radio Equipment

That Radio Equipment shall comply with one or other of the following Interface Requirements:

IR xx

These Interface Requirements have been published by Ofcom in accordance with Article 4.1 of Directive 1995/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment (RTTE) and the mutual recognition of their conformity.

## 3. Special Conditions relating to the Operation of the Radio Equipment

(a) During the period that this Licence remains in force and for 6 months thereafter, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of:

(i) The following details relating to the Radio Equipment:

a) postal address;

b) National Grid Reference, (to 100 Metres resolution);

c) antenna height (AGL) and type;

d) radio frequencies used by the Radio Equipment;

(ii) a statement of the number of subscribing customers.

(b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph (a) above shall be kept.

(c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph (a) above at such intervals as Ofcom shall notify to the Licensee.

(d) The Licensee must also submit to Ofcom in such a manner and at such times, all information relating to the establishment, installation or use of the station for wireless telegraphy or apparatus for wireless telegraphy, whether stored in hard copy or electronic form, as reasonably requested for the purposes of verifying compliance with this Licence or for statistical purposes.

## 4. Site Clearance Requirements

(a) A site clearance certificate is not required for any transmitter (whether indoor or outdoor) which:

(i) only uses a transmitter radiating not more than 17dBW ERP; and

(ii) only uses a transmitter with the highest point of the antenna being less than thirty (30) metres above ground level.

(b) Further, a site clearance certificate is not required for a transmitter which uses an antenna which is placed at an existing site, which has received site clearance by Ofcom, where the height of that antenna does not exceed the antenna height permitted under the existing site clearance certificate by five (5) metres.

(c) Subject to sub-paragraphs (a) and (b), the Radio Equipment must not be established, installed or used without Ofcom first issuing a site clearance certificate for each transmitter.

## 5. Cross-border Coordination

The Radio Equipment shall be operated in compliance with such cross-border coordination and sharing procedures as may be notified to the Licensee by Ofcom.

## 6. Permitted Frequency Bands

Subject to the Out-of-Block Emissions permitted under paragraph 8, the Radio Equipment must only transmit and/or receive on the following frequency band (the "Permitted Frequency Band"):

14xx-14xx MHz

## 7. Permissible Out-of-Block Emissions

[see schedule 3]

## 8. General provision for the amendment to the schedule of transmitter assignments

This schedule describes the conditions Ofcom would apply to the approval of new transmitter equipment

### [Terrestrial Transmission Rights Frequency Range 1452-1479.5 MHz

A licence in this frequency range enables the holder to implement transmissions at any radiated power or antenna height subject to the following conditions.

i) Calculated field strengths of all transmitters operated by the licensee should respect the aggregate field strength limits which may be calculated as applicable to defined test points outside the UK

ii) Interference must not be caused to users of adjacent frequencies (see below for procedures and criteria for assessing interference);

iii) The general provisions on site clearance (and exemption therefrom), applicable to all radiocommunications transmitters, will apply.

The procedures and criteria for assessing interference are given below.

#### (i) Co-channel limits

The co-channel technical conditions of licences in this frequency range refer to or are based upon the provisions of the multilateral international agreement signed by the UK in Maastricht in 2002. This arrangement, and the associated Plan, referred to as 'the Maastricht Plan', is available at the website of the Plan Management Body, the ERO, at http://www.ero.dk/Maastricht-e. Amongst other matters, the Maastricht Plan sets out a channelling plan for the band (each standard frequency is referred to as a 'frequency block'), and propagation calculation methods.

Any transmitter established within this licence whose transmitted bandwidth overlaps with one of the Maastricht Plan frequency blocks will be attributed to one of the allotments listed against the UK in the Maastricht Plan to which that frequency block is attributed, whether or not it lies within the geographical area defined by the allotment.

The sum of the radiated transmitter powers (appropriate to the azimuth of assessment) of all transmitters attributed to a particular allotment in any [100kHz]

bandwidth must not produce a calculated field strength at specified test points and calculated test points in excess of [29 dB(μV/m)] .

It will be possible to implement a service whose bandwidth is greater than that of a standard channel defined in the Maastricht plan. Therefore this calculation must be made separately, and compliance achieved, for each of the Maastricht Plan frequency blocks relevant to the transmitter concerned.

The calculated field strength of the licensee's transmitter network is calculated by the method specified in the Maastricht Plan, Annex 4, Section 2;

The specified test points are the geographical coordinates of test points of non-UK co-block allotments in the Maastricht Plan;

The calculated test points are the outermost of the aggregated test points of the relevant UK allotments, constructed according to the method detailed in the Maastricht Plan Annex 4, Appendix 1.

Protection from interference from other countries can only be sought by Ofcom on behalf of the licensee at the test points of allotments registered in the Maastricht Plan, over the bandwidth of the frequency block attributed to the allotment concerned. Other countries have rights to implement allotments registered in the Maastricht Plan as specified in the Maastricht Plan, Annex 4.

The Maastricht Plan Annex 4 Section 3 details the procedures and criteria for modifying or adding allotments to the plan. It should be assumed that this will not be possible unless, in effect, the calculated field strength of any network related to the new allotment(s) were less than 38 dB(μV/m) (across the full bandwidth of the frequency block) at the boundary of all neighbouring countries. Ofcom makes no undertaking in respect of seeking modification to the Plan on behalf of licensees.

### (ii) Adjacent Channel Limits

{base on code of practice to be agreed by licensees post-award}.

## Terrestrial Transmission Rights Frequency Range 1479.5 – 1492 MHz

As indicated in Section 8, the UK has no defined rights regarding terrestrial transmission in the band, but under the Maastricht Plan the UK has an obligation to protect reception of Broadcast Satellite Sound (BSS-sound) services in neighbouring countries and this band has been designated for BSS sound in the national Frequency Allocation tables of both France and Ireland. Both Administrations have also implemented ECC/DEC/(03)02 regarding use of the band for Satellite Digital Audio Broadcasting systems.

The Maastricht Plan (Annex 2, p. 841) sets the field strength to be protected for BSS-sound digital in the 1.5 GHz band as 29dB(μV/m).

Currently, as far as Ofcom are aware, there is only one BSS-sound satellite broadcasting programmes with a European coverage; this is The WorldSpace "Afristar" satellite filed with the ITU as AFRIBSS at 210E. This satellite has been coordinated and notified under the ITU procedures and its assignments are in the IMFR. Currently, the satellite broadcasts in the band 1467.5 – 1481 MHz in Africa and Europe, but has the capability to use the 1479.5 – 1492 MHz band and it is understood that the company has plans to procure additional capacity to use this 12.5 MHz band in Europe. See http://www.worldspace.com.

In addition to the AFRIBSS, filing there are French filings (Notified) for adjacent slots covering the full BSS band (1467.5 – 1492 MHz) and it is understood that one of these filings may be intended for WorldSpace.

The satellite filing information is available on the ITU Web site under Radiocommunications, Space Services, SNS and attention is drawn to:

- AFRIBSS at 210E

- F-SATDAB-5B at 21.50E

Initial calculations indicate that protecting BSS-Sound at the Maastricht levels 29dB(μV/m) in neighbouring countries will limit the types of service that can be offered in the 1479.5 – 1492 MHz band

i) Calculated field strengths of all transmitters operated by the licensee should respect the aggregate field strength limits which may be calculated as applicable to defined test points outside the UK

ii) Interference must not be caused to users of adjacent frequencies (see below for procedures and criteria for assessing interference);

iii) The general provisions on site clearance (and exemption therefrom), applicable to all radiocommunications transmitters, will apply.

The procedures and criteria for assessing interference are given below.

## (i) Co-channel limits

The co-channel technical conditions of licences in this frequency range refer to or are based upon the provisions of the multilateral international agreement signed by the UK in Maastricht in 2002. This arrangement, and the associated Plan, referred to as 'the Maastricht Plan', is available at the website of the Plan Management Body, the ERO, at http://www.ero.dk/Maastricht-e. Amongst other matters the Maastricht Plan sets out a channelling plan for the band (each standard frequency is referred to as a 'frequency block'), and propagation calculation methods.

Any transmitter established within this licence whose transmitted bandwidth overlaps with one of the Maastricht Plan frequency blocks will be attributed to one of the allotments listed against the UK in the Maastricht Plan to which that frequency block is attributed, whether or not it lies within the geographical area defined by the allotment.

The sum of the radiated transmitter powers (appropriate to the azimuth of assessment) of all transmitters attributed to a particular allotment in any [100kHz][28] bandwidth must not produce a calculated field strength at specified test points and calculated test points in excess of [29 dB(μV/m)][29] .

It will be possible to implement a service whose bandwidth is greater than that of a standard channel defined in the Maastricht plan. Therefore this calculation must be made separately, and compliance achieved, for each of the Maastricht Plan frequency blocks relevant to the transmitter concerned.

The calculated field strength of the licensee's transmitter network is calculated by the method specified in the Maastricht Plan, Annex 4, Section 2;

The specified test points are the geographical coordinates of test points of non-UK co-block allotments in the Maastricht Plan;

[28] The choice of bandwidth impacts on technological neutrality: wider is more neutral, but less effective at guaranteeing protection of other services: 100 kHz is a figure likely to be agreed at the Regional Radio Conference in 2006 on the UHF and VHF bands. The actual figure would need to be agreed by bilateral coordination with neighbouring countries prior to the licensing process.

[29] assessed at 10m receiving height; 29 dB(μV/m) derived from the Maastricht Plan criterion of 41 dB(μV/m), factored for bandwidth difference)

The calculated test points are the outermost of the aggregated test points of the relevant UK allotments, constructed according to the method detailed in the Maastricht Plan Annex 4, Appendix 1.

Protection from interference from other countries can only be sought by Ofcom on behalf of the licensee at the test points of allotments registered in the Maastricht Plan, over the bandwidth of the frequency block attributed to the allotment concerned. Other countries have rights to implement allotments registered in the Maastricht Plan as specified in the Maastricht Plan, Annex 4.

The Maastricht Plan Annex 4 Section 3 details the procedures and criteria for modifying or adding allotments to the plan. It should be assumed that this will not be possible unless, in effect, the calculated field strength of any network related to the new allotment(s) were less than 38 dB(μV/m) (across the full bandwidth of the frequency block) at the boundary of all neighbouring countries. Ofcom makes no undertaking in respect of seeking modification to the Plan on behalf of licensees.]

## 9. Interpretation of terms in this Schedule

In this Schedule:

a) “Mobile Transmit” means transmission from any mobile or user station;
b) “Base Transmit” mean transmission from any base station;
c) "EIRP" means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
d) “ERP” means the effective radiated power. This is the product of the power supplied to the antenna and its gain relative to a half-wave dipole in a given direction;
e) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliWatt (i.e. a value of 0 dBm is 1 mW);
f) “dBW” means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBW is 1 W);
g) “Occupied bandwidth” means the width of the frequency band occupied such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the total mean power of the emission;
h) “Maximum mean EIRP density” means the average EIRP transmitted during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions;
i) “Out-of-Block Emissions” means radio frequency emissions generated by the Radio Equipment and radiated into the frequency bands adjacent (in terms of frequency) to the Licensee’s Permitted Frequency Bands;
j) “Permitted Frequency Bands” means the two frequency bands set out in paragraph 7; and
k) “Notified Licensees” means the holders of wireless telegraphy licences (which relate to the Permitted Frequency Bands) which are notified to the Licensee by Ofcom.

SCHEDULE 2 TO LICENCE NUMBER: **[Insert Licence Number]**

Licence Category: **Licence for use of the Spectrum bands 14xx-14xx MHz**

[Licence fees – date of payment and amount of fee]

SCHEDULE 3 TO LICENCE NUMBER: **[Insert Licence Number]**

Licence Category: **Licence for use of the Spectrum bands 14xx-14xx MHz**

Schedule of transmitter assignments

[details according to system, typically including for each assignment

- location
- height of antenna above ground
- maximum e.r.p.
- horizontal radiation pattern]

## Annex 7

# Other relevant regulation

A7.1 This Annex presents a brief summary of some aspects of the regulatory framework context for the electronic communications and broadcasting sector that may be relevant to Licensees using the spectrum band, other than conditions relating to wireless telegraphy.

A7.2 It is the responsibility of parties interested in using the Spectrum Band to provide electronic communications and broadcasting services to consider what regulation relating to electronic communications networks and services may be relevant to the services that they propose to provide. The same is also true of all other aspects of regulation, such as broadcasting regulation and competition law. This Annex provides only a brief summary of the legal provisions that may be relevant and it is provided for information only. Interested parties should seek their own legal advice as appropriate.

A7.3 This annex covers regulation on the following three areas:

7.3.1 Broadcasting regulation – television

7.3.2 Broadcasting regulation – commercial digital radio

7.3.3 Electronic communication services and networks

## Broadcasting regulation – television

A7.4 Television programmes made available for reception by members of the public by means of an Electronic Communications Network (ECN) or satellite are licensable under the Broadcasting Act 1990 (as amended) and the Communications Act 2003 as Television Licensable Content Services (TLCS). The delivery technology (DMB, DVB-H, IP etc) is not a determining factor when considering whether a service is licensable as a TLCS.

A7.5 The onus is on the provider of each service (such as a TV channel) to determine whether that service requires licensing by Ofcom or not. It is an offence to provide a licensable television service without the appropriate licence.

A7.6 A TV service may be provided by the ECN operator or by another party. It is the provider of the TV service who should hold the Ofcom licence. If a service is already licensed as a TLCS, it does not need a separate TLCS licence to be made available on other ECNs.

A7.7 Once licensed, the television service must comply with all the rules relating to the content and scheduling of programmes and advertising, and the behaviour of licensees, as required by UK and European law.

A7.8 Relevant Codes and Rules for content include:

- Ofcom Broadcasting Code (http://www.ofcom.org.uk/tv/ifi/codes/)
- Rules on the Amount and Distribution of Advertising (http://www.ofcom.org.uk/tv/ifi/codes/)

- Code on Electronic Programme Guides (http://www.ofcom.org.uk/tv/ifi/codes/)
- Code on Sports and Listed Events (http://www.ofcom.org.uk/tv/ifi/codes/)
- Code on Access Services (http://www.ofcom.org.uk/tv/ifi/codes/)
- BCAP Television Advertising Standards Code (http://www.asa.org.uk/asa/codes/)

A7.9 If a licensee is found in breach of the Conditions of the TLCS licence, including breaches of the Codes or Rules, Ofcom can impose sanctions on the licensee. Actions Ofcom can take further to a breach range from publication of a finding of the breach, to imposing a statutory sanction on the licensee. Statutory sanctions include obliging the licensee to broadcast Ofcom's finding, financial penalties and revocation of the licence. Further information can be found in Ofcom's Outline procedure on Statutory Sanctions (http://www.ofcom.org.uk/tv/ifi/guidance/sanctions/#content).

A7.10 Further information about the licensing process for TLCS licences and the conditions that TLCS licensees are subject to are set out in the Guidance notes for licence applicants. The Guidance notes, along with the standard form TLCS licence, are available on the Ofcom website under Ofcom licensing / Television Broadcast Licensing / Guidance notes and application forms (http://www.ofcom.org.uk/tv/ifi/tvlicensing/guidance_notes_and_apps/).

### Possible future changes to the regulation of television broadcasting

A7.11 Ofcom is currently considering whether, and if so how, product placement might be allowed under the Codes and Rules. The consultation closed on13 March 2006. Ofcom is also consulting on what the rules should be for Channel Sponsorship (consultation closes on 20 April 2006). Ofcom consultation documents are available at http://www.ofcom.org.uk/consult/.

A7.12 The most significant piece of European legislation relevant to television broadcasting is the Television Without Frontiers Directive (Council Directive 89/552/EEC of 3 October 1989 on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the pursuit of television broadcasting activities, as amended by Directive 97/36/EC of 19 June 1997). The Television Without Frontiers Directive is currently under review, and the European Commission has published a proposal for changes to the Directive which, if implemented, could widen the licensing and regulation of audio-visual services in the UK to cover services other than television broadcasting. Further information is available on the European Commission's website (http://europa.eu.int/comm/avpolicy/index_en.htm).

## Broadcasting regulation – commercial digital radio

### Local radio multiplex licences

A7.13 When Ofcom is considering licensing a new local radio multiplex service it must issue a notice inviting applications for the licence. Ofcom must assess applications for local radio multiplex licences against specific statutory criteria set out in section 51 of the Broadcasting Act 1996 in order to decide whether, or to whom, to award the licence.

A7.14 Local radio multiplex licences are granted for 12 years, and can be renewed once. The length of the renewed licence period is determined by the date on which the licence was originally granted. Licences granted before 1 October 2002 are eligible for a 12 year renewal period; licences granted between 1 October 2002 and 1

October 2006 are eligible for an eight year renewal period; and licences granted after 1 October 2006 are not eligible for any renewal period.

## National radio multiplex licences

A7.15 The statutory criteria for assessing applications for national radio multiplex licences are slightly different from those for local radio multiplex licences (see section 47 of the Broadcasting Act 1996).

A7.16 National radio multiplex licences are granted for 12 years, and may be renewed on one occasion. As for local radio multiplexes, the length of the renewal period is determined by the date on which the licence was originally granted and licences granted after 1 October 2006 will not be eligible for a renewal.

A7.17 Ofcom must ensure that conditions included in national radio multiplex licences (taken together) secure that an amount of digital capacity on the multiplex frequencies is reserved for every independent national broadcaster for the broadcasting of a simulcast radio service provided by that broadcaster.

## Digital sound programme services and digital additional services

A7.18 A person wishing to provide a sound programme service or an additional service for transmission on a multiplex must hold a national or local digital sound programme service licence or a digital additional services licence (respectively) authorising the provision of that service. There is no competitive process for the award of these licences. Award of a licence does not confer any right to transmit; carriage of a particular service is dependent on commercial negotiations between the service provider and the multiplex operator. The licences are of indefinite duration (i.e. they have no fixed end date).

## Ownership

A7.19 There are specific ownership rules to prevent undue concentration of ownership of multiplex licences and local digital sound programme service licences. No person can hold more than one national radio multiplex licence at the same time. No person can hold two local multiplex licences at the same time where the protected area of one of the licensed services overlaps with the protected area of the other in a way that means that the potential audience for one of them is or includes at least half the potential audience of the other.

A7.20 For local digital sound programme services there is a points system applied to the number of local digital sound programme services that one person can provide on multiplexes in the same market area. For details see the Media Ownership (Local Radio and Appointed News Provider) Order 2003.

## Characteristics of radio multiplex services

A7.21 If a radio multiplex licensee asks Ofcom to vary their multiplex licence to change the characteristics of the digital sound programme services broadcast under the licence, Ofcom must consent to the change if:

- in the case of a national radio multiplex licence, the variation would not unacceptably diminish the capacity of the digital sound programme services broadcast under the licence to appeal to a variety of tastes and interests.

- in the case of a local radio multiplex service, one of the three criteria below is satisfied:
  - that the variation would not unacceptably narrow the range of programmes available by way of local digital sound programme services to persons living in the area or locality for which the licensed multiplex service is provided; or
  - that the variation would be conducive to the maintenance or promotion of fair and effective competition in that area or locality; or
  - that there is evidence that, amongst persons living in that area or locality,
- there is a significant demand for, or significant support for, the change that would result from the variation.

### Data restriction on radio multiplexes

A7.22 It is a statutory requirement that at least 80% of the capacity on a radio multiplex service must be used, or left available to be used, for broadcasting digital sound programme services, simulcast radio services, programme-related services, and relevant technical services. Ofcom can impose conditions in a multiplex licence requiring a figure higher than 80% if it thinks it appropriate to do so. The statutory minimum requirement of 80% can be changed by the Secretary of State.

### General multiplexes

A7.23 Changes made by the Communications Act enable Ofcom to decide to license new multiplex services by way of a wireless telegraphy licence alone, rather than a wireless telegraphy licence plus a Broadcasting Act licence. Such services are described as general multiplex services in section 175 of the Communications Act. Programme providers of services broadcast over these multiplexes would still be required to hold the appropriate Broadcasting Act licence (digital sound programme service or digital additional service licence), thus allowing the content of these services to be regulated.

### Satellite and cable services

A7.24 A person wishing to provide a radio programme service for broadcast over a satellite or cable platform requires a radio licensable content service licence. As with digital sound programme service licences there is no competitive element to the award of these licences. The grant of a licence does not confer any right to broadcast the service over a particular platform. Carriage of the service is dependent on commercial agreement between the programme provider and the satellite or cable platform operator. There is no restriction on the number of radio licensable content service licences that a single person can hold, and the licences are of indefinite duration. The same type of licence is required whether the service is broadcast in digital or analogue form.

### Radio over television multiplexes

A7.25 In order to provide a digital sound programme service for transmission on a television multiplex, a person requires a national digital sound programme service licence. Television multiplexes are subject to a statutory requirement that at least 90% of the capacity on the frequencies on which the multiplex service is broadcast is used (or left available to be used) for the broadcasting of qualifying services, digital

programme services, digital sound programme services provided by the BBC, programme-related services and relevant technical services. Digital sound programme services provided by persons other than the BBC fall outside this list of services, and therefore the number of commercial digital sound programme services that can be provided on a television multiplex is restricted by this rule. The statutory minimum requirement of 90% can be changed by the Secretary of State.

## Electronic Communication Services and Networks

A7.26 As part of its regular reviews of regulatory packages, the European Commission, through the Information Society Directorate-General, has plans to assess the need to update and amend the current framework applicable to Electronic Communications. The relevant Directives include the Framework Directive (2002/21/EC), the Access and Interconnection Directive (2002/19/EC), the Authorisation Directive (2002/20/EC), the Universal Service Directive (2002/22/EC), the Privacy and Electronic Communications Directive (2002/58/EC), the relevant Competition Directive (2002/77/EC) and the Radio Spectrum Decision (676/2002/EC) (all as amended). It is expected that the European Commission will start the assessment and work with Member States from in 2006. This could lead to regulatory proposals from the second half of 2007 onwards; the proposals could result in changes to legislation applicable in the UK. Further information can be obtained from the European Commission and their website at www.europa.eu.int/information_society/activities/index_en.htm.

## Conditions of entitlement

### (a) General Conditions of entitlement

A7.27 All providers of ECS and ECN in the UK are covered by the General Conditions of Entitlement. Out of 21 conditions, some apply to particular categories of ECS or ECN providers, mainly depending on whether they provide public services or networks and whether they provide publicly available telephone services or public telephone networks.

A7.28 It is the responsibility of any undertaking involved in the provision of ECS or ECN to identify which conditions apply to them and to ensure that it complies with them. Further information can be found at http://www.ofcom.org.uk/telecoms/ioi/g_a_regime/gce/gcoe/?a=87101 and the General conditions of entitlement can be found at http://www.ofcom.org.uk/static/archive/oftel/publications/eu_directives/2003/cond_final0703.pdf. It should be noted that from time to time Ofcom consults on changing the General Conditions of Entitlement and such proposals can usually be found on Ofcom's website

A7.29 Ofcom has powers under the Communications Act and Universal Service directive to designate Universal Service Providers and to impose universal service conditions. In June 2005, Ofcom issued a Statement and further Consultation on the Universal Service Obligation (USO)[30] ; it includes some proposals for amendments to General Condition 15 (services for disabled customers) and General Condition 6 (public pay phones). Ofcom expects to publish a statement on its final proposals, and other impacts of the review of USO, in the beginning of 2006.

[30] http://www.ofcom.org.uk/consult/condocs/uso/statement/?a=87101

A7.30 providers and to pass on the retail revenues less certain specified costs. Ofcom also asked for stakeholders' views on the possible extension of premium rate services regulation to calls to 0871 numbers and all sexual entertainment services regardless of price, although the implementation of such proposals would be the subject of further consultation. Both consultations close on 06 December 2005 and Ofcom expects to publish a statement in respect of each consultation in the first half of 2006.

A7.31 In September 2004, Ofcom published a consultation document on new voice services (consultation closes on 03 May 2006), following the emergence of voice services using Voice over IP. More details on the consultation can be found at http://www.ofcom.org.uk/consult/condocs/voipregulation/ That document discusses Ofcom's proposed approach to regulating voice telephony services in the light of new technological developments. In particular, it addresses how different types of VoIP services should be regulated to ensure that consumers' interests can be best protected.

### (b) Premium rate services (PRS)

A7.32 Under sections 120 of the Communications Act, Ofcom has the power to set conditions relating to the provision, content, promotion and marketing of PRS. These conditions are binding on communications providers of a specified description to comply with directions given in accordance with an approved code by an enforcement authority (the Independent Committee for the Supervision of Standards of Telephone Information Services (ICSTIS[31]) ) and if there are no approved codes the provisions of an order under the Act. The latest edition Code of Practice for PRS is available from the ICSTIS website[32] Further information on the regulation of premium rate services is available from both the ICSTIS website and the Ofcom website[33] . ICSTIS is currently having the role of regulation the content and promotion of premium rate services through this Code. Interested parties who may consider providing PRS should conduct their own assessment of how regulatory provisions would apply to their plans.

A7.33 Ofcom also plans to carry out a general review of the scope regulation of PRS in its financial year 2006/07.

## Market reviews

A7.34 It is part of Ofcom's must carry out regular reviews of particular communications markets, at retail and wholesale level, in accordance with the Framework Directive 2002/21/EC and Commission Recommendation 2003/311/EC. Further details on market reviews may be found on the Ofcom Website at http://www.ofcom.org.uk/telecoms/ioi/mrs/?a=87101 and http://www.ofcom.org.uk/bulletins/crt/compreg_telecoms/.

A7.35 The following markets identified in the Commission Recommendation may be of particular relevance to services that could be developed in the Spectrum Bands:

a) access and call origination on public mobile telephone networks;

b) voice call termination on individual mobile networks; and

[31] http://www.icstis.org.uk
[32] See http://www.icstis.org.uk/icstis2002/default.asp?node=5.
[33] See http://www.ofcom.org.uk/telecoms/ioi/nwbnd/prsindex/.

c) the wholesale national market for international roaming on public mobile networks.

A7.36 Other markets may identified by the Commission Recommendation may be relevant.

A7.37 In the case of market (a), Oftel carried out a review in 2003 and found that the mobile network operators (MNOs) did not have SMP, either individually or in combination, as described in the corresponding statement (see http://www.ofcom.org.uk/static/archive/oftel/publications/eu_directives/2003/mobileacco0803.pdf).

A7.38 In the case of market (b), Ofcom found in June 2004 each of the 6 MNOs in the UK to have SMP for wholesale voice call termination provided via their respective network (see http://www.ofcom.org.uk/consult/condocs/mobile_call_termination/wmvct/wmvct.pdf). Remedies were imposed on each of the 6 MNOs, as required by the European framework. The remedies varied to some extent between the 6 operators, reflecting (among other things) considerations of proportionality and taking into account the conditions of each network that were relevant at the time. In summary, Ofcom imposed on the 6 MNOs the following remedies:

a) O2, Orange, T-Mobile and Vodafone: charge controls for 2G voice call termination until 31 March 2006;

b) O2, Orange, T-Mobile and Vodafone: access obligation for 2G voice call termination;

c) O2, Orange, T-Mobile and Vodafone: obligation not to discriminate unduly in relation to 2G voice call termination;

d) O2, Orange, T-Mobile and Vodafone: obligations to notify 2G voice call termination charges in advance and to publish Access Contracts;

e) H3: transparency obligation to notify charges for 2G voice call termination, and to notify 2G and total call volumes[34] ; and

f) Inquam: transparency obligation to notify charges for call termination in advance until it ceased to be an ECS provider and its Wireless Telegraphy Licence was revoked.

A7.39 In June 2005, Ofcom proposed in a consultation to extend the charge controls for 2G call termination for a further 12 months to 31 March 2007. The other remedies imposed in 2004 remain in place. Ofcom has also published a separate consultation document initiating a further market review of voice call termination on individual

[34] On 29 July 2004, H3G appealed Ofcom's determination finding that H3G has SMP; however, H3G did not appeal Ofcom' s determination as to the relevant market. The Tribunal's judgment was handed down on 29 November 2005. The Tribunal concluded that Ofcom erred in its determination as to the existence of SMP because it did not carry out a full assessment of the extent to which BT had countervailing buyer power. The Tribunal stated, however, that on its reconsideration it would be open to Ofcom to reach the same conclusion. Ofcom is currently reconsidering this matter in accordance with the terms of the consent order approved by the Tribunal at the directions hearing on 16 December 2005 and as drawn on 10 March 2006: see http://www.catribunal.org.uk/documents/Order1047H3G161205.pdf"

mobile networks, and plans to conclude this review before March 2007. For these two documents, see: http://www.ofcom.org.uk/consult/condocs/wholesale/ and http://www.ofcom.org.uk/consult/condocs/termination/. The consultation period on the proposal to extend the 2G call termination charge controls for a further 12 months closed on 30 August 2005 and Ofcom has published a statement. Ofcom is about to publish a second CIM market review consultation document.

A7.40 In the case of market (c), the European Regulators Group recently published a framework [35] to help national regulators consider potential competition problems in individual wholesale roaming markets. On 8 February 2006, the European Commission proposed an EC Regulation under Article 95 EC Treaty[36]. Ofcom is still considering the specifics of this proposal and are co-ordinating work with the ERG to gain a greater understanding of the European Commission's detailed thinking.

A7.41 Ofcom also has the discretion under the Communications Act to review electronic communications markets other than those described above, and to take action as it determines appropriate.

## Other provisions

A7.42 Ofcom also has the power under the Communications Act to impose access-related conditions. These may include obligations to secure end-to-end connectivity, so that end-users of public ECS may communicate with each other. These obligations may be imposed in some circumstances without a prior finding of SMP.

A7.43 To date, Ofcom has not imposed any access-related conditions under section 73 of Communications Act 2003 on any UK mobile network operator, though it has the power to do so if the conditions set out in the legal framework are met.

## Network identification codes and number resources

A7.44 Ofcom allocates mobile telephone service numbers and mobile network codes ("MNCs") to those who control mobile communications networks and who, in the case of mobile telephone service numbers, need public numbering for their customers.

A7.45 MNCs are allocated individually in accordance with the National Telephone Numbering Plan ("the Plan")[37] and ITU-T Recommendation E.212[38] . Mobile telephone service numbers are allocated in units of 100,000 numbers for services in accordance with the Plan and ITU-T Recommendations E.212 and E.164238. Definitions of these numbers and related services are set out in the Plan published by Ofcom from time to time.

[35] See ERG(05)20rev1 http://erg.eu.int/doc/publications/consult_wholesale_intl_roaming/erg_05_20_rev1_wir_common_position.pdf

[36] http://europa.eu.int/rapid/pressReleasesAction.do?reference=SPEECH/06/69&format=HTML&aged=0&language=EN&guiLanguage=en

[37] " See http://www.ofcom.org.uk/telecoms/ioi/numbers/261701.pdf

[38] Further information may be obtained from the ITU and the relevant webpage is http://www.itu.int/ITU-T/inr/

A7.46 Ofcom would expect to allocate MNCs only to public electronic communication network ("PECN") providers. Those operating private networks in conjunction with PECNs will not require their own independent mobile network identity. Their individuality can be demonstrated, where necessary, by location area codes.

## Competition in communications markets

A7.47 In addition to its sectoral powers conferred by the Communications Act 2003, Ofcom can also act in relation to communications matters under Chapter I of the Competition Act 1998 and Article 81 of the EC Treaty, to address agreements preventing, restricting or distorting competition, under Chapter II of the Competition Act 1998 and Article 82 of the EC Treaty to address abuse of a dominant position, and under the Enterprise Act 2002, to address such matters as suspected adverse effects on competition.

A7.48 On 22 September 2005 Ofcom accepted undertakings from British Telecommunications plc pursuant to section 154 of the Enterprise Act 2002. see http://www.ofcom.org.uk/consult/condocs/statement_tsr/

A7.49 Further information about how Ofcom has used these powers can be found on the Ofcom Website, in particular at http://www.ofcom.org.uk/bulletins/comp_bull_index/ and http://www.ofcom.org.uk/bulletins/crt/.

## Annex 8

# Impact Assessment

## Introduction

A8.1 This annex when read in conjunction with the rest of this consultation document sets out an Impact Assessment (IA) as defined by section 7 of the Communications Act 2003.

A8.2 Consistent with Ofcom's guidelines on the use of Impact Assessments[39], this IA:

- Defines the issue being considered and identifies the citizen/ consumer interest;
- Defines the policy objective
- Identifies and assesses the options and identifies the impacts on stakeholders; and
- Assesses the impact on competition.

## The issue being considered and the citizen/ consumer interest

A8.3 This consultation document is considering the award of the 1452 1492 MHz band of spectrum, including different options for packaging the auction and the design of the awards process. This band of spectrum could potentially be used to support the use of a wide variety of end uses, a number of which could have the potential to create substantial benefits for citizens/ consumers. As set out by Ofcom previously in its spectrum framework plan documents, Ofcom's view is that where possible, citizen/ consumer interests in relation to the allocation of spectrum are best served through spectrum trading and liberalisation.

## The policy objective

A8.4 Ofcom has a principal duty to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate, by promoting competition. Further, in securing this principal duty Ofcom is required to secure the optimal use of wireless telegraphy of the electro-magnetic spectrum[40]. Therefore, the objective of the policy is to award the available spectrum in such a way as to maximum the likelihood that it will secure optimal use of the spectrum and to minimise any competition concerns that may arise.

## Identification and assessment of options and the impacts on stakeholders

### Licence exemption

A8.5 Ofcom could allocate this spectrum on a licence exempt basis or with licences. The options are considered in the table below.

[39] "Better policy making: Ofcom's approach to Impact Assessment", 21 July 2005.
[40] Ofcom's duties relevant to the award of this spectrum are set out in detail in Section 3.

| Option | Advantages | Disadvantages |
|---|---|---|
| Licensed spectrum | Reduced risk of interference means that different operators will have the confidence to invest in deploying services in this spectrum | Higher costs of allocating and administering the spectrum. |
| Licence exempt spectrum | Notwithstanding potential interference, many service providers could exploit the spectrum and innovative uses might develop. | Given the potential uses of this spectrum, deployment of most of these technologies is likely to lead to significant interference.<br><br>The high probability of interference is likely to depress the value that can be generated from licence exempt use of this spectrum |

A8.6 Given the risks of inefficiency from a licence exempt approach Ofcom is proposing to licence this spectrum.

## Choice of assignment mechanism

A8.7 Ofcom could allocate this spectrum in a variety of ways that can be grouped in three ways, auction, "first come, first served" and comparative selection. Comparative selection was ruled out during the SFR:IP consultation process. The other options are considered below

| Option | Advantages | Disadvantages |
|---|---|---|
| Auction | Clear and simple criteria for identifying winning bids<br><br>Open, transparent, and non-discriminatory<br><br>Most likely to lead to an efficient outcome | Transaction and participation cost may be incurred by bidders |
| "First come, first served" | | Appropriate where supply exceeds demand. In this case the market assessment suggests that this will not be the case |

A8.8 Ofcom's general view is that an auction mechanism is the preferred tool for assigning licences to unused spectrum. Having considered the particular circumstances of this spectrum Ofcom proposes to award this spectrum using an auction mechanism.

## Technology and service neutrality

A8.9 This spectrum could be awarded on either a technology and service neutral basis or it could be mandated for a particular technology or service. These options are considered in the table below.

| Option | Advantages | Disadvantages |
|---|---|---|
| Technology and service neutral approach | The market is allowed to determine the optimum use of the spectrum<br><br>The potential efficiency of the auction is maximised by allowing bidders the option of using the technology and service that they prefer<br><br>Demand assessment suggests that a range of different technologies and services wish to use this spectrum, this approach allows the market to choose the best use<br><br>Consistent with the framework directive<br><br>Does not constrain future use | Bidders in auction face uncertainty over nature of adjacent users (although risks can be mitigated by defining appropriate spectrum usage rights) |
| Mandate a specific service or technology | Bidders have certainty over nature of adjacent spectrum users<br><br>In certain circumstances, may assist in facilitating international harmonisation of equipment (though this can also be achieved by less intrusive means). | Requires Ofcom to choose one or more technologies or services<br><br>Could result in a sub optimal choice of technology or services<br><br>Could exclude technologies or services that may provide greater benefits than the chosen technologies or services |

A8.10 Therefore, in order to maximise efficiency and to enable the market to choose the most efficient outcome, Ofcom proposes to use a technology and service neutral approach

## Packaging options and competition issues

A8.11 Given the varying constraints on the use of different parts of this band. Ofcom has looked at the packaging options for two different sub-bands, namely:

- Lower 27.5MHz (1452 – 1479.5MHz)
- Upper 12.5MHz (1479.5 – 1492MHz)

A8.12 For this spectrum Ofcom has considered whether the packaging of the spectrum could negatively impact on competition in downstream markets if control of all or a

significant proportion of the spectrum were to be gained by a limited number of bidders. It has also considered whether any competition problems would be caused if a successful bidder already held a position of strength in any markets such that it may have anti-competitive motives for acquiring the spectrum. If this were to be the case it may be appropriate to package the spectrum in such a way as to promote multiple entry and/or place restrictions on the amount of spectrum that any single bidder can acquire.

A8.13 The types of services that could be offered using this spectrum would operate in a number of different downstream markets, including mobile television/multimedia, high speed data and broadcast radio.

A8.14 Mobile television/ multimedia will essentially be a new service, although it may incorporate elements of existing services, such as terrestrial TV and mobile telephony. It is not clear at this stage what the relevant economic market will be for such services and it could be relatively narrow, incorporating only mobile television and multimedia services or broader including other platforms such as 3G mobile telephony, podcasting and downloading of audio and video content and potentially even terrestrial television. If a single bidder were to acquire the available spectrum and particularly if this bidder were a large contents right holder, then this may have potential to cause competition concerns, through a possibility that such a bidder could utilise its position to create a barrier to entry by excluding rival content or denying their content to rival operators. However, if such a strategy is possible (and it is not clear that it would be) it would likely be more appropriate to use competition law, or specific regulatory remedies to address such issues as and when they arise. As such, in this circumstance, where it is not clear that such issues do arise, it is not necessary to address these through spectrum policy.

A8.15 In the case of using the spectrum to offer high-speed data services, any competition concerns would appear to be very limited. On the demand side, there is a variety of fixed-line and satellite providers of high-speed data services and this is an area where mobile telephony operators are also looking to offer services over their networks. On the supply side there is other spectrum becoming available that may be better suited to deploying WiMAX and IP Wireless technologies, such as 2010-2025 MHz, 2500-2690 MHz and 3.5 GHz.

A8.16 As for broadcast radio it is not clear what the relevant economic market would be for these services and could include both terrestrial and satellite digital radio as well as analogue radio and possibly also podcasts and downloads of radio programmes. There is currently a wide range of T-DAB services in the UK and Ofcom has recently announced that further spectrum will be made available for T-DAB deployment in VHF Band III, sub band 3 for local and national services. If the spectrum in 1452 – 1492 MHz band were to be used for providing digital radio then receivers will need to be developed that can receive both this band and the current T-DAB broadcasts. The current availability of T-DAB, the new capacity that is being made available, the growth in radio listening over the internet and television and the fact that there are no plans to switch off analogue radio broadcasts suggest that there is limited scope for a bidder to negatively affect competition in downstream radio broadcast markets.

A8.17 In the context of satellite digital radio it may be the case, due to the international issues set out in Section 5 that any satellite radio service provider will be advantaged relative to other potential bidders for the upper 12.5MHz of spectrum. However, the existence of these constraints may mean that it is efficient for a satellite user to successfully bid for the spectrum and it would not be appropriate to place restrictions

on satellite radio operators from bidding on the upper 12.5 MHz. Nonetheless, it is possible that non satellite radio operators will bid for the upper 12.5 MHz, but that their willingness to pay will be lower than for the lower 27.5 MHz, reflecting the impact of the international constraints.

## Overview of packaging options for lower 27.5 MHz

A8.18 Ofcom has identified and assessed four possible packaging options for the lower 27.5 MHz. The table below gives an overview of these packaging options, together with their respective advantages and disadvantages. These are considered in more detail in section 6

| Option | Advantages | Disadvantages |
|---|---|---|
| Option A: package in 1.7 MHz lots | Promotes competition<br><br>Different interference constraints between lots are made explicit<br><br>Market can determine optimum aggregation<br><br>Maximum accommodation of alternative uses | Aggregation risk for users requiring larger amounts of spectrum *(may be mitigated through appropriate auction design)*<br><br>Sub-optimal outcomes would need to be resolved in the secondary market<br><br>Larger number of lots tend to add complexity to the award process |
| Option B: package in 5.1 MHz lots | Removes aggregation risk for users requiring (multiple of) 5.1 MHz lots<br><br>Less complex award process (fewer lots) | Unsatisfactory for users not seeking (multiples of) 5.1 MHz. These users would need to rely on secondary trading which may involve high transaction costs<br><br>Risk of regulatory failure through picking the sub-optimal package size<br><br>Potentially inconsistent with approach of technology neutrality, as choice of package size may favour certain technologies |
| Option C: package in varied-sized lots | May remove aggregation risks for users requiring particular amounts of spectrum<br><br>Potentially allows a greater variety of uses (than options B and D) and reduced aggregation risk than option A | Larger number of lots tend to add complexity to the award process though this can be mitigated through the auction design |

| Option | Advantages | Disadvantages |
|---|---|---|
| Option D: package in one 27.5 MHz lot | Quick and simple award process<br><br>Minimal involvement from Ofcom | Spectrum may be allocated inefficiently and relies on an efficient secondary market (which at present is unlikely)<br><br>Potentially restricts the development of competition and variety of applications |

A8.19 Although these four broad spectrum packaging options have been identified and assessed by Ofcom, they are not necessarily exclusive. For example, as discussed in Section 7, it may be possible to allow the market to choose between alternative package options without creating undue aggregation risks for bidders by using combinatorial bidding.

## Award options for the upper 12.5 MHz

A8.20 In light of the international constraints that have been identified there are four broad options available for awarding the upper 12.5 MHz block:

- Award it through a pan-European process;
- Award it simultaneously with the lower blocks (1452 – 1479.5 MHz);
- Award it separately from the lower blocks;
- Postpone the award of the available spectrum.

| Option | Advantages | Disadvantages |
|---|---|---|
| Pan-European award: This would involve withholding the award of the upper 12.5 MHz block and discussing with European neighbours how the spectrum should be awarded | If successful, it would take into account the externalities caused by different countries awarding spectrum for different uses, for example, the value of the spectrum across a number of countries will be greater than the sum of the value of the spectrum in each country individually, particularly for terrestrial use.<br><br>If done quickly, it would lead to an efficient award of this block of spectrum. | Given the processes that would be involved, award of the spectrum would be delayed by around two years and agreement cannot be guaranteed.<br><br>This approach would not allow complementarity and substitutability of upper 12.5MHz and lower 27.5MHz to be addressed through the award process.<br><br>There are doubts about the feasibility and acceptability of an effective and appropriate approach to the award from the political and institutional point of view<br><br>It would require individual |

| Option | Advantages | Disadvantages |
|---|---|---|
| | | nations to carry out a separate terrestrial awards for the use of the spectrum, in addition to a pan-European satellite award. |
| Simultaneous award: This option would involve awarding the upper 12.5 MHz block simultaneously with the award of the spectrum in the lower 27.5 MHz blocks in a single awards process | To the extent to which the upper 12.5 MHz and the lower 27.5 MHz blocks are complementary or substitutable, then a simultaneous award will allow bidders to respond to these issues through changing their valuations/ bids in response to other bidders' behaviour. This will, all other things remaining equal, lead to a more efficient allocation of the available spectrum.<br><br>It would also be quicker and administratively cheaper than holding a separate auction for the upper 12.5 MHz block.<br><br>It would be consistent with awarding spectrum rights on a technology and usage-neutral basis.<br><br>It would result in spectrum for both satellite and terrestrial use being awarded simultaneously. | Terrestrial rights in the upper 12.5 MHz block will be severely constrained (and may not be well defined) by the satellite rights that result from the various satellite filings that have been made, which may limit any interest that there would be for terrestrial rights in this block. This could result in competition in bidding for this upper block being limited.<br><br>It increases the complexity of the award process somewhat, but this increase in complexity is not significant. |
| Separate award: This would involve holding back the award of the upper 12.5 MHz block until some time after the award of the lower 27.5 MHz blocks. | | Awarding the upper 12.5 MHz block in a separate process from the award of the lower 27.5 MHz would prevent bidders from taking into account the extent to which spectrum in the different blocks are substitutes or compliments, risking an inefficient allocation of the spectrum.<br><br>It will be administratively more expensive than a simultaneous award process. |

| Option | Advantages | Disadvantages |
|---|---|---|
| Postpone the award: This approach would involve postponing the award of all 40 MHz of the available spectrum until the usage rights of the upper 12.5 MHz have been clarified. | Bidders will be able to take valuation decisions in full knowledge of the usage rights for all available spectrum, including the upper 12.5 MHz. | It would lead to a significant delay of around 18 to 24 months for the award of the lower 27.5MHz of the available spectrum, for which significant demand has been identified. Any delay would involve significant opportunity costs. |

A8.21 After considering the advantages and disadvantages of these four options, it is Ofcom's view that the upper 12.5 MHz of spectrum should be awarded simultaneously with the lower 27.5 MHz. This approach will maximise the opportunity for bidders to manage their substitution and aggregation risks and increase the efficiency of the primary allocation of the spectrum. It will also mean that the spectrum will become available to market quicker than the other options and would not delay the award of the lower 27.5 MHz.

## Geographic packaging

A8.22 In addition to packaging the spectrum into lots of different sizes this spectrum could be divided geographically. In the first instance the choice is between UK-wide and regional allocation.

| Option | Advantages | Disadvantages |
|---|---|---|
| UK wide basis | The auction should be cheaper and simpler than a regional one.<br><br>If there is a viable national use and it is the highest value use of the spectrum, the spectrum will flow immediately to this use. | The value of the spectrum may be higher to a group of regional users which were unable to come together to bid for the spectrum because of coordination problems. However this risk is mitigated by the tradability of the spectrum and the ability for regional users to buy part of the spectrum post auction from the national licensee. There is no evidence that this issue is significant, on the basis of the market assessment. |
| Regional basis | Potential spectrum users which only want to operate in one area or region can bid for that region<br><br>If the most efficient use of the spectrum is regional, the spectrum will quickly be allocated to its most valuable use. | There is little evidence of demand for spectrum on a regional basis, raising the likelihood that this approach could lead to spectrum being inefficiently allocated<br><br>A regional auction may be more complex and costly than a national auction.<br><br>Co-ordination with neighbours along regional boundaries could waste spectrum and limit the viability of service provision along these boundaries. |

A8.23 Having considered the advantages and disadvantages of the options Ofcom proposes to allocate this spectrum on a UK wide basis (subject to any international restrictions).

## Auction design options for the different packages

A8.24 There are a number of different auction formats available, which may be suitable for the award of multiple lots of spectrum frequencies. In selecting the appropriate format for this auction, it is helpful to consider four key choices in design:

- Simultaneous or sequential sale of lots;
- Single round (sealed bid) or multiple rounds (ascending bids);
- Generic or specific lots;
- Package (combinatorial) bidding.

A8.25 The advantages and disadvantages associated with each of these four choices in auction design are set out in the table below

| **Option** | **Advantages** | **Disadvantages** |
|---|---|---|
| Simultaneous rather than sequential sale of lots | For most categories of bidder, all the lots are potentially close substitutes meaning that bidders preferences will be affected by the relative prices of individual lots.<br><br>Most bidders are likely to bid for multiple lots, meaning the lots are complementary.<br><br>Simultaneous award can reduce bidders' substitution and aggregation risks. | |
| Multiple round (ascending bids) rather than single round (sealed bids) | In the absence of competition concerns, considered to produce more efficient outcomes as bidders can learn from observing behaviour of competitors over the course of the auction – particularly important where the spectrum can be used to support new downstream services where there is greater uncertainty.<br><br>Allowing bidders to respond to relative prices reduces substitution and aggregation risks | Award process more complex than a single round award, but not so great as to justify using a significantly less efficient auction format. |
| Specific lots rather than generic lots | Allows bidders to express a preference between lots.<br><br>Allows bidders to reflect in their valuations differences between lots usage rights, relating to interference constraints as set out in the Maastricht Plan. | More complex than award with generic lots. |
| Use of package (combinatorial) bidding | Could enhance the efficiency of the auction, particularly where there are strong complementarities amongst lots, and the pattern of complementarities vary by bidder.<br><br>Reduces risks of stranded lots where bidders are left with unwanted lots at the end of the auction<br><br>Removes the risk that there could be unsold lots as a result of "step changes" in demand (which can occur in SMRAs where withdrawals are allowed). | Makes the auction more complex and less transparent, especially if unlimited packages are allowed (full combinatorial SMRA). |

A8.26 With the support of independent auction advisers, Ofcom has come to the conclusion that using a simultaneous, multiple round process is the most appropriate approach for this specific award. Ofcom also believes that it is appropriate to use specific lots rather than generic lots. However, it is less clear whether the benefits of allowing some form of package bidding are sufficient to justify the challenge of deploying a new and relatively complex auction design. Ofcom therefore intends to explore further the case for using SMRA formats both with and without package bidding.

## Annex 9

# Candidate auction formats

## Introduction

A9.1 Section 6 of this document sets out several possible options for the packaging of the 1452 – 1492 MHz spectrum band. In short, the available 40 MHz of spectrum can be awarded as one spectrum block, or alternatively it can be divided into multiple lots of 1.7MHz, multiple lots of 5.1 MHz, or lots of varied sizes. The packaging solution that will eventually be taken forward for this award impacts on the specific auction design format and rules to be adopted.

A9.2 For illustration purposes in this annex only, we assume an award whereby the spectrum is packaged as follows:

| **Sub band:** | **Illustrative packaging solution** |
|---|---|
| Lower 27.5 MHz (1452 – 1479.5 MHz) | Lots A-P: 16 lots of 1.7 MHz |
| Upper 12.5 MHz (1479.5 – 1492 MHz) | Lot Q: 1 lot of 12.5 MHz |

A9.3 The auction format and rules required for other packaging solutions would be very similar to the ones described here.

A9.4 Section 7 of this document sets out Ofcom's arguments for proposing to use an SMRA (Simultaneous Multiple Round Auction) format, given an award involving multiple spectrum lots. SMRAs have been widely deployed by spectrum managers to award multiple lots; for example, the UK 3G, BFWA and PFWA auctions all used SMRA formats. There is great scope for varying the detailed auction rules to meet the specific challenges created by individual awards.

A9.5 For this award, Ofcom has identified two leading candidate SMRA formats for awarding the available lots:

- **SMRA with enhanced switching**: an SMRA with rules that facilitate switching between lots; or
- **SMRA with limited combinatorial bidding:** an SMRA with the ability to make combinatorial bids for triples of lots.

A9.6 In the following subsections, we describe the main features of the two auction formats.

## SMRA with enhanced switching

A9.7 This format is an adaptation of the standard SMRA developed and used by the United States FCC for multi-unit spectrum auctions, and subsequently adopted by spectrum managers in other countries, such as the United Kingdom. It is particularly suitable where a band is divided into a large number of lots by frequency, as it reduces risks that bidders fail to win contiguous spectrum lots where they need such

spectrum. The format was used successfully in Norway in 2004 to award 150 lots of spectrum (6 regions each with 25 lots of 3.5MHz) in the 3.5GHz band.

A9.8 The key adaptation from a standard SMRA is the introduction of enhanced 'switching' rules to increase flexibility for bidders seeking contiguous lots. This reduces bidder exposure to substitution and aggregation risks, and should therefore produce a more efficient outcome than the standard SMRA. However, in the absence of package bidding, it cannot entirely eliminate aggregation risks. In this auction, these risks may impact particularly on those bidders seeking to aggregate lots into blocks of 5MHz or more.

## Making bids

A9.9 Bidding proceeds in multiple rounds and finishes simultaneously for all lots.

A9.10 Figure 27 shows an example of a simple bid form. Bids are made for single lots. There are no restrictions on what bids can be made other than available eligibility.

A9.11 The amounts bid per lot are non-discretionary. To make a bid for a lot, bidders simply check a box next to that lot to confirm that they accept the new bid amount. Bidders that have the current high bid on a lot may increase their bid if they wish.

**Figure 27: Illustrative example of bid form for SMRA with enhanced switching**

| Lot | High bidder | Current Price | New Bid Amount | BID | WD |
|---|---|---|---|---|---|
| A | Tom | £ xxx | £ ppp | ☐ | ☐ |
| B | Tom | £ xxx | £ xxx | ☐ | ☐ |
| C | Tom | £ xxx | £ xxx | ☐ | ☐ |
| D | Dick | £ xxx | £ xxx | ☐ | ☐ |
| E | Dick | £ xxx | £ xxx | ☐ | ☐ |
| F | Ofcom | £ xxx | £ xxx | ☐ | ☐ |
| G | Ofcom | £ xxx | £ xxx | ☐ | ☐ |
| H | Ofcom | £ xxx | £ xxx | ☐ | ☐ |
| I | Emma | £ xxx | £ xxx | ☐ | ☐ |
| J | Emma | £ xxx | £ xxx | ☐ | ☐ |
| K | Emma | £ xxx | £ xxx | ☐ | ☐ |
| L | Emma | £ xxx | £ xxx | ☐ | ☐ |
| M | Emma | £ xxx | £ xxx | ☐ | ☐ |
| N | Emma | £ xxx | £ xxx | ☐ | ☐ |
| O | Peter | £ xxx | £ xxx | ☐ | ☐ |
| P | Jo | £ xxx | £ xxx | ☐ | ☐ |
| Q | Jo | £ xxx | £ xxx | ☐ | ☐ |

Notes: Simple check box bidding – bidders simply check the box to make a bid for a specific lot at the new bid amount. WD = Withdraw; this option would only be available on a lot-by-lot basis to the current high bidders on that lot.

Source: DotEcon

## Eligibility and activity requirements

A9.12 Bidders have an ***eligibility*** that limits the number of lots on which they can bid. Each lot has an associated number of ***eligibility points***. Prior to the auction, bidders submit a deposit linked to the number of eligibility points that they require given the maximum number of lots that they wish to bid for. This determines their eligibility in round 1 of the auction.

A9.13 In subsequent rounds, each bidder's eligibility is determined by their bidding activity in the previous round. In order to maintain eligibility from one round to the next, bidders must exceed a certain minimum level of ***activity***, a so-called ***activity requirement***. This mechanism prevents bidders 'hiding' their demand until late in the auction.

A9.14 A bidder's level of activity in each round is determined by the sum of:

- the eligibility points associated with the lots on which they were the current highest bidder at the start of the round (excluding any such bids that are withdrawn); plus
- the eligibility points associated any other lots on which they placed new bids during the round.

Thus, a bidder that is the current highest bidder on a lot is not obliged to bid on that lot in the next round in order to maintain eligibility.

A9.15 Ofcom may set the activity requirement at 100% of eligibility throughout the auction. Alternatively, it may start with a lower level of activity requirement (e.g. 60% of eligibility), with the auction moving through ***stages*** where the activity requirement is tightened until it reaches 100%. The later approach is more complex but may offer some advantage in terms of facilitating switching and substitution behaviour.

A9.16 Detailed discussion of the eligibility rules can be found under 'auction rules common to both formats' further down in this annex, as these rules are fairly standard to both the candidate auction formats.

## Winner determination

A9.17 At the end of each round, provisional winning bids are chosen by taking the highest bid received for each lot. If two or more bidders submitted a new bid on the same lot in the last round, then the high bidder is determined from between them using a process of random selection.

A9.18 The bidder that submitted the highest bid on a lot in the previous round is the ***current highest bidder***.

## Making withdrawals and switching

A9.19 Bidders that are current high bidders on a lot may withdraw their demand in the next round but only if they make a new bid on another lot on which they are not the current high bidder. This makes switching between lots significantly more fluid than under standard FCC-style SMRA rules as withdrawals are not penalised provided that there are corresponding new bids. This should improve efficiency as it is much easier for a bidder wishing to aggregate contiguous demand to move between blocks in response to relative price movements.

A9.20 These rules would apply to lots A-P (the 1.7 MHz lots in the lower 27.5 MHz spectrum band), but may or may not be extended to lot Q (the 12.5 MHz lot).

A9.21 In the event that a bidder withdraws its demand from a lot and there are no new bids on that lot in the same round, there are two possible approaches that Ofcom could take. Either:

- the lot reverts to Ofcom at the current price; or
- the lot reverts to previous bids (if there are any), which are reactivated[41], at the amount of those bids.

A9.22 Ofcom has not decided yet which of these approaches it would use. The latter approach, which was used for the Norwegian 3.5GHz auction, is more complex to implement, requiring additional rules in relation to the reactivation of bids where bidders had previously lost eligibility. The former approach is simpler but would create a small risk that one or more lots may go unsold unnecessarily.

A9.23 In either case, in the event that a lot reverted to Ofcom, the auctioneer would reserve the right to reduce the current price in the next and subsequent rounds. However, once a bidder has bid for a specific lot, it would only be permitted to bid again on that lot at a price higher than its previous bid, removing any incentive to withdraw to achieve lower prices.

## Current prices and bid increments

A9.24 Initially, the prices of lots A-P (the 1.7 MHz lots in 1452 – 1479.5 MHz spectrum band) would be the same and set equal to an amount determined by Ofcom. Lot Q (the 12.5 MHz lot in the 1479.5 – 1492 MHz spectrum band) would have a higher initial price, reflecting its larger spectrum endowment. We consider the issue of the level of reserve prices under 'auction rules common to both formats' further down.

A9.25 In round 1, the bid amount for each lot is the current price. The bid amount for a lot would remain at this level in successive rounds until a bid is received for that lot.

A9.26 Once a bid has been received for a lot, the new bid amount in the next round is the current price plus a fixed ***bid increment*** determined by the auctioneer.

A9.27 The bid increment may be a fixed amount or a fixed percentage of the current price. The auctioneer would have discretion to alter the amount of the bid increment from round-to-round, but would always announce any change in advance of the round in which the change is implemented. Ofcom envisages that, in any particular round, the same fixed or percentage increment would be applied across lots A-P (the 1.7MHz lots), but a different increment may be applied to lot Q (the 12.5 MHz lot).

## End of auction

A9.28 The auction ends when there is a round in which there are no new bids or withdrawals. Lots are awarded to those bidders that were the current highest bidders in the final round at the price determined by their last bids.

[41] Ofcom would only reactive previous bids which had lapsed because a bidder had subsequently dropped its activity. Bids that had lapsed because a bidder had shifted activity to another lot would not be considered.

## SMRA with limited combinatorial bidding

A9.29 This format is also an adaptation of the standard SMRA, but with the significant innovation that bidders may bid for packages of three contiguous lots, as well as for single lots. It is particularly suitable where a band is divided by frequency into multiple, contiguous lots, and some bidders face predictable patterns of aggregation risks (i.e. in this case, the need to amalgamate blocks of 5MHz spectrum). The format has not been used before, although the rules described below have some similarity to those proposed by the FCC for the US 700MHz band.[42] This auction format would, however, be significantly less complicated than the FCC auction, as the lots are national rather than regional, and Ofcom proposes to limit the scope for combinatorial bidding to triples of lots.

A9.30 The introduction of combinatorial bidding should significantly increase flexibility for bidders seeking contiguous lots. This should substantially mitigate bidder exposure to substitution and aggregation risks, and may therefore produce a more efficient outcome than the other candidate auction format. Furthermore, with the introduction of combinatorial bidding, it is no longer necessary to use rules on bid withdrawals to facilitate switching between lots, thus simplifying the choices that bidders need to make on a round-by-round basis.

### Making bids

A9.31 Bidding proceeds in multiple rounds and finishes simultaneously for all lots.

A9.32 Bids are made for packages, consisting of either single lots (of which there are 17) or contiguous triples of lots excluding lot Q (of which there are 14). Contiguous triples amount to about 5.1MHz of spectrum in total. Other package bids are not permitted, so the bidding options are substantially more limited than in a full combinatorial auction.

A9.33 Figure 28 shows an example of a simple bid form. There are no restrictions on what bids can be made other than available eligibility. For instance, a bidder could bid both on a triple and a single lot contained within that triple or for two overlapping triples. Bids are non-exclusive, so that more than one of a bidder's bids can win, provided they do not include the same lots.

[42] This auction was postponed for regulatory reasons, so the auction rules were never implemented.

**Figure 28: Illustrative example of bid form for SMRA with limited combinatorial bidding**

| Lot | High bidder | Type of bid | Current Price | Bids for single lots | Bids for triples | |
|---|---|---|---|---|---|---|
| A | Tom | Triple | £ xxx | £ xxx ^ | | |
| B | Tom | Triple | £ xxx | £ xxx ^ | ABC | £ xxx ^ |
| C | Tom | Triple | £ xxx | £ xxx ^ | BCD | £ xxx ^ |
| D | Dick | Single | £ xxx | £ xxx ^ | CDE | £ xxx ^ |
| E | Dick | Single | £ xxx | £ xxx ^ | DEF | £ xxx ^ |
| F | Peter | Triple | £ xxx | £ xxx ^ | EFG | £ xxx ^ |
| G | Peter | Triple | £ xxx | £ xxx ^ | FGH | £ xxx ^ |
| H | Peter | Triple | £ xxx | £ xxx ^ | GHI | £ xxx ^ |
| I | Emma | Triple | £ xxx | £ xxx ^ | HIJ | £ xxx ^ |
| J | Emma | Triple | £ xxx | £ xxx ^ | IJK | £ xxx ^ |
| K | Emma | Triple | £ xxx | £ xxx ^ | JKL | £ xxx ^ |
| L | Emma | Triple | £ xxx | £ xxx ^ | KLM | £ xxx ^ |
| M | Emma | Triple | £ xxx | £ xxx ^ | LMN | £ xxx ^ |
| N | Emma | Triple | £ xxx | £ xxx ^ | MNO | £ xxx ^ |
| O | Ofcom | None | £ xxx | £ xxx ^ | NOP | £ xxx ^ |
| P | Dick | Single | £ xxx | £ xxx ^ | | |
| Q | Jo | Single | £ xxx | £ xxx ^ | | |

Notes: Simple menu bidding – to make a bid for a single or triple, bidders select from a drop down menu containing a limited number of bid amount options.

Source: DotEcon

## Eligibility and activity requirements

A9.34 The rules on eligibility and activity requirements are essentially the same as for the other candidate auction format.

A9.35 For the purposes of determining activity levels, a bidder is considered to be active on a lot in a round if it:

- had the current high bid on that lot after completion of the previous round; or
- submitted a new bid on that lot in the round.

A9.36 The total level of activity for each bidder is calculated by summing the eligibility points associated with the lots on which they are active. Note that even if a bidder has submitted multiple bids featuring the same lots, each lot is only considered once for the purpose of calculating activity levels.

## Winner determination

A9.37 At the end of each round, provisional winning bids are chosen by maximising the aggregate value of accepted bids subject to each lot only being allocated at most once. There is no restriction on the number of provisionally winning bids accepted from any single bidder.

A9.38 If there is more than one combination of valid bids that has the same highest aggregate value, then a process of random selection would be used to determine which combination is successful.

## Current prices and bid increments

A9.39 As with the other candidate auction formats, the initial prices of lots A-P would be set equal, with lot Q having a higher initial price. We consider the issue of the level of reserve prices further down in 'auction rules common to both formats'. The initial price of a package is the sum of the prices of lots within them (i.e. triples are initially three times the price of singles).

A9.40 In round 1, the minimum bid for each package is the initial price.

A9.41 After the first round, Ofcom would compute ***shadow prices*** of individual lots implied by the bids so far received. These are prices such that:

- winning bids are equal to the sum of shadow prices of the lots within the package;
- (as far as possible) losing bids are less than that sum of shadow prices of the lots within the package.

A9.42 By construction, where a single bid is a current high bid, the shadow price is equal to the amount of the current high bid. Where a triple bid is a current high bid, the determination of shadow prices for individual lots is more complex. It would be determined by application of an algorithm that would distribute the amount of the winning triple bid across the component lots.

A9.43 From round 2 onwards, the minimum bid for each package (including both singles and triples) would be:

- the initial price for the package at the start of auction (only relevant if no bids have been received for any of the lots within the package); or
- the sum of the shadow prices for the component lots of the package that has the current high bid, plus a bid increment.

A9.44 The bid increment may be a fixed amount or a fixed percentage of the shadow price. The auctioneer would have discretion to alter the amount of the bid increment from round-to-round, but would always announce any change in advance of the round in which the change is implemented. To avoid complicated amounts, the resulting

minimum bid would be rounded off, for example to whole £10,000s. Ofcom envisages that, in any particular round, the same fixed or percentage increment would be applied across lots A-P (the 1.7MHz lots in the lower 27.5 MHz), but a different increment may be applied to lot Q (the 12.5 MHz lot).

A9.45 Ofcom also intends to set maximum bids and to restrict bid options to limited number of levels between the minimum and maximum. The purpose of restricting bids in this way is to prevent errors by bidders (i.e. excessive bids) and restrict the scope for strategic behaviour (such as jump bidding or signalling) which might distort the auction. The appropriate level of the maximum bid for particular packages has not yet been determined.

## End of auction

A9.46 If there are two consecutive rounds in which there are no changes in the winning bids, the auction would enter a ***provisional final round***. This process is designed to hasten the end of the auction if there are bidders who remain eligible to bid (i.e. are active) but have not been current high bidders in two consecutive rounds. The auction would end after the provisional final round unless there is a new winning bid. If a new winning bid did emerge, then the auction would revert to normal rounds.

A9.47 Lots are awarded to those bidders that were the current highest bidders in the final round at the price determined by their last bids.

## Annex 10

# Glossary

**2G**

"Two G": second generation of mobile telephony systems using digital encoding. 2G networks support voice and limited data communications.

**3G**

The third generation cellular phone system, currently being deployed, which offers higher data rates than previous systems allowing services such as videophones.

**AIP**

Administrative incentive pricing: a fee charged to users of the spectrum to encourage them to make economically efficient use of their spectrum.

**Band**

A defined range of frequencies that may be allocated for a particular radio service, or shared between radio services.

**CDMA**

Code Division Multiple Access: A radio transmission method where individual traffic transmissions use the same frequency, but where users' traffic is separated by means of different codes.

**CDMA-1x**

A variant of the cdma2000 standard utilising nominal 1.25 MHz carriers.

**CEPT**

Conference of European Postal and Telecommunications administrations, comprising over 40 European administrations.

**Communications Act**

Communications Act 2003, which came into force in 2003.

**Co-ordination**

This term refers to the process under which users seek to come to a mutual agreement to share access to a particular range of frequencies while avoiding undue interference.

**dBW**

Decibels above one Watt: a logarithmic representation of radio frequency power with respect to one Watt.

**ECC**

Electronic Communications Committee: a committee that reports to CEPT.

**EIRP**

Equivalent Isotropically Radiated Power: a theoretical measure of the power radiated by a transmitter/antenna - defined as the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna.

**ERP**

Effective Radiated Power: a theoretical measure of the power radiated by a transmitter/antenna - defined as the product of the power supplied to the antenna and its gain relative to a halfwave dipole in a given direction.

**GHz**

Gigahertz: a unit of frequency equal to 1000 million (1 x 109) Hz or cycles per second.

**kHz**

Kilohertz: a unit of frequency, equal to 1000 (1 x 103) Hz or cycles per second.

**Liberalisation**

Allowing licence holders to change the use to which they put their spectrum, within constraints to prevent interference.

**Licence class**

Type of licence issued by Ofcom, for example PAMR. Volume classes refer to those licence classes for which there are significant numbers of licensees, for example on site PBR with 26,000 licensees.

**Licence exempt**

Allowing anyone to use the spectrum for any application under certain specified restrictions, but typically with maximum power levels. The current regulations are the Wireless Telegraphy (Exemption) Regulations 2003 (SI 2003 No. 74), available at: http://www.legislation.hmso.gov.uk/si/si2003/20030074.htm

**MHz**

Megahertz: a unit of frequency equal to 1,000,000 (1 x 106) Hz or cycles per second.

**MOD**

Ministry of Defence.

**Ofcom**

Office of Communications. Ofcom took over the RA's responsibility for spectrum management in the UK in December 2003.

**Out-of-block emissions**

Emissions cause by use of the spectrum covered by a particular licence that fall immediately outside the spectrum block covered by that licence.

**Partial transfer**

In a spectrum trading market, licence holders may transfer only a part of the rights and obligations associated with their spectrum licence - whereby the licence can be divided (e.g. partitioned) by geography, frequency and by time.

**PAMR**

Public Access Mobile Radio

**PMR**

Private Mobile Radio

**RA**

The Radiocommunications Agency: a former executive agency of the Department of Trade and Industry, which was responsible for the management of most non-military spectrum in the UK and for representing the UK in relevant international bodies. The RA's functions transferred to Ofcom in December 2003.

**SMO**

Spectrum Management Organisation

**Spectrum Framework Review (SFR)**

Ofcom consultation published in November 2004 and resulting statement published in June 2005 by Ofcom on how spectrum will be managed in the future.

**Spectrum Framework Review: Implementation Plan (SFR:IP)**

Ofcom consultation published in January 2005 by Ofcom on the release of spectrum in 2005 – 08, and on extending spectrum liberalisation and trading to mobile services.

**Spectrum mask**

A way of specifying the amount of power that a transmitter is allowed to transmit into neighbouring frequency channels.

**Spectrum trading**

Process through which spectrum licence holders are able to transfer some or all of their rights to a third party.

**TETRA**

A digital two-way radio standard developed by the European Telecommunications Standards Institute (ETSI)

**TETRAPOL**

A digital PMR technology

**Trading Regulations**

The Statutory Regulations that facilitate spectrum trading.

**Undue interference**

Interference in relation to any wireless telegraphy which is undue and also harmful (as described in section 19(5) and (5A) of the Wireless Telegraphy Act 1949). In summary this includes interference that creates dangers or risks of dangers to the functioning of any radiocommunications service designed for the purposes of navigation or safety services, or if the interference degrades, obstructs or repeatedly interrupts authorised broadcasting or other wireless telegraphy.

**Wireless telegraphy**

The means of sending information without the use of a wired system.

**Wireless telegraphy licences**

Licences issued under the Wireless Telegraphy Act 1949 (as amended).

**WT Acts**

Wireless Telegraphy Act 1949 and Wireless Telegraphy Act 1998 (both as amended).