OFFICE OF COMMUNICATIONS

Award of available spectrum: 1452 – 1492 MHz

This document sets out Ofcom's decisions for the award of wireless telegraphy licences in this spectrum band. The Information Memorandum for this award is published separately

Statement

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Contents

Section 1

Executive summary

1.1 Starting in 2003, we have published a number of documents that relate to the award of the 1452-1492 MHz spectrum. This statement sets out our conclusions on the matters raised in the various consultation and discussion documents and our consideration of the responses that stakeholders made to those documents.

1.2 The key elements of the award will be as follows:

- We will hold an auction in the spring of 2008 for the award of UK wireless telegraphy licences to use the 1452-1492 MHz spectrum band.
- The spectrum between 1452-1479.5 MHz will be packaged into 16 lots, each of approximately 1.7 MHz and the spectrum between 1479.5 and 1492 MHz will be packaged as a single lot. All spectrum lots will be for use throughout the UK.
- The auction will take the form of a combinatorial clock auction.
- The licences will have an indefinite term with an initial period of fifteen years (during which time our powers to revoke will be limited).
- The licences will be tradable.
- The licences will be technology and application neutral.

1.3 At the same time as this statement we are also publishing the following documents:

- An information memorandum, which sets out relevant information that interested parties should take into account when considering their possible participation in the award process; and
- A notice of our proposal to make four statutory instruments in relation to the award process.

1.4 Interested parties are advised to familiarise themselves with all of the auction regulations, in particular the rules that prevent association and collusion between bidders.

1.5 We intend to start the award process in the spring of 2008.

Section 2

Introduction

2.1 In 2002, in Maastricht, members of the CEPT signed a Special Arrangement that agreed international rights of use for the 1452-1479.5 MHz band. Following that we held a consultation in 2003[1] on the whole 1452-1492 MHz band to undertake an initial consideration of possible uses for the band.

2.2 Since that initial consultation, technological, regulatory and international developments have changed our views on how to award this band. The speed of technology development has increased and, over recent years, interest in using the 1452-1492 MHz for mobile multimedia and mobile TV has been increasing. In the UK, Ofcom was created and spectrum regulation in Europe and the UK has moved away from command and control mechanisms towards market led mechanisms. The Maastricht 2002 Special Arrangement was revised in July 2007 and, since then, the European Commission has been considering making a decision on this band that would be binding on all member states.

2.3 As a result, since 2003, we have needed to carry out further consultations to consider the future use of this band:

- Ofcom's "Spectrum Framework Review: Implementation Plan"[2] (SFR: IP) was published in January 2005;
- "Award of available spectrum: 1452-1492 MHz" [3] was published in March 2006 ("the March 2006 consultation");
- Two discussion documents were published in February 2007, the "Discussion document on the award of available spectrum 1452 – 1492 MHz: Auction design"[4] ("the auction design discussion document") and the "Discussion document on the award of available spectrum 1452 – 1492 MHz: Technical aspects"[5] ("the technical discussion document"); and
- Most recently in July 2007 we published a consultation titled "The award of available spectrum 1452-1492 MHz"[6] ("the July 2007 consultation")

We also carried out a number of stakeholder events in order to explain our proposals and to understand stakeholders concerns better.

2.4 We discussed the responses to the 2003 and the 2005 document in the March 2006 consultation document. There is a summary of the key points made in the other documents in this section and the responses to those documents are discussed in this document.

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[1] 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) published in October 2003

[2] http://www.ofcom.org.uk/consult/condocs/sfrip/sfip/sfr-plan.pdf

[3] http://www.ofcom.org.uk/consult/condocs/1452-1492/

[4] http://www.ofcom.org.uk/consult/condocs/1452design/

[5] http://www.ofcom.org.uk/consult/condocs/1452tech/

[6] http://www.ofcom.org.uk/consult/condocs/1452_1492/

The March 2006 consultation document

2.5 In the March 2006 consultation, we consulted on proposals for the award of available spectrum in the 1452 – 1492 MHz frequency band. In the consultation document, we set out a number of factors relevant to the spectrum award. These included:

- The current use of the available spectrum (Section 2);
- Background on potential uses of the available spectrum, based on a market study that we commissioned (Section 2);
- Potential substitute spectrum that could be used to deliver similar services as those identified in the market study (Section 2);
- Our powers and duties (Section 3);
- Our approach to spectrum management, including our objectives for the award (Section 4);
- A range of international issues and an assessment of how these could impact on potential users of the available spectrum (Section 5);
- Options for packaging the spectrum for the award (Section 6);
- Issues to consider when determining auction formats for the award of spectrum (Section 7);
- Options of auction formats for auctioning the available spectrum (Section 7); and
- Proposed technical and regulatory conditions that would be specific to the wireless telegraphy licences that would be awarded to allow use of the available spectrum (Section 8).

2.6 As explained in the March 2006 consultation document, our main objective in this award is to promote the optimal use of the electro-magnetic spectrum, particularly in the 1452 –1492 MHz frequency band.

2.7 32 responses were received to the March 2006 consultation. The non-confidential responses that were received have been published on our website[7] and our consideration of those responses is included throughout this document.

The February 2007 discussion documents

2.8 Following the March 2006 consultation, in order to address some of the issues raised by respondents, on 15 February 2007 we published two discussion documents relating to the award of the 1452-1492 MHz band. One document addressed aspects of the auction design and the other considered aspects of the technical licence conditions.

2.9 The auction design discussion document proposed rules for a combinatorial auction design for the LBand award. The purpose of the document was to explain the key features of the combinatorial clock auction format and set out how such an auction format may be expected to work in practice. It also summarised the two auction

[7] http://www.ofcom.org.uk/consult/condocs/1452-1492/responses/

formats set out in the consultation document and compared these with the combinatorial clock auction format.

2.10 In the technical discussion document we laid out a number of alternative approaches to the technical conditions associated with the award of the 1452 – 1479.5 MHz sub band. The revised technical conditions proposed in the document were designed to give the market greater certainty while not unduly inhibiting alternative technologies.

2.11 Specifically the technical conditions document put forward for consultation four proposals;

- Proposal 1 – A spectrum mask approach based on an augmented Maastricht mask, as referred to in the consultation document;
- Proposal 2 – A spectrum mask approach based on the European Telecommunications Standards Institute (ETSI) critical mask;
- Proposal 3 – A Spectrum Usage Rights (SURs) approach based on an augmented Maastricht mask; and
- Proposal 4 – A SURs approach based on the ETSI critical mask.

2.12 17 responses were received to those documents. The non-confidential responses that were received have been published on our website[8] and our consideration of those responses is included throughout this document.

The July 2007 consultation

2.13 Respondents to the February 2007 discussion documents raised a number of further points in response to the documents and, in July 2007, we published a final consultation document in relation to specific aspects of the 1452-1492 MHz award. The purpose of that document was threefold:

- Firstly to set out revised technical conditions for two proposed SURs for the 1452-1479.5 MHz sub-band, one set of rights for a high power-low density network and another set of rights for a low power-high density network;
- Secondly to set out details of a combinatorial-clock auction design that allows bidders to guarantee, through the auction, that they have adequate frequency separation from other users with different SURs; and
- Thirdly to discuss issues relating to possible inefficient hoarding of spectrum in this band.

2.14 Eight responses were received to the July 2007 consultation. The non-confidential responses that were received have been published on our website[9] and our consideration of those responses are included throughout this document.

[8] http://www.ofcom.org.uk/consult/condocs/1452design/responses/ and http://www.ofcom.org.uk/consult/condocs/1452tech/responses/
[9] http://www.ofcom.org.uk/consult/condocs/1452_1492/responses/

Purpose of this document

2.15 Having carefully considered all of the responses to the consultations, this document contains a discussion of those responses and our decisions relating to the award of the 1452-1492 MHz spectrum.

Associated Documents

2.16 Alongside this statement we are publishing the following documents:

- An information memorandum - this sets out relevant information that interested parties should take into account when considering their possible participation in the award process.

- A notice of our proposal to make four statutory instruments in relation to the award process in accordance with section 122 of the Wireless Telegraphy Act 2006. These statutory instruments include the auction regulations, regulations extending spectrum trading to the band, regulations to allow for publication of the identity of licensees and terms of the licences in the band and an order limiting the number of licences in the band. The statutory consultation period for these instruments expires on 18 January 2008.

Structure of this document

2.17 Section 3 of this document discusses our conclusions on spectrum packaging while Section 4 looks at the auction format. Section 5 concludes on the technical licence conditions while Section 6 concludes on the other regulatory conditions, rights and obligations. Finally Section 7 discusses the next steps.

2.18 Annex 1 contains a detailed summary of responses and Annex 2 contains a discussion of a relaxed revealed preference rule as it would apply to this auction. Annex 3 contains the final impact assessment in the light of the consultation responses. Annex 4 contains a description of the propagation and compliance modelling and Annex 5 contains draft licences.

Section 3

Spectrum packaging

3.1 We split our discussion of packaging in two, one part discussed the packaging proposals for the 1452-1479.5 MHz sub band and the other the proposals for the 1479.5-1492 MHz sub band.

Packing for the 1452 to 1479.5 MHz sub-band

3.2 The March 2006 consultation document put forward four options for the packaging of the lower 27.5 MHz (1452 – 1479.5 MHz):

- dividing the spectrum into 16 lots of 1.7 MHz;
- dividing the spectrum into five lots of 5.1 MHz and one lot of 1.7 MHz ;
- dividing the spectrum into varied-sized lots; and
- offering the spectrum as one 27.5 MHz block.

3.3 There were mixed views on this question, however the majority of respondents felt that 16 x 1.7MHz blocks would be the best packaging option. A number of operators stated that for their purposes they would want blocks of differing sizes (e.g. Nokia – 7 MHz, BBC – 1.7 MHz, 5.1 MHz, 10.2 MHz or 27.5 MHz, satellite operators an additional 12.5 MHz block) and so would prefer 16 x 1.7 MHz to be able to put together the blocks that they needed.

3.4 Digital One and Emap radio argued for blocks of 1.7 MHz to ensure that DAB (and their variants) had a level playing field with technologies that needed wider bandwidths.

3.5 Vodafone and a confidential respondent argued that the only technology neutral options would be to award the spectrum either as 1.7 MHz blocks or as a single 27.5 MHz block. Anything else would favour particular technologies. One respondent felt that a single block option would raise more competition concerns than 1.7MHz block options (although they had concerns about both options). A number of other respondents also pointed out that packaging the spectrum in blocks larger than the 1.7MHz in the Maastricht arrangement would discriminate in favour of particular technologies.

3.6 Qualcomm wanted 5 x 5.1 MHz lots to allow both 1.7 MHz and 5.1 MHz systems

Packing for the 1479.5 to 1492 MHz sub-band

3.7 Our proposal for the upper 12.5 MHz (i.e. 1479.5-1492 MHz) was that it should be packaged for award as a single block.

3.8 Almost all respondents agreed with this proposal.

3.9 However National Grid Wireless (“NGW”) argued for more 1.7 MHz blocks in the upper 12.5 MHz as a matter of principle to ensure that the spectrum was available on “the basis of equal opportunity for terrestrial, satellite-only, or hybrid networks”. The Digital Television Group (DTG) stated that they could see no case for reserving the

spectrum exclusively for satellite operators. Some satellite operators reiterated their objection to awarding the spectrum through an auction.

Our packaging decision

3.10 Our aim when packaging spectrum is to ensure that it is feasible for a diverse range of potential users to bid for appropriate spectrum in order to ensure that they will be able to accommodate the technology that they choose (subject to any technical constraints).

3.11 For the lower 27.5 MHz stakeholders suggested a need for a variety of different sized spectrum blocks, not just 5.1 MHz. In addition they have indicated that the different restrictions on coverage that are created by the Maastricht Special Arrangement for each 1.7 MHz block means that that they would not necessarily want to create packages of contiguous lots. Therefore, in order to allow the greatest flexibility we consider that individual 1.7 MHz lots are the most appropriate way to package this spectrum. As discussed below the auction design will allow bidders to explicitly bid for specific packages of spectrum made up of one or more 1.7 MHz blocks that could be contiguous or non-contiguous.

3.12 For the upper 12.5 MHz, the international constraints mean that the winning bidder will need to co-ordinate with overseas satellite operators. International satellite use means that bidders that have not successfully completed international co-ordination can not be certain about the future interference that will be received, or levels of protection they will be required to provide to mitigate exported interference into neighbouring administrations in specific parts of the sub-band. Therefore awarding the sub-band in smaller lots would mean that bidders would face substantial uncertainty in valuing the smaller lots. Therefore we consider that assigning this sub-band as a single lot is most likely to lead to an efficient allocation of the spectrum.

3.13 In addition, in the March 2006 consultation document, we stated that we considered that all of the available spectrum should be offered on a UK-wide basis, albeit that licensees should have the ability after the award to geographically divide a UK-wide block of spectrum if desired. No comments have been received that suggested that this should not be the case.

3.14 Therefore, we have decided to package 1452-1479.5 MHz into 16, blocks each of approximately 1.7 MHz and to package 1479.5-1492 MHz into a single 12.5 MHz lot. All of the blocks will allow use throughout the UK.

Section 4

Auction format

4.1 In the March 2006 consultation document, we proposed that the most appropriate assignment mechanism for this spectrum would be to award it through an auction. We also laid out a number of characteristics that we considered would be appropriate for any auction of this spectrum. In particular that it would be appropriate to auction this spectrum using a simultaneous, multiple round ascending (SMRA) auction with specific lots.

4.2 As part of the same consultation we set out two auction formats that we considered to be potential candidates for securing the objective of an optimal allocation of the available spectrum. The two candidate auction formats were:

- A SMRA auction with augmented switching rules; and
- A SMRA auction with limited package bidding.

4.3 Both of these formats had advantages and disadvantages, in particular relating to exposure to substitution and aggregation risks and challenges to implementation.

Responses to the March 2006 consultation

4.4 Aside from the satellite operators, there was broad support for using an auction, and specifically an SMRA auction, as the allocation mechanism. Reasons given for this support included the range of different uses, the ability to select multiple lots and the ability to adapt bidding strategies. Some satellite operators (e.g. Inmarsat, Alcatel) felt that an auction would discriminate against them compared to terrestrial users as:

- They had high upfront network costs;
- They needed the same frequency to be available in different countries prior to operations; and
- Their service was intrinsically international so a series of auctions in various countries with uncertain outcomes would make business planning difficult and also would impose high costs that may not allow a viable business case.

4.5 Any operator that wishes to roll out a network will have high up front costs. It is for that operator to decide what the value of spectrum is to it in light of those costs. Using an alternative award mechanism does not address that problem.

4.6 There has been no desire from other member states or the European Commission to hold a pan-European award of this spectrum so the need for the same frequency to be available in different countries is not affected by the award mechanism. The same is true of the claim for an “intrinsically international” nature to the satellite service.

4.7 The BBC pointed out that “the auction process does not necessarily guarantee an outcome that delivers the optimum solution based either on technical considerations or the overall economic or social benefit to the UK from any particular technology”. However it also believed that for this band the market could choose the highest value service through the auction.

4.8 We agree that the auction does not guarantee an optimal outcome. However, there is general support for the use of an auction and compared to the alternative award mechanisms. We believe that awarding the spectrum through an auction is the award mechanism most likely to fulfil our statutory duties in this case.

4.9 A number of respondents (e.g. O2, Digital One and Orange) felt that they needed more information and consultation before a final auction design was chosen.

Further auction designs

4.10 We have published a number of alternative SMRA auction designs for consultation since the March 2006 consultation document. The February 2007 auction design discussion document introduced the idea of a simultaneous multiple-round clock auction ("combinatorial clock" auction). The combinatorial clock auction appeared to have a number of advantages over both the SMRA with augmented switching rules and the SMRA with limited package bidding. In particular, the combinatorial clock auction could remove the exposure risk for bidders, reduce the threshold problem, allow price discovery and help bidders to effectively express their preferences. To the extent that these advantages were to materialise in any award, then this auction format would be more likely to lead to the desired outcome of securing an efficient allocation of the available spectrum.

4.11 Most respondents supported the combinatorial clock auction, although there was a feeling from some (e.g. BT, Wrege Associates) that more detail was needed before they could comment properly. Some respondents (e.g. the BBC, BT and David Hall Systems) asked us to consider ways for different networks to co-ordinate through the auction. Orange suggested that the bidders could nominate technologies a part of the auction process to allow other bidders to assess the impact of their potential neighbours from round to round.

4.12 As a result of some of the responses, in the July 2007 consultation document we proposed amending the combinatorial clock auction format from that set out in the February 2007 auction design discussion document. The amendments put forward were necessary to accommodate the changes proposed to the technical specification of the spectrum frequency lots being licensed (see Section 5 below). In particular, the amended combinatorial clock auction allows successful bidders to guarantee through the auction that they are adjacent to either:

- The top or the bottom of the band;
- Users who want to roll out a similar network to their own i.e. either high power-low density or low power-high density; or
- A guard band of 2 lots (3.4 MHz) between high power-low density and low power-high density networks.

4.13 As discussed above, a number of respondents to both the March 2006 consultation and the February 2007 auction design discussion document felt that they required further detail on the auction process in order to be able to comment further and that we should consult on these before the final auction design was chosen.

4.14 In response we published our latest views on the proposed rules and procedures for the auction as part of the July 2007 consultation document and there was general agreement with this amended auction design. Only one additional concern with the auction was raised as part of that consultation. Arqiva suggested that bidders should

have the option of submitting two bids per round, (one high power and the other low power). While it is not possible to submit two bids per round in the primary bid rounds, bidders have the ability to submit two bids for the same selection of lots (each nominating a different licence condition) during the supplementary bids round. As a result we do not intend to make any further changes.

4.15 Having considered the responses we have decided that we will use an auction as the assignment mechanism to award the available spectrum in the 1452 -1492 MHz spectrum band, specifically we will use combinatorial clock auction. The auction design will allow bidders to bid in each primary bid round on packages of lots of one of two spectrum usage rights (although switching between types of usage right is allowed between primary bid rounds and bidders can bid in the supplementary bids round for the same package of lots with different usage rights). It will also ensure that there is a sufficient guard band between networks utilising different usage rights. Full details of the auction design are contained in the information memorandum and draft regulations which are published alongside this statement.

Simultaneous award of all of 1452-1492 MHz

4.16 A simultaneous award of all 40 MHz had general support (assuming that it would not lead to a delay in the award of the bottom 27.5MHz) except from parts of the satellite industry. The BBC saw the benefits as speed to market, increased market certainty and meeting market demand.

4.17 Some of the satellite operators held the view that the top part of the spectrum should not be considered a substitute or complement to the rest of the spectrum and that it should not be tied into the auction. For example ASMS felt that, given the differences in satellite and terrestrial business cases and technologies the spectrum should not be joined.

4.18 However, although some operators may not see 1452-1479.5 MHz and 1479.5-1492 MHz as substitutable, others do. The auction design is intended to accommodate both those who do and those who don't see the spectrum as substitutable. Therefore, in order to achieve an efficient allocation of the spectrum we will award all 40 MHz of the 1452-1492 MHz band through the same auction.

Specific auction rules

4.19 In the March 2006 consultation we consulted on a number of specific rules, some of these were revised and explained in greater detail in Annex 8 of the July 2007 consultation. Our decisions on this are as below.

Eligibility rules

4.20 We intend that each lot in the auction will have an associated number of eligibility points.

4.21 A bidder's ability to make bids for multiple lots within a package in a particular round of the auction will be constrained by their prevailing eligibility in that round. This in turn is determined by their bidding activity over previous rounds.

4.22 H3G have stated that they think that, in principle, bids at the supplementary stage "should only be restricted so as to be consistent with bids made during the clock stage i.e. by a suitable "revealed preference" rule". Arqiva in one of their responses stated the view that blocks should have different eligibility points associated with

them (i.e. that LP should have less eligibility that LA-LO), and WorldSpace stated that they thought that LQ should have less than 3 eligibility points. In addition in the context of some other awards bidders have raised similar concerns.

4.23 We are aware that bidders may believe that there are differences in the relative values of the lots. An eligibility points rule may have some limitations in dealing with this structure of preferences. How much that matters depends on the particular circumstances of an award including the structure and extent of demand for the lots. Accordingly, we are still considering whether it would be appropriate to use a revealed preference activity rule rather than an eligibility points based rule in this award. It may be that such a rule would be more appropriate for this award since it would have advantages in dealing with the issue of differences in relative values between the lots. However, such a rule would also have disadvantages including adding significant additional complexity to the rules and the fact that it is untried in real world auctions. A description of a possible form that this rule could take, if adopted, is in Annex 2. If we decide to do adopt this rule, or one like it, we would make suitable changes to the regulations and the Information Memorandum.

Reserve price

4.24 We will set a reserve price of £50,000 for each of the 16 1.7 MHz lots and £150,000 for the upper 12.5 MHz lot. These reserve prices will also determine the initial prices for each of the available lots in the first round of the auction.

4.25 One confidential response suggested that the reserve prices should be higher in order to discourage spurious bidders. We have considered this but have decided to leave the reserve prices as they are as we wish to encourage a wide range of applicants to take part in the award and do not want the reserve price to be set at a level which will unduly deter them. In addition, all bids that are made during the auction process will remain valid until the end of the auction and the award regulations currently require a 100% deposit which will further discourage spurious bids.

Deposits

4.26 We will set an initial level of deposit of £50,000 at the time of application. This will increase to £50,000 per eligibility point at commencement of the auction. Each bidders' initial eligibility will thus be determined by the level of deposit that they have paid before the auction.

4.27 At various stages during the auction, bidders will be required to increase the amount of their deposits to ensure that they do not bid beyond their means. All bidders will be required to top-up their deposit to 100% of their highest bid, prior to us identifying the winning bidders.

4.28 No stakeholders have a raised a concern with 100% deposits in this auction, however they have raised this concern in the context of other auctions. We will keep this issue under review and if appropriate we may change the rules to require less than 100% deposits during the auction. If we did decide to change this policy we would make suitable changes to the Regulations and Information Memorandum.

Payment terms

4.29 Winning bidders will be required to pay 100% of the relevant licence fee before a licence is granted to them.

Transparency

4.30 We proposed in the March 2006 document that the auction would be fully transparent to alleviate common value uncertainty and reduce the risk of a fragmented assignment. However we also stated that 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. Arqiva commented that ideally there would be full transparency, but would want to know what packages have been bid for in each round.

4.31 Since that consultation we have made proposals relating to the auction design that reduce aggregation risk and give greater certainty about the rights of use of users in adjacent channels which will reduce the risk from a fragmented outcome occurring. However, the risks for "weak" bidders still remain.

4.32 Therefore, the auction will be partially transparent. Comprehensive information about the number of bids for each spectrum usage right on each lot will be released after each round. In addition, bidders will know the identity of all other bidders before the auction starts, although during the auction they will not be able to monitor the bids that they make.

4.33 We will complete the award process by publishing the details of all valid auction stage bids made by each bidder, the names of the persons to whom the licences were granted, the selection of lots included in those licences, the licence condition assigned to those licences and the details of the licence fees paid.

Pace of the auction

4.34 Arqiva stated that in order to address issues with internal financial sign off, the clock stage should have no more than one round per day; there should be the ability to continue bidding for 2-3 rounds before actually topping up a deposit and there should be several days between the two stages

4.35 We will allow several weeks between the invitation for applications for this award and the award starting place to aid internal processes to take place. In addition while we will allow an appropriate amount of time between rounds of the auction, we have not seen a problem in previous, high stake auctions in holding several rounds per day.

4.36 The auction rules will give us flexibility in managing the pace of the auction.

Prohibition on bidder association and collusion

4.37 One respondent requested further clarity on what was possible under the bidder group, qualification and exclusion rules as they felt that the rules stopped them from carrying out certain desirable activities.

4.38 There are specific rules to prohibit collusion and bidder association that state the circumstances under which bidders will be qualified and when they may be excluded or lose their deposits. We do not intend to change these rules from those used in previous auctions. In particular the rules include conditions stating that no bidder can share confidential information with another bidder and that no employee or director of any organisation can take part in the preparation of more than one bidder or share confidential information between two bidders.

Auction system

4.39 We will carry out the auction using an electronic system with the ability to accept bids in alternative forms in specific situations if necessary. Wrege Associates suggested that there should be a tool to allow bidders to construct and bid on their full set of preferences and also that we should publish how the winner determination problem will be calculated so bidders can reproduce it. Arqiva suggest that to aid bidders the auction software should suggest at the end of the first stage the range of feasible bids in the second stage.

4.40 The electronic auction system will allow bidders to 'upload' files of supplementary bids produced by other software; Bidders will therefore be free to develop their own tools to construct bids that reflect their preferences. Further details of the rules that will determine the winning bids are provided in the regulations (the precise algorithm to be used is not relevant as the rules are entirely determinative). The electronic auction system will provide a summary of the constraints that apply to supplementary bids.

Section 5

Technical licence conditions

March 2006 consultation

5.1 The March 2006 consultation included proposals relating to the technical licence conditions that would apply to licences in this band. It included a proposal that to help manage the co-ordination of transmitters, licensees should agree a Code of Practice within 6 months after the licences are awarded.

5.2 Although many respondents agreed with the concept of an industry code of practice, others felt that there could be problems with the approach as it could create unquantifiable risks. The most fully articulated version of the concern stated that bidders would not know at the time of auction what services would be in the adjacent spectrum. As a result it would be difficult to assign a value to a spectrum block prior to the auction as they would not know the extent and the ways in which they would be able to use that block (e.g. they would not know if they would need to cap ERP, use approved sites or have to provide guard bands). This uncertainty would be reflected in their bids and therefore the spectrum would not be allocated efficiently in the primary market.

5.3 In response to concerns raised on the proposed code of practice, and other concerns regarding the technical licence conditions, we published the "Discussion document on the award of available spectrum 1452 – 1492 MHz: Technical aspects" in February 2007.

Spectrum usage rights for 1452 – 1479.5 MHz

February 2007 Technical consultation

5.4 In the February 2007 technical discussion document we laid out a number of alternative approaches to the technical conditions associated with the award of the 1452 – 1479.5 MHz sub band. We proposed Spectrum Usage Rights (SURs) based on the ETSI critical mask for T-DAB (digital radio) standard (Proposal 4 in the February 2007 technical discussion document), and also SURs for the upper sub-band, 1479.5 to 1492 MHz. The revised technical conditions proposed in the document were designed to give the market greater certainty while not unduly inhibiting alternative technologies.

5.5 The February 2007 technical discussion document maintained the requirement for an industry Code of Practice to mitigate adjacent channel interference.

5.6 Reponses to this were mixed with a general view that the ETSI mask was preferred to the Maastricht mask. However views were split between whether the SUR or the spectrum mask approach should be followed. The most widespread concern (e.g. from Qualcomm, Arqiva and BBC) was that there was still not enough certainty about adjacent users, particularly as to how high and low power networks would co-exist.

5.7 T-Mobile, Arqiva and Intellect were concerned that there was not enough clarity as to what would happen if mobile uplinks were deployed.

5.8 A number of concerns were also raised about SURs in general and the need for more information. These comments reflected those that had been raised as part of

other Ofcom consultations. These points have been dealt with as part of the consultation on the general development of SURs. The statement on this is planned to be published shortly.

5.9 Respondents continued to raise concerns regarding the Code of Practice, stating that it may be difficult to realise. The BBC suggested that there should be no time limit to its development. There was broad support for Proposal 4 (SUR based on ETSI critical mask for T-DAB), although several respondents expressed some concerns regarding the practicality of SURs. It was also suggested that the in-band PFD level was too low as it was based on the Maastricht Special Arrangement, which planned for mobile, outdoor coverage, whereas the business model for mobile multimedia in this band would be to provide portable indoor coverage.

5.10 Even with the proposed SUR based on the ETSI critical mask and the Code of Practice, stakeholder concerns remained regarding managing adjacent channel interference and the risk of hole-punching. This was also raised at the stakeholder presentation we hosted in March 2007. Stakeholders were concerned that it would be too difficult to resolve different network topologies, especially with high power and low power applications in neighbouring frequency blocks.

5.11 The issues raised in response to the Discussion Document and at the stakeholder presentation were addressed by the further consultation document published in July 2007.

July 2007 technical consultation

5.12 In the July 2007 consultation we sought to address the concerns stakeholders had with the technical licence conditions, in particular with managing adjacent channel interference.

Licence conditions to manage ACI

5.13 We recognised the difficulty operators would have in coordinating networks with different topologies. To address this we proposed two sets of technical licence conditions for the 1452 – 1479.5 MHz sub-band. One set of conditions would not limit the maximum power of individual transmitters but would limit their maximum density; the other set of technical conditions would limit the maximum power of individual transmitters but would not limit their maximum density. The two licence classes would be separated by a guard band. This would ensure that any licensee would be adjacent to a licensee with a likely similar network topology or a guard band. We proposed that:

- For the licences that had a density limit we would permit 80 transmitters per 50km x 50km square;
- For the licences that had a power limit we would permit an EIRP limit of 6 kW; and
- The guard band should be 3.4 MHz (2 x 1.7 MHz), and there should be no right to transmit in the guard band.

5.14 All respondents agreed that splitting the band into two SURs, one based on an EIRP limit and the other on a transmitter density limit, was required to help mitigate ACI. Three respondents stated that the proposed density limit of 80 transmitters per 50 X 50 km square would not be sufficient to allow a mobile multimedia network to provide

coverage to a dense, urban environment such as London, especially when considering outgoing interference. Example networks showed that in order to serve London (within the M25) 140 – 150 transmitters per 2500 km² would be required. We have considered stakeholder comments on this and decided to increase the density limit to 150 transmitters per 2500 km².

5.15 With respect to the transmitter density limit some stakeholders asked us to consider whether low power, indoor transmitters (to serve shopping centres, airports etc) need to be included. We have noted stakeholder comments on this and have decided that, for this spectrum award, indoor transmitters with an EIRP equal to or less than 2 Watts will not be included in the transmitter density calculation, nor will they be included when assessing compliance with the SUR PFD limit.

5.16 The BBC considered that the proposal for the EIRP limit of 6 kW was a little high. However all other respondents who commented agreed with the proposal. In considering all stakeholder comments on this we have decided that the EIRP limit will be 6 kW.

5.17 Most respondents agreed with the proposal that 3.4 MHz (2 lots) was suitable separation between the SURs. However, T-Mobile stated that 3.4 MHz was sufficient if the spectrum was limited to downlinks but that ACI may still occur if mobile transmitters were used. We believe that 3.4 MHz provides effective protection to ACI between the two SURs without creating an inefficient use of spectrum.

5.18 All respondents agreed with our proposals that there should be no right to transmit in the guard bands, although licensees could request Ofcom to allow use of the guard band providing all affected licensees agreed.

5.19 Respondents were split on whether a transmitter EIRP mask was required. It was stated that if the low power sub-band is used for two way communications, mobile handsets have the potential to generate outgoing interference from an unpredictable density of locations. Therefore, it would be valuable to define a spectrum mask for the uplink/mobile.

5.20 The BBC stated that SURs on their own might not provide adequate protection to transmissions in neighbouring channels. They have concerns that the broad categories for high power and low power licence classes may be insufficient in themselves to ensure adequate protection when combined with the basic SUR definitions.

5.21 They go on to say that EIRP masks have proven very effective in the past at controlling ACI, and that they are not comfortable with removing the requirement for a spectrum mask.

5.22 Our general policy is to set technical restrictions that are the minimum necessary to provide adequate protection against harmful interference. We believe that as the SUR PFD out-of-band limits are based on the ETSI critical mask then there is sufficient restriction to out-of-band emissions while providing for flexibility of use. Therefore, we do not propose an EIRP mask for transmitters.

In-band PFD limit

5.23 We proposed that the in-band SUR PFD limit should be increased to provide for portable indoor coverage for mobile multimedia services. This PFD limit was based on the link budget for hand held reception of T-DMB (Class B reception mode for

portable indoor coverage with a location probability of 95%) as detailed in European Broadcast Union document TECH-3317: Planning parameters for hand-held reception.

5.24 The proposal to increase the SUR PFD limit was supported by stakeholders, therefore we have decided to increase the in-band PFD limit to -48 dBW/m²/MHz.

PFD limits for frequency blocks LO and LP

5.25 We also proposed that the PFD SUR limits for frequency blocks LO and LP be increased to be consistent with the SUR PFD limits for blocks LA to LN.

5.26 With respect to frequency blocks LO and LP all respondents agreed with the proposal that the SUR PFD limits for channels LO and LP should be increased to be consistent with channels LA to LN. WorldSpace stated that, to aid the efficient use of the spectrum, the licensees of LN, LO and LP should be required to coordinate with the licensee of the upper 12.5 MHz.

5.27 We have decided that frequency blocks LO and LP shall have the same in-band PFD limits as frequency blocks LA to LN, and that the holder of LP will be required to agree a Code of Practice with the holder of 1479.5-1492 MHz as discussed below. It should be noted that international restrictions as defined in the Maastricht Special Arrangement and the ITU Radio Regulations will apply in all instances.

Compliance through modelling

5.28 In the July 2007 consultation we proposed that modelling be used for compliance testing using ITU Recommendation ITU-R P.1546-3 with appropriate terrain and clutter databases. We further proposed that 95% locations be used for specifying aggregate PFD emission restrictions. All respondents agreed with this proposal, however, stakeholders expressed concerns with the proposed model and highlighted that the terrain and clutter databases are vital to provide accurate modelling.

5.29 While respondents raised a number of specific concerns with the proposed model, there were no suggestions for alternative models that we should use that may solve those problems, and we are not aware of any models that would be more suitable. If agreed by all licensees in the future we would consider requests to change licences to require compliance using a different propagation model.

5.30 However we have held further informal discussions with stakeholders on the issues raised by the proposal to verify compliance with the licence conditions through modelling. These discussions specifically addressed the suitability of the proposed model (P.1546-3), its application and the clutter and terrain databases. Based on these discussions we determined the methodology to be used for determining compliance to the licence terms. This methodology is detailed in Annex 4.

5.31 In summary our decision is that compliance with the licence terms will be determined through modelling based on the methodology given in Annex 4. ITU Recommendation P.1546-3 came into force in November, 2007 and we consider that it is the most suitable model to use for this spectrum at this time.

5.32 We have concluded that the terrain database Ordnance Survey “Panorama DTM” 50 m resolution digital terrain map shall be used. At the present time we have not decided on a suitable clutter database, however, a number of suppliers have been identified and we are evaluating the databases to assess which is most suitable.

5.33 With respect to the proposal that 95% of locations be used for specifying aggregate PFD emission restrictions two respondents stated that testing should be carried out to confirm that this figure is suitable. Two other respondents stated they had concerns that there was insufficient margin between what is specified in the SUR and what is required by a real network. We believe that there is sufficient margin included in the EBU TECH-3317, and stakeholder analysis indicates a margin of approximately 10 dBs. Therefore, we are of the opinion that 95% locations is a suitable figure for specifying aggregate PFD compliance.

1479.5 – 1492 MHz sub-band

5.34 We developed a set of SURs for the upper 12.5 MHz of the band based on the assumption that the most likely use of this band would be for satellite DAB (S-DAB). The in-band PFD limits are determined from a generic reference which was based on two S-DAB systems, Sirius and Global Radio. The out-of-band PFD limits are developed from the in-band PFD limits with the application of attenuation levels specified in ITU-R Recommendation SM.1541. Respondents who commented on this supported the proposal and we have decided to use these SURs in the licence for the upper 12.5 MHz of the band.

5.35 Although the SUR PFD limits are derived for an S-DAB system it does not preclude the implementation of a terrestrial service in this band, providing that this terrestrial service complies with the defined SUR PFD limits and any international restrictions.

5.36 It should be noted that a licence will not be issued for any satellite component as we do not licence satellites.

Engineering codes of practice

5.37 Following the various consultations there is general agreement from stakeholders that the technical licence conditions are now at a stage where they are satisfied that they have enough certainty about both the rights of use that they will have for this band, and about the way that adjacent users will use the spectrum. However stakeholders also generally agree that industry codes of practice will be needed to manage adjacent channel interference.

5.38 Therefore, we have concluded that three engineering codes of practice will be needed:

- one between licensees that have licences with a power limit;
- a second between licensees that have licences that have a transmitter density limit; and
- a third between the licensee in LP and the licensee in 1479.5-1492 MHz.

5.39 The codes should deal with the procedural and technical issues with managing engineering coordination. Licensees should agree a Code of Practice within 6 months after the licences are awarded. These Codes 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 Codes.

5.40 We expect that, in developing the codes, at a minimum, the following principles should be considered:

- Efficient 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.

5.41 A number of stakeholders wanted clarity over our role in the codes of practice and for us to have an active role if required.

5.42 As stated in the March 2006 consultation, the licences will give us the power to impose an engineering coordination procedure if, for example, licensees either fail to agree the Codes or where it is clear that the objective sought by the Codes is not being achieved, either through lack of cooperation or shortcomings in the Codes themselves.

5.43 As a matter of policy, we will not have a role in resolving individual engineering coordination disputes. We will only become directly involved where the objectives sought by the Codes of Practice are clearly not being secured. Such involvement will be limited to our imposition 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 we have imposed, this will be treated like any other breach of licence conditions.

Mobile transmitters

5.44 As discussed above a number of respondents requested clarity on the question of whether mobile transmissions would be allowed in this spectrum. We have not received any evidence of short term demand for spectrum in this band for services that require mobile transmitters, however, for the avoidance of doubt mobile transmitters are allowed to operate in this band.

5.45 The licences as drafted include a requirement that licensees inform us of the location of their transmitters in order to enable compliance by modelling. In practice this will make it difficult for licensees to deploy mobile transmitters. We are, however, planning to hold a general consultation on the question of using modelling to check compliance with SURs for mobile transmission which is likely to be concluded in the first half of 2008. This should lead to a robust set of general conditions for using modelling to check compliance for SURs with mobile transmissions.

5.46 We can not pre-judge the outcome of any request for a licence variation, however, we would be likely to permit licence variations that would allow licensees to deploy mobile transmitters if they were to comply with these general conditions.

5.47 However, as with other transmitters, if licensees want to deploy mobile transmitters they will need to have the agreement of their neighbours through the Code of Practice on ACI. Any request for a licence variation to remove the requirement to have to comply with the Code of Practice would be very unlikely to be granted unless agreed by all affected parties.

Example licences

5.48 Draft sample licences have been published in Annex 2.

Site clearance

5.49 Following our notice regarding the closure of the National Frequency Assignment Panel (NFAP) and the Working Group on Radio Site Clearance (WGRSC) processes on 31 August 2007, there is no requirement for site clearance or coordination with Government departments or the Civil Aviation Authority for the band 1452 – 1492 MHz. We now provide details on our website[10] of the frequency bands and service types where co-ordination and clearance processes will continue to apply.

Effect of incoming and outgoing interference as a result of the Maastricht 2002 Special Arrangement

5.50 In parallel with the March 2006 consultation document we published a consultant's report "International interference analysis for future use of 1452-1492 MHz range". Extracts from this report were reproduced in section 5 of that consultation document. Subsequent analysis has shown that the analysis that Mason carried out in March 2006 assumed trigger field strength values for co-ordination that were different from those stated in the Maastricht 2002 Special Arrangement. In particular:

- Outgoing co-channel interference from UK systems to continental T-DAB, should be calculated assuming a maximum permissible equivalent field strength for co-channel interference of 41 dBµV/m, which includes an 18 dB propagation correction to protect the wanted T-DAB signals for 99% locations against interference from another T-DAB transmitter. The earlier work by Mason did not include this propagation correction.

- Outgoing adjacent channel interference from UK systems in block LP to continental S-DAB systems in blocks LQ and above, should be calculated on the basis that the maximum field strength that UK services must not exceed is 42 dBµV/m.

5.51 In addition, the ERO has now published the location of calculated test points for each MA02 allotment which were not previously available.

5.52 We have asked Mason to carry out the analysis again and the results of this revised analysis will be published on our website[11]. However we should emphasise that this analysis is still indicative and that any applicant for this spectrum should conduct their own analysis before making a decision to bid in the award process.

[10] http://www.ofcom.org.uk/radiocomms/isu/arrangements/
[11] http://www.ofcom.org.uk/radiocomms/spectrumawards/awardspending/award_1452/

Section 6

Other regulatory conditions, rights and obligations

6.1 In the March 2006 consultation we made a number of further proposals relating to non-technical licence conditions. These are discussed in this section.

Licence term

6.2 There was general support for the proposals relating to the licence term.

6.3 Therefore the licence will have an indefinite duration, with an initial period of 15 years during which we will limit our powers to revoke the licence. After this initial period we will have the power to revoke for spectrum management reasons on not less than 5 years' notice. This could lead to the licence being terminated the day after the expiry of the 15 year initial period or any time thereafter.

Licence fees

6.4 Nokia felt that the auction payment should be payable across the 15 year licence period to avoid biasing the auction towards bidders with access to low interest rates or available capital. Intellect wanted payments to be spread in order to maximise the number of bidders and enhance competition.

6.5 By ensuring that the fee is paid in full before the licences are issued it means that we do not run the risk of having to withdraw the licence for non-payment in the future and so possibly lead to consumer services having to be withdrawn.

6.6 Intelsat felt that satellite radio licenses should be awarded on a cost recovery basis as anything else could be a financial burden severe enough to discourage infrastructure investment.

6.7 We have a responsibility to ensure the efficient use of spectrum and we believe that the information that is provided though an auction is the best way to ensure efficient use in these bands. Investment decisions including how much, if anything, a bidder is willing to pay for a licence is a matter for individual bidders.

6.8 Orange wanted more clarity about spectrum fees at the end of the 15 year period in order to allow proper business planning.

6.9 We can not know the market or other conditions that will exist in 15 years time so we do not think that it would be sensible to decide now what the fee regime will be at that point. Based on the majority of responses we also consider that certainty for the first 15 years is suitable initial period for business planning. However, before introducing fees after the 15 year initial period we would give licensees suitable notice.

6.10 Therefore, it is our decision that 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 and that will be payable in full before the licences are award. After the expiry of the initial period, if the licensee continues to hold the licence, there may be additional charges in line with our policy on spectrum pricing at that time.

Spectrum trading

6.11 Some respondents (e.g. Orange) felt that there would need to be more clarity about definition of the property rights that were being bought, otherwise it was not clear how the spectrum could be traded. They felt that spectrum usage rights would need to be fully resolved before award.

6.12 As discussed in Section 5 We have carried out further consultations on the initial technical licence conditions and there is now general agreement that the licences will provide adequate certainty. As a result we believe that there is now sufficient certainty for licences to be traded.

6.13 A number of the satellite responses did not think that it would be appropriate for the satellite spectrum to be tradable. ONDAS quoted an Ofcom consultation that said "Ofcom does not propose to introduce trading in exclusive satellite bands" (although ONDAS was indifferent to the "tradability" of the spectrum).

6.14 None of this spectrum is for exclusive satellite use. The ITU allocates this spectrum on a co-primary basis to four different services. We intend to allocate this spectrum on a service and technology neutral basis and in order to allow long term market led efficient use of the spectrum we believe that it should be tradable.

6.15 Therefore the licence will be tradable. All types of trade - partial or total; concurrent or outright - will be permitted.

Service and technology neutrality

6.16 The licences will contain the minimum necessary technical conditions and will not specify either the technology to be used or the services that must be offered.

6.17 A service and technology neutral approach was supported by most respondents as an appropriate way of allocating spectrum that has a variety of potential uses.

6.18 One respondent felt that it may be appropriate (e.g. where there are considerable social welfare externalities associated for a particular use) to move away from service neutrality and consider allocating spectrum for public service mobile TV although they still supported technology neutrality. In addition they felt that we should specifically take account of our role in maintaining and strengthening public service broadcasting (PSB) when considering issues of high-level spectrum policy. Specifically that we should ensure that PSBs have access to spectrum to provide PSB content to viewers on mobile TV. It felt that this may require us to allocate some of this spectrum to one or more PSBs or include "must carry" obligations in some of the licences

6.19 PSBs will have no restrictions on their ability to participate in this award. For this spectrum band we have not identified any market failures or any evidence of social benefits that would require us to intervene to support public service broadcasting on mobile TV.

6.20 The satellite operators wanted us to allocate at least the top 12.5MHz exclusively to satellite use. SAP REG and WorldSpace felt that technology neutrality would not take into account the consumer benefits and the greater efficiency of satellite use in achieving nationwide coverage and the possible spectrum use inefficiencies imposed by the technical constraints. Intelsat felt that a hybrid satellite / terrestrial solution would uniquely meet a number of our section 3 duties.

6.21 We have not seen any evidence to suggest that there will be more efficient use of this spectrum if some services are excluded from using this spectrum. In particular, mobile TV and satellite services will not be excluded from using any of the spectrum that is being awarded and the spectrum packaging and the auction design have been designed to ensure that as many services as possible are able to use the spectrum.

6.22 One respondent raised concerns that we were not putting restrictions on 3G use on the use of the 1452-1492 MHz spectrum, particularly in the context of the 2000 3G auctions. They contended that this should be done in order to ensure investment certainty and competitive neutrality and to avoid discriminatory treatment if the spectrum was to be used for a mobile service. In addition the respondent felt that we should consider the impact on licensees that have coverage obligations of not including coverage obligations in these licences.

6.23 Another respondent raised similar concerns stating that we needed to recognise the existing restrictions on mobile operators when determining restrictions on new spectrum. It stated that it was important that where operators provide similar services the regulatory regime should not favour one group of operators over another to avoid undue discrimination. They stated that the approach risked distorting competition as:

- New licensees could deploy 3G type systems before the existing licensees could recoup their investment and before decisions on 2G liberalisation have been made; and

- There were differences in conditions between these and existing licences, in particular in roll out obligations, tradability, duration and licensee fees.

6.24 Digital One made a similar point stating that it would be unfair to oblige some radio stations to “buy digital spectrum via an auction while other operators are able to win licences under the Broadcasting Act 1996”.

Undue discrimination

6.25 We consider that undue discrimination can only arise where like cases are treated differently, or different cases are treated alike, without objective justification for the treatment given.

6.26 At a general level, We consider that past decisions on licensing conditions do not necessarily determine how future licensing decisions should be made, subject to relevant consideration of the requirements under EU and UK law (in particular section 9(7) of the Wireless Telegraphy Act 2006 and article 7.3 of the Authorisation Directive). The 2G and 3G licences were awarded at times when different spectrum policy conditions prevailed. For example, when 2G licences were awarded in the 1990s, the conditions of spectrum scarcity were different. Also, the application of market mechanisms, such as spectrum trading and spectrum auctions, and the introduction of a technology neutral approach to spectrum awards were only being considered as policy options whereas they have since been adopted as the basis of spectrum policy following consultation.

6.27 In itself, the existence of conditions in current licences that are different from those proposed for new licences is not a justification for preventing the introduction of changes when their overall benefits have been identified and when changes to the legal framework have been made to make their implementation possible. In this context, we note that the 3G licences have different conditions to those of the 2G

licences, yet we are not aware of any claims of discrimination on that basis, neither do we believe that those differences give rise to discrimination for similar reasons to those expressed in relation to the proposed licences.

6.28 We have considered carefully whether the proposed licence terms could discriminate unduly against any person, including existing licensees in others spectrum such as the MNOs. Undue discrimination can only arise where different treatment is given to persons in similar circumstances, or where the same treatment is given to persons in different circumstances, and there is a lack of objective justification for the treatment given.

6.29 We have identified a number of differences between the proposed licences for use of this band on the one hand and existing 2G, 3G and other licences on the other. The main differences are as follows.

a) The prevailing spectrum management policy at the time of award has changed in recognition of the benefits of market mechanisms and flexibility. As discussed above, spectrum policy conditions at the time of award were such that both 2G and 3G licences specify the technology to be used and are not tradable. 3G licences also include roll-out obligations.

b) The manner of award differs. The 2G licences were awarded by comparative selection, with the regulator (at the time, the Secretary of State) deciding who licence holders should be, not by auction.

c) International obligations are different, particularly in relation to technology neutrality relating to the relevant spectrum. The GSM Directive applies to part of the 900 MHz spectrum and its existence prevents the application of a technology neutral approach to that spectrum. At the time of 3G licence award the UMTS Decision applied, requiring a technology specific award for some of the spectrum that was awarded. The relevant international conditions that apply are laid out in section 3 of the Information Memorandum for this award. There is currently no binding European Commission Decision that applies to this spectrum. The Maastricht 2002 Special Arrangement as revised in Constanta in 2007 focuses on the needs of mobile multimedia services, although it allows us to carry out a service and technology neutral award in the UK.

d) Moreover, the EU legal context has changed. The Framework Directive that came into force in April 2002 permitted trading whereas, at the time of the 3G auction in 2000 it was understood in the UK that trading was not permitted under the previous Licensing Directive[12].

e) It is also possible that the services offered using the available bands could compete in different downstream markets to those served using 2G spectrum (at 900 MHz and 1800 MHz) and using 3G spectrum (at 2.1 GHz).

6.30 These differences in circumstances at time of award are such that we do not consider that the proposals involve undue discrimination. In addition, we note that the MNOs will be able to participate in the award of this band on the same terms as all other bidders. Hence, there would be no source of discrimination against them in the proposed award itself.

[12] See in particular paragraph 2.2.8 in the Information Memorandum for the 3G auction of 2000

Investment certainty

6.31 It is certainly true that if there were to be new entry into markets that overlap with 3G services as a result of new spectrum awards, then this could be expected to reduce the profits that the MNOs would otherwise expect to make in the absence of competition from new entrants. This is a natural consequence of competition in downstream markets which it is our duty to promote.

6.32 Moreover, this would only be a source of concern that would require us to consider a different course of action if the new spectrum awards were to create a distortion in competition. There is no evidence to suggest that such distortion will take place as a result of this award. If it does then we have ex post competition powers which can be used to address anti-competitive behaviours in certain circumstances.

6.33 Related to this, a point was raised about the status of decisions related to the liberalisation of 2G spectrum. Our consultation on this issue, "Application of spectrum liberalisation and trading to the mobile sector[13]", closed on 29 November 2007 and summarised the latest positions on this issue. However, as with other spectrum bands, we will attempt to give as much clarity as possible over the status of this spectrum before the award but do not see any reason to delay the award until that clarity has been obtained.

Differences in licence conditions

6.34 We consider that the tenure conditions, and roll-out obligations for licences have been clearly set out at the time of their award. In particular, in the Information Memorandum for the 2000 3G auction, it was made clear ahead of the award and after consultation with stakeholders, that roll-out obligations would be included in the licences on offer. In section 2.2 (in particular paragraph 2.2.4) and at appendix K[14] of the Information Memorandum for the 3G auction of 2000, the 3G licence condition on roll-out is clearly stated.

6.35 It was also made clear at the time of the 2000 auction that further spectrum would be made available that could be used for similar technologies and services (and therefore that there could be future entry into the mobile communications market)[15]. It was not stated that future awards of spectrum would be subject to the same conditions, including roll-out obligations, as in the 2000 award. The means by which future awards of spectrum would be allocated were also not stated.

6.36 Participation in the 2000 auction reflected the acceptance of those conditions. The prices paid by the winning bidders in the auction, which has been judged open, fair and transparent, should also have reflected the implications of those conditions. Similarly, we would expect the prices paid in any new award to reflect the conditions attaching to the licences to be awarded. Therefore, we are of the view that the award of licences with the conditions proposed in this consultation would not be unfair to holders of existing licences.

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

[14] Template licence, schedule 1, paragraph 4 a): "The Licensee shall install, maintain and use Radio Equipment (as specified in paragraph 9 of Schedule 1) in such a way as to enable the provision of, by no later than 31 December 2007, and to maintain thereafter, a telecommunications service by means of the Radio Equipment to an area where at least 80% of the population of the UK live".

[15] See the Information Memorandum for the 3G auction, in particular section 3.4.1 and A5.2

Conclusion

6.37 As result we believe that it is appropriate to allocate this spectrum on a service and technology neutral basis.

Limits on applying for spectrum

6.38 One respondent suggested that there could be competitive risks if BT were to acquire the spectrum and as a result gain the ability to compete with elements of the services provided by mobile network operators. It was concerned that BT could leverage its position in fixed telecommunications into related wireless markets.

6.39 There is no reason why we should consider additional competition for the mobile network operators a matter for concern of itself. In the specific case of BT we do not believe that there is any evidence to suggest that, if BT gained access to spectrum for the provision of wireless services in these bands, it would necessarily require further regulation as a direct result of the spectrum holding. Also, we have ex post competition powers which can be used to address anti-competitive behaviours in certain circumstances.

6.40 If the available spectrum is used to provide broadband services, then these services are likely to compete mainly with mobile data communications services rather than with fixed broadband services, at least in the short term. Ofcom has recently concluded that fixed broadband services are in a different market from mobile broadband services[16]. Since these two markets are separate, we believe that BT would have little incentive or purpose in trying to close off competition in mobile data communications in order to maintain its position in wholesale markets for fixed telecommunications. Moreover, it seems unlikely that BT could gain a position of dominance as a result of the proposed award either in the provision of mobile services (and access and call origination on public mobile telephone networks in the UK is considered to be competitive) or in the provision of new mobile or other services.

6.41 The question could, in principle, become more relevant if there is significant convergence between mobile broadband and fixed broadband services over time. However, those services are currently provided by a number of operators, and the number of operators and services might increase as a result of this, and other, spectrum awards. Moreover, through its undertakings under the Enterprise Act 2002 and ex ante conditions imposed on it as a provider with SMP[17], BT is under specific obligations to allow use of its infrastructure by other providers at a wholesale level for the provision of fixed voice and broadband data services to address dominance. Those provisions, in addition to infrastructure competition between BT's network and other fixed networks (including cable), increase the competitive pressures on BT at both a wholesale and a retail level. However, if we become aware of the need for modifications in remedies we will address them.

[16] See Ofcom's "Review of wholesale broadband access markets 2006/07" pages 23 and 24 available at http://www.ofcom.org.uk/consult/condocs/wbamr07/wbamr07.pdf

[17] See the statement on the Strategic Review of Telecommunications, published on 22 September 2005 (http://www.ofcom.org.uk/consult/condocs/statement_tsr/statement.pdf), and associated documents on local loop unbundling and wholesale line rental, such as it statements of 30 November 2005 (http://www.ofcom.org.uk/consult/condocs/llu/statement/), 15 December 2005 (http://www.ofcom.org.uk/consult/condocs/line_rental/wlrffp_statement/) and 24 January 2006 (http://www.ofcom.org.uk/consult/condocs/wlrcharge/statement/).

6.42 In addition there are a number of forthcoming spectrum awards that will provide opportunities to acquire spectrum that can be used to provide similar wireless services to those that can be provided in this spectrum.

6.43 Therefore we do not intend to include any additional restrictions on BT if they choose to take part in this award. In general 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.

Substitute spectrum

6.44 A number of respondents (e.g. O2, BT, BBC, Digital TV Group) commented on the importance of certainty regarding the status of other spectrum. In particular there was a general view that as a minimum there should be clarity over the future of Channel 36 and ideally all of the UHF spectrum. Arqiva felt that the most efficient outcome would be an earlier (or simultaneous) auction for channel 36.

6.45 The latest information on the status of the other spectrum awards is available on our website[18]. We intend to publish further information relating to Channel 36 in the Digital Dividend Review statement before the end of 2007. In particular this will include clarity on the award of Channel 36 in respect to: the status of clearance, early use of Channel 36, and early award of Channel 36.

Existing users of the spectrum

6.46 A few respondents to the March 2006 consultation requested extensions for the fixed links licences to guarantee their access to the spectrum past 31 March 2007. They stated a number of difficulties in being able to move by that date and risks to the provision of various services, and a number of commercial reasons why they considered it may be undesirable to move. They also questioned why notice was being given before the auction was going to take place and why links were not to be allowed in parts of the country where they believed there would be limited alternative use. In addition they had a number of concerns with a six month rolling licence and some wanted their fixed links to have a reserved position in the auction.

6.47 The decision to stop licensing fixed links in this band was taken over a decade ago and fixed links licensees have been under notice since 1996 that they will be moved to other frequencies. So while there will be an impact on the fixed links users there has been sufficient time for existing licensees to make alternative plans. The international agreements on this band mean that we can not be certain that the existing licensees would not suffer from interference.

6.48 Giving notice to existing licensees before the award of new licenses helps to ensure that spectrum is unencumbered by existing users which will reduce the restrictions on the use of the spectrum. As a result it will allow us to fulfil our statutory duty to secure the optimal use of the spectrum.

6.49 The award of the spectrum will be on a service and technology neutral basis and the spectrum will be fully tradable. As a result, if they wish to, fixed links licensees will have the ability to acquire the spectrum for their services through the award or to negotiate with new licensees to gain access to the spectrum. This may be particularly suitable if the users believe there will be limited alternative demand,

[18] http://www.ofcom.org.uk/radiocomms/spectrumawards/

however we are not aware of any reason why we would need to intervene to ensure this.

6.50 Because fixed links use of 1452 – 1492MHz has been at risk for a number of years we have been redeploying fixed links licensees in the 1452-1492MHz band to a comparable link in the 1.4GHz band (1350-1375MHz paired with 1492-1517MHz) that has been made available for fixed links users.

6.51 In addition we have granted all fixed links licensees an extension to their licences to 31 December 2007. A number of specific fixed links users of the spectrum have been granted further permission to continue using their spectrum in the 1452-1492 MHz band after 31 December 2007. These specific users are listed in the table below.

Date	
28 February 2008	Wiltshire and East Anglia ambulance trusts to cease using the band (Licence Nos. 247129 & 247003) For further details see http://146.101.202.225/public-tnr/wtrSearch.do
31 March 2008	North East Ambulance Trust comprising Cleveland, Northumbria & Durham. (Licence Nos. 246979, 247062, & 246997) For further details see http://146.101.202.225/public-tnr/wtrSearch.do
30 April 2008	Cumbria ambulance trust to cease using the band (Licence No. 246986) For further details see http://146.101.202.225/public-tnr/wtrSearch.do
31 May 2008	Merseyside, Oxfordshire, Royal Berkshire, Shropshire, Staffordshire and Warwickshire (CWA) ambulance trusts to cease using the band (Licence Nos. 247052, 246920, 246929, 247098, 247102 & 247125) For further details see http://146.101.202.225/public-tnr/wtrSearch.do
31 December 2008	Highlands & Islands Fire & Rescue to cease using the band For further details contact Ofcom.

Inefficient hoarding of spectrum

6.52 In their response to the March 2006 consultation document Emap wanted licence conditions to include timescales for implementation, to “avoid stockpiling or hoarding” for “any defensive or market manipulation purposes”.

6.53 We consulted further on whether it would be appropriate to include any licence conditions to prohibit the inefficient hoarding of spectrum. In the July 2007 consultation document we laid out the reasons why we considered that this would not be appropriate. No respondents disagreed with that view therefore we will not include such a condition in licences for this award.

International conditions

Maastricht 2002 Special Arrangement

6.54 In the March 2006 consultation we asked if stakeholders agreed with our proposed approach to address the international issues resulting from Maastricht 2002 Special Arrangement.

6.55 There was general agreement to our approach to gain additional flexibility for this spectrum.

6.56 O2 and the DTG felt that the priority for this negotiation should be to ensure clarity about the ability to use the guard bands.

6.57 Many respondents (e.g. Vodafone) commented that they would want certainty over the outcome of the negotiations and resolution of the international issues before the auction. In addition those who commented (e.g. Nokia, DTG, O2, Vodafone) seemed to be happy with a short delay (possibly up to a year) to the award if that would allow the international position to be clarified. This would give bidder more flexibility and better knowledge in order to value the spectrum and so lead to a more economically efficient outcome.

6.58 Although they did not oppose our approach the BBC felt that moving ahead under the Maastricht 2002 Special Arrangement would reduce risks for the market as there was a very short timeframe and a risk of delay if there were negotiations.

6.59 ANFR felt that a new regional CEPT conference was "the only practical way to ensure regional harmonisation and so contribute to the development of the European internal market". A CEPT approach to the revision was also advocated by Alcatel to "avoid unilateral national initiative what may put at stake the efficient use of spectrum at European scale". ANFR also made it clear that they would maintain their request for S-DAB protection. Qualcomm feel that European harmonisation is important as mobile terminals are a pan-European market. A number of other respondents (e.g. O2 and Orange) also pointed out the importance of a harmonised European approach to give the market certainty.

6.60 Following the March 2006 consultation, we have worked with our neighbours to gain greater clarity over the rights of use of the spectrum. In particular, we have worked within the CEPT to develop pan-European approaches to this band. However while harmonisation can be desirable we believe that market-led, rather than regulator-imposed, harmonisation leads to the most efficient use of spectrum. As a result, we have tried to increase the flexible use of this band rather than imposing service or technology restrictions.

6.61 As a result, following the Electronic Communications Committee (ECC) meeting on 2-4 July 2007, 32 administrations agreed and signed a partial revision to the Maastricht 2002 Special Arrangement[19]. This includes the majority of the Member States of the European Union including the UK and all of the UK's near neighbours.

6.62 In general terms, the partial revision allows additional flexibility for administrations to use the 1452-1479.5 MHz band. In particular it supports:

- the application of an envelope concept i.e. that the plan entries could be used for terrestrial mobile multimedia services with characteristics that may be different from those appearing in the Plan but within the envelope of their T-DAB Plan entry; and

- the aggregation of blocks to accommodate mobile multimedia services with wider bandwidths than T-DAB.

[19]Available from the ERO website: http://www.ero.dk/

The European Commission

6.63 As discussed in previous documents, the European Commission (EC) has been considering making a binding decision to harmonise the use of the 1452-1479.5 MHz band. This has forced us to delay the award of this spectrum as the risk of the decision created uncertainty for all potential applicants.

6.64 The Radio Spectrum Committee met in October 2007 and the chairman's report of the meeting[20] stated:

"Mobile Multimedia in the L-band: The Commission presented a revised draft Decision (RSCOM07-68 Rev1) for a technology-neutral opening of the L-band (1.4 GHz). The discussion revealed significant opposition to the proposal, on the basis that this approach was not necessary because the revised Maastricht Special Arrangement provided a sufficient legally binding framework in Europe. The Commission did not agree with this premise: while the Maastricht Special Arrangement provides the technical parameters required to avoid interference across borders, the Commission Decision would in addition ensure that the frequency band is designated and made available within a certain time framework throughout the European Union, thus giving the mobile multimedia industry clear investment prospects in this band. The Commission would further seek consensus on this issue".

6.65 No specific further plans have been put forward so, in light of this, we do not consider that there is any further reason to delay the award of this spectrum.

Other international arrangements

6.66 Some satellite respondents felt that 1467-1479.5 MHz should be protected as satellite spectrum. Alcatel felt that "considering that the Maastricht 2002 Special Arrangement is put in breach by Ofcom's national initiative, some countries may request the protection of S-DAB receivers in the whole upper 25MHz". A similar view was held by ESOA who suggested that neighbouring counties may demand protection and that in order for the approach to be non-discriminatory "priority access has to be maintained in the 25MHz of the upper band".

6.67 The ITU allocates the 1452-1492 MHz spectrum for four different services on a co-primary basis only one of which is satellite services (restricted to broadcasting satellite) so there does not appear to be any reason to protect satellite services over any others. The Maastricht 2002 Special Arrangement has been notified to the ITU as a relevant special arrangement and has been signed by all of the UK's near neighbours, so for 1452-1479.5 MHz that agreement governs the terrestrial rights.

[20] http://ec.europa.eu/information_society/policy/radio_spectrum/docs/ref_docs/rsc21_public_docs/rsc21_chair_rep.pdf

Section 7

Next steps

7.1 Draft regulations and an Information Memorandum have been published alongside this document. The draft regulations are subject to a statutory consultation that closes on 18 January 2008.

7.2 After the close of this consultation we will consider the responses and amend the regulations if necessary. Following this we intend to make the regulations in February 2008.

7.3 The regulations will come into force in March, 21 days after they are made. We expect the closing date for applications to also be in March.

7.4 Following pre-qualification checks we expect that the auction will start in April 2008.

Annex 1

Summary of responses

Issue raised	Comments	Ofcom response
Satellite and 1479.5-1492 MHz		
Pan-European S-DAB Services	A number of respondents felt that we should consider the negative effects on further deployment of Pan-European S-DAB services in restricting feasibility of Satellite services and creating problems for satellite systems which could be deployed in the upper portion of the spectrum. A number of respondents felt that this band should be reserved for Satellite services. Some satellite respondents felt that 1467-1479.5 MHz should also be protected as satellite spectrum.	Our spectrum packaging and decisions on technical conditions, in particular in 1479.5-1492 MHz will enable satellite operators to acquire suitable spectrum. Given the range of technologies that may wish to use this spectrum both now and in the future, we do not believe that we would fulfil our statutory duties if we were to exclude any services and technologies from using the band.
Top 12.5 Mhz and RSA	Inmarsat stated that we should withhold licensing the top 12.5 MHz until we had conducted a consultation on RSA.	The award is for terrestrial rights and the satellite transmission rights are subject to the ITU process and are unaffected by the auction. Satellite operators are not precluded from taking part in the award.
Satellite proposals for the award	Alcatel believes that not guaranteeing the availability of 1479.5-1492 MHz for satellite and not exempting access to the spectrum from market mechanisms will impacting the feasibility of their European Satellite Digital Radio (E-SDR) project, which will put significant burden on the development of digital radio and multimedia services through the E-SDR system in the UK.	Whether an organisation should carry out a project is a commercial decision for them, we will seek to provide appropriate information to allow a non-discriminatory award to take place. We do not believe that we would fulfil our statutory duties if we were to exclude any services and technologies from using the spectrum and that a market mechanism will lead to the most efficient use of the spectrum.
CEPT process	Alcatel felt that a CEPT process should be undertaken to replan the band.	The CEPT Frequency Management Working Group set up a project team, FM PT45, to look at ways of making the use of this band more flexible. This group considered whether there would be any merit in replanning the 1452 - 1479.5 MHz band and concluded

Issue raised	Comments	Ofcom response
		that there was no support to carry out such an exercise. For the band 1479.5 – 1492 MHz FM PT45 concluded that the regulatory framework as currently provided by the Decision ECC DEC/(03)/02 appears sufficient, and that no further actions would therefore be required at this stage. It should be noted that the UK has not signed the ECC decision on this band and as such it is not binding on the UK.
Satellite need for the same frequency across Europe.	Five responders feel that auctions should not be used in this instance as the odds are stacked against Satellite operators in favour of Terrestrial operators because Satellite services need the same frequencies to be available in several countries.	The rights of a satellite operator to broadcast into a country are determined through an ITU process. As with all other international arrangements, we will expect all licensees to comply with all relevant international arrangements. Satellite radio services have already launched in a number of countries in Europe and around the world, therefore it is not clear that it is correct that Satellite services require frequencies in multiple countries. Satellite operators will have the same opportunity as other operators to acquire spectrum in the award process.
Participation of satellite operators	ESOA stated that there is no legal basis on which satellite operators could seek to participate in the award process.	Satellite operators can take part in the award on the same basis as any other operator. The auction is for terrestrial rights to use this spectrum. It should be noted that a licence will not be issued for any satellite component as we do not licence satellites.
Satellite use of the spectrum	ASMS Task Force stated that consideration should be given to a second S-DAB system in the 1452-1492 MHz spectrum.	This award will not preclude any services or technologies from using the band. All licensees must comply with relevant international arrangements.
Use of top 12.5	Arqiva feel PMSE maybe a good	We have not seen significant

Issue raised	Comments	Ofcom response
MHz	use for the top 12.5 MHz because of the need for low power uses to protect European Satellite Services.	demand for PMSE use of this band, however PMSE operators will not be precluded from taking part in the award.
Award of the upper 12.5 MHz	Satellite operators see no advantage for the industry by awarding this spectrum by auction. Inmarsat feels that the Upper 12.5 MHz should be reserved strictly for Satellite services.	We believe that awarding all of this spectrum on a service and technology neutral basis is most likely to lead to an efficient use of this spectrum. Excluding all uses of the spectrum except for satellite use is not likely to lead to an efficient outcome.
Use for satellite infill	ONDAS felt that "prospective S-DAB operators should not be prevented from using this spectrum for a terrestrial in-fill component" and that we should "open the band 1452-1492 for use by S-DAB operators". Other respondents held similar views.	This is not prevented in this award.
Participation of satellite users	ESOA felt that while the process allowed satellite operators to take part, that was not the same as a non-discriminatory process e.g. as they felt that the draft licence does not provide similar levels of detail for satellite and terrestrial operators.	The process is service and technology neutral and the rules that all bidders will have to follow during the award process have been fully laid out in the draft regulations. In addition we have carried out a number of consultations and laid out the reasons for the decisions that we have taken in the various documents that we have published. As a result we consider that the award process does not discriminate again particular types of user. Full draft licences have been published for both types of licence in the 1452-1479.5 MHz band, and for the 1479.5-1492 MHz band.
Satellite use of the top 25 MHz	ESOA stated that it seemed "obvious that priority access for satellite has to be maintained in the 25 MHz of the upper band" based on the ITU radio regulations and Resolution 528 from WARC-92. A number of other respondents made similar comments about	The ITU Radio Regulations allocate the top 25 MHz i.e. 1467-1492 MHz on a co-primary basis to four different services only one of which is a satellite services, so, that is not a basis to consider excluding non-satellite services. Resolution 528 restricts the ability

Issue raised	Comments	Ofcom response
	satellite services.	of broadcasting satellite to only be able to use the 1467-1492 MHz part of the 1452-1492 MHz band. It does not restrict any of the other co-primary services as a result. The international satellite filings in accordance with ITU Radio Regulations allow the co-ordination of satellites with each other, they do not oblige the UK to protect satellite reception in the UK. Satellite operators will have the same opportunity as all other operators to obtain licences for this spectrum. Therefore we see no basis to exclude some services or technologies from using any part of this spectrum.
Similarities between satellite and terrestrial operators	ESOA stated that the reasons why a satellite operator may not launch a service may also apply to terrestrial operators.	We agree with this comment.
Making 1467 – 1492 MHz available	Alcatel feel that 1467 – 1492 MHz should be considered as a priority for use by the hybrid satellite/terrestrial systems, and that terrestrial only technology is considered only in the 1452 – 1467 MHz range, given the fact that the auction mechanism is not appropriate for the development of satellite projects. ANFR also supports the development of hybrid satellite/terrestrial digital radio initiatives that will make use of the BSS (sound) allocation in the 1467 – 1492 MHz to serve Europe. France is the notifying administration of several corresponding ITU filings, with possible impacts on the organisation of the band at European level. SAP REG feel that due consideration should be given to the eventuality of accommodation of a second S-DAB system in the 1467 – 1492 MHz range, in conformity with	To exclude services from the 1467-1492 MHz band would be unlikely to lead to an efficient allocation of spectrum as it would discriminate against those services and reduce competition for the spectrum. The spectrum will be fully tradable and service and technology neutral. As a result if services such as digital radio do not wish to acquire spectrum during this award then they will have the ability to do so in the secondary market.

Issue raised	Comments	Ofcom response
	the original 1467 – 1492 MHz ITU allocation which harmonised this frequency range for S-DAB use at global level.	
International framework		
European network development	ONDAS stated that under its statutory duties we "must not assign frequencies in this band in any way that impedes the development of European-wide networks".	We believe that fully tradable, application and technology neutral spectrum will create the opportunity for the market to deliver a European-wide network if that is what it wants to do.
ECC decision	Some respondents commented on the ECC decision on 1479.5-1492 MHz in this award.	The UK has not signed the ECC decision on this band and as such it is not binding on the UK.
Maastricht	Ten respondents generally support the approach to address the International issues in proposing to seek more flexibility within the Maastricht Plan through negotiation.	Revisions to the MA02 Special Arrangement were agreed in July 2007 that allow for the application of an envelope concept and the aggregation of blocks to accommodate services with wide bandwidths than T-DAB.
Harmonisation	Some respondents, wanted more attention to be paid to European harmonisation when making decisions and supported Commissioner Reding.	We believe that awarding tradable, service and technology neutral licence will allow the market to make the most appropriate harmonisation decisions.
Harmonisation	Alcatel, ANFR and one other respondent felt that a European process under the auspices of CEPT should be undertaken. This is because the efficient use of spectrum at European level maybe at stake if decisions regarding its re-organisation are taken unilaterally on a national basis. O2 stated the importance of securing International agreement for a more flexible approach, to give the market certainty. The BBC feels that as there is little certainty on the potential international usage rights for this spectrum it will make the value of the spectrum difficult to determine for bidders.	There has been no indication from the CEPT or CEPT administrations that there is a desire for a pan-European award of this band, and in a number of countries services have already been launched
Flexibility within the Maastricht Plan	Some respondents feel that it is essential to secure flexibility before the auction takes place. BT feel that finding more flexibility within the Maastricht Plan through agreement	Following the end of the CEPT FM PT45 work on this band, revisions to the MA02 Special Arrangement were agreed in July 2007 that allow for the application of an

Issue raised	Comments	Ofcom response
	with out International neighbours offers the greatest flexibility for rolling out services which may not fit in with T-DAB characteristics. Digital One and ESOA state however, that there is no certainty in this approach that the UK's International neighbours will be accommodating. T Mobile felt that we should wait until the work of FM PT45 was complete before awarding the spectrum..	envelope concept and the aggregation of blocks (including use of the guard bands) to accommodate services with wide bandwidths than T-DAB.
Wiesbaden and Maastricht Plans	Four respondents feel we should maintain our former consent to the internationally agreed and confirmed Wiesbaden and Maastricht Plans.	The revisions that have been made to the MA02 Special Arrangement give all users of the band greater rights than before. In particular the changes do not affect the specific allotments that each country has.
Renegotiations of the Interference Environment	Vodafone feels the results of our renegotiations of the interference environment will have a significant impact upon the potential value of certain spectrum lots. If we are not able to conclude these negotiations before the auction then we must indicate clearly the anticipated outcome in order for bidders to be able to assess the value of different lots. Qualcomm recommended that we did not issue licences before the European situation was clear.	Revisions to the MA02 Special Arrangement were agreed in July 2007 that allow for the application of an envelope concept and the aggregation of blocks to accommodate services with wide bandwidths than T-DAB.
Interference	Four respondents feel there could be cases of cross-border harmful interference.	The incoming and outgoing interference restrictions in the international agreements are not planned to be changed or renegotiated before the award. Any interference (either incoming or outgoing) must fall within the limits in the international agreements.
Negotiations	Intellect, O2 and ESOA believe negotiations with other countries should be accelerated as to provide bidders with the best information.	Revisions to the MA02 Special Arrangement were agreed in July 2007 that allow for the application of an envelope concept and the aggregation of blocks to accommodate services with wide

Issue raised	Comments	Ofcom response
		bandwidths than T-DAB. No further revisions are planned, however there is always the possibility of a decision by the European Commission that is binding on Member States.
Auction design		
Auction testing	H3G and Wrege Associates wanted to ensure that auction designs were fully tested before a design was chosen and the BBC stated that they were concerned about practical implementation as the auction design had not been used before in the UK. H3G also wanted a trial auction for bidders.	We have carried out testing on this auction design and similar auction designs that have been used in other awards before making a final choice. Further testing will be carried out before the regulations are made. In addition we intend to hold mock auctions for interested parties before the final award.
Draft auction rules	A number of respondents wanted a consultation on the draft rules and implementation of the auction before the consultation on the draft regulations. BT and others wanted to sees more detailed auction rules and examples of how the rules would be applied in practice.	These matters were included in the July 2007 consultation.
Auction design	H3G noted that they had provided detailed comments on the combinatorial clock auction in the Market Analysis report that they provided as a response to the 2500-2690MHz award.	The points raised have been dealt with in the context of the 2500-2690MHz award in particular as part of the documents published in August 2007[21].
Auction design criteria	One respondent wanted us to consult on the criteria that we were was using to judge the different auction and assignment mechanisms.	A discussion of the key choices in selecting the auction format and an initial comparison of the action formats was provided in Section 7 of the March 2006 consultation document, and a discussion on the choice of assignment mechanism was provided in section 4 of that document. A further comparison of the candidate auction formats with the factors which could be relevant to the decision was carried our in Section 3 of the February 2007 auction design discussion document.

[21] http://www.ofcom.org.uk/consult/condocs/2ghzdiscuss/main.pdf

Issue raised	Comments	Ofcom response
Auction design approach	One respondent wanted greater detail about our approach to auction designs and how concerns with "strong" and "weak" bidders, strategic behaviour and the "winners curse" would be addressed.	While no auction design can fully address all concerns: • Concerns with "strong" and "weak" bidders have been reduced by having a partially transparent auction and including a sealed bid element; and • Concerns with strategic behaviour and the "winners curse" have been reduced by including a second price rule
Auction rules clarification	One respondent wanted clarification of which were the "auction rules common to both formats".	These are the rules discussed in paragraph 7.32 onwards in the March 2006 consultation document.
Use of auction mechanism	ESOA stated that they disputed the appropriateness of an auction mechanism as it would create a risk that the band will not be available for terrestrial or satellite use.	The application and technology neutral auction will be to make the terrestrial transmission rights to use this spectrum in the UK available. It should be noted that a licence will not be issued for any satellite component as we do not licence satellites
Auction testing	One respondent considered that the auction design should be rigorously tested against other auction formats and the results shared with potential bidders.	We have undertaken further testing of the proposed auction format which is extending into early 2008. We will include the conclusions of this testing in our statement when making regulations.
Example auction format	One respondent stated that we should provide examples of other applications of the proposed auction format.	This auction has been designed specifically for this award to reflect the specific characteristics of the spectrum on offer so there are no examples.
Auction efficiency	One respondent stated that they do not believe that we have shown that the proposed auction format is more likely to lead to efficient outcomes. Specifically they made comments	Bid shading – This auction uses a second price rule rather than a first price rule that was proposed for the other auction. The rule minimises payments (subject to no

Issue raised	Comments	Ofcom response
	on statements made by us regarding: incentives to shade bids- it is not clear that the proposed auction format will reduce such incentives; aggregation risks/ stranded lots – the benefits of the proposed auction format are not unique to it; the threshold problem – there is no evidence that this is reduced compared to other available formats; the complexity for bidders – does not agree that the auction format is relatively straightforward for bidders; and the risks of strategic demand reduction – Ofcom's statement is contradicted by statements made by the original auction designers.	bidder or combination of bidders being willing to pay more) so we expect the incentives to shade to be reduced. Aggregation risk/ stranded lots – while other potential auction formats may also be able to remove these risks, this is the only one of the three candidate auction formats that we considered to do so. Threshold problem – the fact that prices in the primary bid rounds will be set by us rather than bidders should reduce the threshold problem. Complexity for bidders – we stated that the primary bid rounds was relatively straightforward for bidders (not the auction as a whole). We recognised that the supplementary bids round might be complicated but that the challenge should be reduced by the price discovery allowed by the primary bid rounds. Risks of strategic demand reduction - The use of specific lots in this auction means that it is harder for bidders to benefit from strategic demand reduction than it would be with generic lots. Therefore we consider that it is likely to be less of a concern in this auction than in auctions with generic lots. We do not expect the combinatorial clock auction design to solve all of potential issues with spectrum auctions and have not claimed that is does. However we think that overall for the reasons given in various documents this auction design is more likely than the other candidate auction designs to lead to an efficient outcome for this award.
Auction	One respondent considered that	Different spectrum bands have

Issue raised	Comments	Ofcom response
differences	there were a number of differences in detail between the proposed auction format for this award and the 2.6GHz award which require further explanation.	different characteristics, and so the process for awarding different spectrum bands will also be different. We have set out the reasons for the choices that we have made in the context of each award.
Activity rules	One respondent considered that we should consider using a revealed preference activity rule in place of an eligibility point activity rule.	We are considering the use of such an activity rule in this document and have set out our proposals for what such a rule might look like in Annex 2
Pricing rule	One respondent considered that we should consider replacing the second price rule in the supplementary bids round with a single-round pay-as-bid auction as it is better understood and a second price rule does not eliminate the incentives for insincere bidding and manipulation.	While it may not eliminate the incentives for strategic behaviour a second price rule is more likely to encourage truthful bidding than a pay-as-bid rule as the rule minimises payments (subject to no bidder or combination of bidders being willing to pay more). Therefore it does not force a bidder to shade its bids if it wants to retain any surplus of the economic value to itself.
Links between auction rounds	One respondent considered that we need to provide further clarity of whether the prices to be paid will be linked to the revenues in the primary bid rounds.	All of the bids in the primary bid rounds will be taken into account when determining the winning bids and the prices that will be paid.
Auction speed	Arqiva was concerned that the auction should proceed slowly to allow time for internal financial sign off.	We will allow several weeks between the invitation for applications for this award and the award starting to aid internal processes to take place. In addition we will allow an appropriate amount of time between rounds of the auction.
Full combinatorial auction	The BBC wanted us to consider the full range of adjacent packages that could be required in an SMRA with limited packages to see if this was feasible	The award enables bidders to bid for all of the specific packages that they are interested in.
Technical conditions and Code of Practice		
Code of Practice	Five respondents supported our proposal for an Industry Code of Practice to the March 2006 consultation, whereas six feel this could prove difficult.	In light of the comments on the March 2006 consultation we published further consultations in order to define the technical rights of use more clearly. This had the additional effect of making it easier

Issue raised	Comments	Ofcom response
	The BBC, BT and one other respondent feel that if the Industry is unable to agree such a code, then we should be responsible for facilitating, instigating, implementing and enforcing a regulatory code of practise to control adjacent channel interference.	to agree the Code of Practice The licensees will have the ability to determine what the industry code of practise should be so if licensees feel that this should be minimal then they can do so. We will retain the power to impose an engineering coordination procedure if necessary.
Compliance testing	BBC stated concerns about how pfd limits would be measured as measurements are time consuming and difficult in practice so support use of a standardised prediction model.	We have decided to test compliance using modelling rather than measurement.
Power limits	BBC stated a concern about any upper limit on power as may not be the most appropriate technical solution in all cases.	One of the sets of technical licence conditions has no upper limit on power.
Clarity on technical conditions	There was a request in response to the March 2006 consultation document for greater clarity on the technical licence conditions, in particular how they may change as a result of the international discussions on the Maastricht 2002 Special Arrangement.	We have consulted further on the technical licence conditions and have also concluded the international discussions.
Mobile transmitters	A number of respondents (e.g. Arqiva, T Mobile, Intellect) wanted clarity over mobile uplinks.	We will allow mobile transmitters. This issue, is discussed in more detail in Section 5
Site clearance	The BBC stated that we should reconsider the 50W ERP power level below which site clearances are not required as it could cause interference.	As discussed in Section 5 since that comment was made we have decided that there is no need for site clearance.
Draft regulations	BT wanted to see specific draft regulations explaining how SURs would work in practice.	Both draft regulations and draft licences have been published in parallel with this document.
Code of Practice	Four respondents (Ondas and a number of Delphi companies) felt that there was no need for a new or separate Code of Practice beyond those in the Maastricht and Wiesbaden plans.	The various international agreements are designed to agree international rights of use. The Code of Practice and the technical licence conditions are also designed to manage interference within the UK and so further

Issue raised	Comments	Ofcom response
		conditions beyond those in the international arrangements are needed.
Technical usage rights	ESOA stated there was no guarantee that usage rights can be defined with any certainty.	The usage rights for the spectrum are those in the licences
Adjacent Channel Interference	Three respondents considered that Ofcom and the Industry need to agree guidance for how interference should be managed before the auction takes place. A suggestion by four of the respondents is to take one of the industry standard approaches, use of EIRP Mask, out of band PFD Mask, technical co-ordination or technical standards could be employed depending on circumstances.	We have increased the amount of technical detail that will be included in the licence and also separated licensees that have different technical conditions in their licenses.
Packaging		
Packaging of the upper 12.5 MHz	A large number of respondents agreed that the upper part 12.5 MHz of available spectrum should be awarded as one lot. National Grid Wireless Ltd stated that the upper 12.5 MHz should be awarded in 1.7 MHz blocks. Therefore ensuring that the spectrum was available on the basis of equal opportunity for terrestrial, satellite-only or hybrid networks.	When choosing the most appropriate way to package spectrum we seek to ensure that the package is suitable for the most likely uses without excluding other uses. In this case satellite is the most likely use and a single block does not exclude other uses We will be awarding the top 12.5 MHz as a single block of spectrum
Packaging	The BBC suggests the 'Embryonic' idea to aid the market to decide on the optimal packaging approach through a pre-bid phase. A combination of four T-DAB blocks to form a 6.848 MHz DVB-H block in the L-Band is proposed by Nokia to make it possible to share L-Band between services.	The auction design will allow bidders to bid for the specific packages of 1.7 MHz blocks that they choose.
Packaging of the lower 27.5 MHz	Eleven of the responders feel the lower 27.5 MHz should be Packaged in 1.7MHz lots (Option A). Qualcomm preferred Option B, packaging in 5 x 5.1 MHz lots with one remaining 1.7 MHz lot.	We have decided to package the spectrum as in Option A, i.e. individual 1.7 MHz blocks. This will be in accordance with the Wiesbaden and Maastricht agreements.

Issue raised	Comments	Ofcom response
	ASMS went with the opinion of varied sized lots (Option C) whereas Vodafone preferred option D, packaged as one 27.5 MHz lot. Two respondents feel that all four of the packaging options have certain drawbacks. Picking anyone of these four may favour one technology over another and therefore not meet Ofcom's aim of technology neutrality. It is Ofcom's duty to select the optimal packaging approach leading into the auction based on the best economic advice it has reached from its consultants. Five of the respondents said the packaging should be assigned in accordance with the Wiesbaden and Maastricht agreements. National Grid Wireless UK state that if the auction results in the spectrum being released in an overly fragmented manner, there would be a risk of market failure.	The auction design will allow bidders to explicitly only bid for blocks of the size that they want so if bidder only want blocks of e.g. 5.1 MHz or 27.5 MHz then they are able to only bid for those We consider that the packaging and auction design together will lead to an efficient allocation of spectrum The spectrum will be assigned in a way that is determined through the award process, therefore if it is assigned in a way that some stakeholder consider to be "fragmented" that will be as an outcome of a market led process that will be most likely to lead to an efficient allocation of spectrum.
Other issues		
Suitable Technologies	Arqiva and the BBC believe there are a limited range of suitable technologies for the spectrum.	The spectrum is to be awarded on a fully tradable, service and technology neutral basis, this will create the possibility for it to be used for a range of technologies both now and in the future.
Issues relating to bands outside of 1452 – 1492 MHz	BT believes we must clarify our intention with regard to Channel 36 spectrum. BT and O2 feel further information is required on 2 GHz MSS bands for similar services that maybe deployed in the 1452 – 1492 MHz band. Three respondents believe proposals and timetable for award of released UHF band IV/V should be clarified as soon as possible and in advance of the LBand award. Mecel feels that in order to facilitate the early introduction of new multimedia applications we should instead invite applications for use of the 2010 – 2025 MHz band and vacant parts of the 2500 – 2690 MHz band.	We will provide as much information as possible regarding other spectrum awards, however given that a strong demand has been expressed to allow this spectrum to be made available as soon as possible, We do not believe that this should be a reason to delay the award. Moreover we have already made available detailed information relating to the award of 2500-2690 MHz and plan to make available as much information as possible relating to Channel 36 before the award, in particular in the DDR statement planned before the end of 2007.

Issue raised	Comments	Ofcom response
Existing Users	Existing Fixed Links users want additional time to vacate their services. Two respondents feel that protection from interference should be given to existing users.	We have considered if any existing users should be given the right to continue to use the band and all fixed links users have been given an extension to 31 December 2007, while a few specific users have been given an extension no later than December 2008.
Existing 1.5 GHz Links	Three respondents believe that we should state whether existing 1.5 GHz links in this band have had their entries in the ITU master frequency register maintained.	The UK does not have fixed links registered in the ITU master register
Preclude DAB Services	EMAP, Intellect and WorldSpace felt that the award process should not preclude DAB applications. Digital One wanted us to "consider the importance of ensuring that all local and Community radio stations are given the opportunity to broadcast digitally in the future and this L-Band spectrum may provide the last platform for them to do so".	The award process will be service and technology neutral and the packaging will not exclude DAB applications. . We have not seen any evidence to suggest that we should intervene in the award of this spectrum to support local or community radio stations.
Spreading of the payment.	Intellect, Intelsat and Nokia proposes consideration is given to spreading payment in order to maximise the number of bidders, therefore enhancing competition.	It is not clear that there are problems with the capital markets that would mean that organisations would find it not possible to obtain the funding that they needed.
Policy Regime	Two respondents are concerned that we are proposing to auction this spectrum whilst aspects of the policy regime that will apply to the new licensees will remain uncertain.	The terms that will be included in the licence will be the terms that licensees will be expected to follow.
Timing of the award	Six respondents agree that all of the Spectrum should be awarded as soon as practically possible and see no obvious reason why both parts of the band should not be awarded simultaneously. However, ASMS, ANFR and Digital One do not agree that the entire spectrum 1452 – 1492 MHz should be awarded at the same time and as soon as practically possible. Two respondents believe that the timing of the auction is highly	The award is planned to take place as soon as possible, the delays so far have been due to the uncertainty that has arisen due to prospective international decisions, however these have now been resolved.

Issue raised	Comments	Ofcom response
	dependant on us securing International agreement to a more flexible approach. Therefore, as stated by Intellect, any initiative to progress International agreement in advance of an auction would be welcomed. Nokia suggested it would be better to defer the auction to allow negotiations to reach a more stable point.	
Licence term	One respondent wanted further reasoning and consultation for the minimum licence terms.	The basis for proposing a 15 year minimum term was based on the modelling of a number of business cases for deploying various technologies. The consultation was designed to understand if there were any reasons why 15 years may not be appropriate and no reasons were given for why it would not be appropriate but no reasons were put forward so there has been no basis to consider that this was incorrect.
Hoarding	Digital One and EMAP suggest a Use it or lose it clause to ensure that corporations do not get licences and then not utilise the capacity.	We consulted on the issue of inefficient hoarding in the July 2007 consultation and the reasons for not including licence condition relating to this.
Principles and general approach	One respondent felt that we should consult on the principles and approach that it would apply to various issues related to the award (e.g. competition, auction design etc).	The March 2006 consultation document included a discussion of "Ofcom's duties and functions" in relation to this award as Section 3 and a discussion of "Ofcom's objective's and proposed approach to the award" as Section 4. Both of these sections were put forward for consultation.
Refunds and compensation	ESOA stated that there would be no refund if the spectrum was unusable and that there would be no right of compensation if licence holders suffered disruption or consequential loss.	A licensee will have the rights to use the spectrum within the conditions laid out in their licence which are made clear at the time of the award. It is not clear why there would be any basis for a refund or compensation.
Competition risk	Nokia stated that there may be a competition risk if a single bidder acquired all of the spectrum.	We consider that for this band there are reasons why one bidder may need to use all of this spectrum to provide a service. In

Issue raised	Comments	Ofcom response
		addition there are a number of other bands that are available that can be used to provide similar services. So, we believe that the costs of including specific conditions in this award to address competition concerns to complement those that are already available to us outweigh any benefits.
Commercial viability	National Grid Wireless stated that they felt that there should be a minimum requirement that all bidders have a commercially viable business plan.	We believe that the most efficient use of this spectrum will be achieved by using a market led approach and imposing the minimum constraints on applicants. As a result we do not believe that creating additional application burdens through our validation of a business plan is necessary in this award.

Annex 2

Description of a relaxed revealed preference activity rule

Introduction

A2.1 The March 2006 consultation document, the February 2007 discussion document and the July 2007 consultation document each envisaged the use of an eligibility points activity rule in the proposed auction design. This is the activity rule which is also proposed in Section 4 of this document as well as the associated Information Memorandum and the draft Regulations. However, we have received comments from stakeholders, both in the context of this spectrum award and others, that the proposed eligibility points activity rule might lead to an inefficient outcome of the auction. In light of these comments and further work undertaken by us, we are considering whether a "relaxed revealed preference" activity rule would better help us meet our duty of securing optimal use of the available spectrum.

A2.2 This Annex discusses revealed preference activity rules in general terms, then sets out what a relaxed revealed preference activity rule might look like in the context of the 1452-1492 MHz spectrum award.

Revealed preference activity rules

A2.3 Revealed preference is a process by which a bidder would, as the auction proceeds, reveal which combination of lots it prefers, at the given relative prevailing prices, in preference to all of the other available combination of lots. In the context of an auction activity rule, what this would do is limit the ability of a bidder to change its relative valuations of different combinations of lots as the auction progresses.

A2.4 In a strict form, a revealed preference activity rule would prevent a bidder from bidding on a combination of lots at a price which was inconsistent with its bidding behaviour in a previous round of the auction. A bidder would, in each and every round, have to bid in a manner consistent with its bidding behaviour in earlier rounds. If a bidder revealed in one round that it preferred combination of lots A to combination of lots B when combinations of lots A was £10,000 more expensive than combination of lots B that bidder could not in a later round bid on combination of lots B unless it was less than £10,000 less expensive than combination of lots A.

A2.5 In the context of an auction where it might be expected that a bidder's relative valuation of different combinations of lots may change (for example there exists significant common value uncertainty) such a strict form of a revealed preference activity rule is probably not desirable. This is because such a strict form of the activity rule would prevent a bidder from updating its relative valuations of different combinations of lots in light of information revealed as the auction progresses. Therefore, in such circumstances it is desirable to consider a revealed preference activity rule which has a more relaxed constraint on a bidder's behaviour through the auction.

A relaxed revealed preference activity rule

A2.6 A relaxed revealed preference activity rule would allow a bidder to revise its relative valuation of combinations of lots as the auction progresses. However, in doing this, the activity rule cannot be "too relaxed" as this would risk allowing a bidder to hide its true relative valuation of combinations of lots which could potentially undermine the efficiency of the auction process. Therefore, a relaxed revealed preference activity rule would need to strike an appropriate balance between giving a bidder flexibility to reflect its change in relative valuations between combinations of lots in light of information from the auction and not providing so much flexibility that a bidder could manipulate the auction design such that the efficiency of the auction is undermined.

A2.7 In broad terms there are two main (potentially interacting) ways in which the activity rule can be relaxed. One is the amount by which a bidder can revise its relative valuation of combinations of lots as the auction progresses and the other is for how many rounds of the auction previous bidding behaviour is taken into account. Under the strict form of a revealed preference activity rule a bidder can only revise its relative valuations of a combination of lots in a way which is strictly consistent with all previous bids made in all proceeding rounds of the auction.

A possible relaxed revealed preference activity rule for the 1492-1492 MHz award

Constraint on bids in the first primary bid round

A2.8 A bidder's eligibility to bid in the first primary bid round of the 1452-1492 MHz award would be the same as that proposed for the eligibility rule activity rule. Eligibility would be determined by reference to the amount that each bidder has on deposit with us at the specified time prior to the start of the first primary bid round, with each whole £50,000 on deposit equating to one eligibility point.

Constraint on bids in subsequent primary bid rounds

A2.9 Our proposal for a revealed preference activity rule in the award would be for a relaxed form of the activity rule. The rule would be relaxed such that:

i) only a bidder's bid in the immediately proceeding primary bid round would be taken into account when considering whether the rule had been met; and

ii) the amount which the bidder was seeking to bid on the alternative combination of lots would have to have not increased by "too much more" than the amount by which the price of the combination of lots on which it bid in the previous round had increased by.

A2.10 The "too much more" relaxation parameter in bullet ii) above would be announced by the auctioneer proceeding each primary bid round.

A2.11 This form of relaxed revealed preference activity rule has two attractive characteristics which are not present in the more constrained form of the activity rule:

i) because a bidder is only constrained by its bid in the immediately proceeding primary bid round the bidder is always able to bid on the same combination of

lots in the next round (although noting that this may not necessarily be the optimal bidding strategy); and

ii) if the bidder bids consistently in each primary bid round for its most preferred combination of lots (and its relative valuations of different combinations of lots do not change more quickly than is permitted by the relaxation factor in each round) it will always be able to bid for its most preferred combination of lots in every primary bid round.

Constraints on bids in the supplementary bids round

A2.12 All supplementary bids must exceed the sum of the reserve prices for the component lots within the package.

A2.13 In addition, all supplementary bids must satisfy the following condition:

$$b(x) \leq B(x_t) + (x - x_t).p_t + \max [e_t.|(x - x_t).p_t|, q_t.B(x_t)]$$

Where:

- b(x) is the amount of the supplementary bid for the package, x;
- x_t is the package that the bidder bid on in primary bid round t;
- $B(x_t)$ is the highest principal stage bid made by the bidder for package x_t, including all primary round bids and any supplementary bid for this package;
- $(x - x_t).p_t$ is the difference in price between package x and package x_t in round t.
- e_t (≥ 0) is the first supplementary bids round relaxation factor for primary bid round t (announced before the start of the supplementary bids round);
- q_t (≥ 0) is the second supplementary bids round relaxation for primary bid round t (announced before the start of the supplementary bids round); and
- | . | is the modulus (or absolute value).

A2.14 The two supplementary round relaxation parameters, e_t and q_t, will be set by the auctioneer.

Annex 3

Regulatory Impact Assessment

Introduction

A3.1 In accordance with government practice, where a statutory regulation is proposed, a Regulatory Impact Assessment (RIA) must be undertaken. The analysis presented in this Annex represents a Regulatory Impact assessment, as defined in section 7 of the Communications Act 2003 (the "2003 Act").

A3.2 The issues raised in this RIA are discussed in other parts of this document and this RIA should be read together with the rest of this document.

A3.3 RIAs provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policymaking. This is reflected in section 7 of the 2003 Act, which means that generally we will carry out impact assessments where proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in our activities. However, as a matter of policy we are committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. In accordance with section 7 of the 2003 Act, in producing this RIA, we have had regard to such general guidance as it considers appropriate including related to Cabinet Office guidance. For further information about our approach to impact assessments, see the guidelines, "Better policy-making: Ofcom's approach to impact assessment", which are on our website: http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf

The issue being considered and the citizen/ consumer interest

A3.4 This statement concerns the award of the 1452-1492 MHz band of spectrum, including different options for packaging the spectrum and the design of the award process. This band of spectrum could potentially be used to support a wide variety of end uses, a number of which could have the potential to create substantial benefits for citizens/ consumers. As we set out previously in our spectrum framework review documents, our view is that in general, citizen and consumer interests in relation to the allocation of spectrum are best served through leaving decisions about spectrum use to the market.

The policy objective

A3.5 We have 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 these principal duties we are required to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum[22]. Therefore, the objective of the policy is to award the available spectrum in such a way as to maximum the likelihood that we will secure optimal use of the spectrum.

[22] Ofcom's duties relevant to the award of this spectrum are set out in detail in Section 3 of the March 2006 consultation.

Identification and assessment of options and the impacts on stakeholders

Licence exemption

A3.6 We could allocate this spectrum on a licence exempt basis or with licences. The options are considered in the table below.

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. The high probability of interference is likely to depress the value that can be generated from licence exempt use of this spectrum.

Choice of assignment mechanism

A3.7 We could allocate this spectrum in a variety of ways that can be grouped in three ways, auction, “first come, first served” and comparative selection. The options are considered below.

Option	Advantages	Disadvantages
Auction	Clear and simple criteria for identifying winning bids. Open, transparent, and non-discriminatory. Most likely to lead to an efficient outcome.	Transaction and participation cost may be incurred by bidders.
Comparative selection		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 applicant able to use it to maximum advantage.
“First come, first served”		Appropriate where supply exceeds demand. In this case the market assessment suggests that this will not be the case.

Technology and service neutrality

A3.8 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. The potential efficiency of the auction is maximised by allowing bidders the option of using the technology and service that they prefer. 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. Consistent with the framework directive. 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. In certain circumstances, may assist in facilitating international harmonisation of equipment (though this can also be achieved by less intrusive means).	Requires us to choose one or more technologies or services. Could result in a sub optimal choice of technology or services. Could exclude technologies or services that may provide greater benefits than the chosen technologies or services.

Packaging options

A3.9 Given the varying constraints on the use of different parts of this band. We have looked at the packaging options for two different sub-bands, namely:

- Lower 27.5MHz (1452 – 1479.5MHz); and
- Upper 12.5MHz (1479.5 – 1492MHz)

Overview of packaging options for lower 27.5 MHz

A3.10 We have 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.

Option	Advantages	Disadvantages
Option A: package in 1.7 MHz lots	Promotes competition. Different interference constraints between lots are made explicit. Market can determine optimum aggregation. Maximum accommodation of alternative uses.	Aggregation risk for users requiring larger amounts of spectrum (may be mitigated through appropriate auction design). Sub-optimal outcomes would need to be resolved in the secondary market. 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. 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. Risk of regulatory failure through picking the sub-optimal package size. 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. 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. Minimal Ofcom involvement.	Spectrum may be allocated inefficiently and relies on an efficient secondary market (which at present is unlikely). Potentially restricts the development of competition and variety of applications

Award options for the upper 12.5 MHz

A3.11 In light of the international constraints that have been identified there are three 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); and
- Award it separately from the lower blocks

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. 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. This approach would not allow complementarity and substitutability of upper 12.5MHz and lower 27.5MHz to be addressed through the award process. 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. It would require individual nations to carry out a separate terrestrial awards for the use of the spectrum, in addition to a pan-European satellite award.

Option	Advantages	Disadvantages
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. It would also be quicker and administratively cheaper than holding a separate auction for the upper 12.5 MHz block. It would be consistent with awarding spectrum rights on a technology and usage-neutral basis. 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. 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. It will be administratively more expensive than a simultaneous award process.

Geographic packaging

A3.12 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. 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 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 A regional auction may be more complex and costly than a national auction. Co-ordination with neighbours along regional boundaries could waste spectrum and limit the viability of service provision along these boundaries.

Auction design options

A3.13 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; and
- Package (combinatorial) bidding.

A3.14 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. Most bidders are likely to bid for multiple lots, meaning the lots are complementary. 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. 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. 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. Reduces risks of stranded lots where bidders are left with unwanted lots at the end of the auction. 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).

Choice of specific auction format

A3.15 Three candidate SMRA auction formats were considered in detail they were:

- The SMRA auction with augmented switching rules ("augmented switching");
- The SMRA auction with limited package bidding ("limited package"; and
- The combinatorial clock auction ("combinatorial clock").

A3.16 The advantages and disadvantages of these three auction designs are considered against six criteria in the table below. Those criteria are:

- Bid shading:
- Aggregation risk/ stranded lots;
- Threshold problem;
- Complexity for bidders;
- Unsold lots; and
- Strategic demand reduction.

Bid shading	
Augmented switching	Bid shading is likely. This is particularly true where there is a risk of stranded lots (see below). With such a risk, bidders bid more cautiously than they would otherwise do in attempt to avoid being stranded with unwanted lots.
Limited package	Bid shading is possible. This is particularly so where bidders are seeking packages of lots that do not equate with the pre-specified package of 5.1 MHz. This is for the same reason as with a SMRA with augmented switching rules and the risk that bidders will be stranded with unwanted lots.
Combinatorial clock	This auction format should reduce any incentive for a bidder to shade its bids compared to the other candidate formats. This is because the calculation of the price that winning bidders pay will minimise payments, subject to the condition that no losing bidder or combination of bidders (including combinations of losing and winning bidders) would, on the basis of their bids, be willing to pay more. It may be that some incentive to shade bids will remain, but this incentive is likely to be weak.
Aggregation risk/ stranded lots	
Augmented switching	While augmented switching rules can mitigate aggregation risks, there remains a risk of stranded lots with this auction format. The ability of bidders to switch away from lots as prices increase mean that bidders seeking packages of lots risk being stranded with a subset of the lots on which they were bidding when the auction ends.
Limited package	By pre-packaging lots, this auction format reduces aggregation risks for bidders, removing them completely for those bidders seeking 5.1 MHz of spectrum. However, risks remain for those bidders seeking different sized packages.

Combinatorial clock	All package bids are mutually exclusive. This means that bidders will only face the possibility of winning packages that they have explicitly bid for and as such, as long as bidders bid truthfully, there is no aggregation risk for bidders or a risk of being stranded with unwanted lots.
Threshold problem	
Augmented switching	The threshold problem does not arise with this auction format because there are no package bids.
Limited package	The threshold problem could be prominent in this auction format, particularly if there is demand for single lots from some bidders and these bidders are seeking to outbid those bidders seeking 5.1 MHz packages.
Combinatorial clock	Clock auctions can help small bidders to co-ordinate their bids where there is a threshold problem. However, to the extent there is demand for small packages of lots (including single lots), the threshold problem will to some extent remain.
Complexity for bidders	
Augmented switching	This auction format would be complex for bidders. While the mechanics of bidding are quite simple and this is a variation on the widely used SMRA format, bidders will need to manage the process of switching bids across multiple lots and reconcile their own demand with that of other bidders. Further, there may be scope for strategic behaviour by bidders, which could distort outcomes (although activity rules can go someway to mitigate this risk).
Limited package	This auction format should be relatively straightforward for bidders. Bidders will interact with a relatively straightforward bidding tool and will be able to express demand for specific lots, shifting demand in response to changes in relative prices. However, as prices will be calculated using an algorithm, the calculation of these prices may not be transparent.
Combinatorial clock	The clock stage would be relatively straightforward for bidders, who would be able to bid on a mutually exclusive basis on packages of lots in each round of the clock stage. Moreover, whilst bidders may need to submit supplementary bids for a number of packages, the challenge of doing this should be reduced by the price discovery which the clock stage should provide.
Unsold lots	
Augmented switching	As there is an aggregation risk and a risk of stranded lots with this auction format, there will also be a risk of unsold lots. However, this risk can be reduced by the design of the switching rules, although reducing the risk of unsold lots will increase the risk of stranded lots as the risk would be shifted from the auctioneer to the bidders.
Limited package	There would remain some risk of unsold lots with this auction format.
Combinatorial	There is unlikely to be unsold lots with this auction format as all bids are

clock	mutually exclusive and bids from the clock stage carry through to the best and final offers stage. The risk of unsold lots will be greater where there is a lack of competition.
Strategic demand reduction	
Augmented switching	The risk of strategic demand reduction exists with this auction format, although because prices will not necessarily be uniform across lots, then there is a reduction in the incentive for bidders to strategically reduce demand, so may not be that relevant.
Limited package	There is also a risk of strategic demand reduction with this auction format, although again because prices will not necessarily be uniform across lots there is a reduction in the incentive for bidders to strategically reduce demand, so may not be that relevant.
Combinatorial clock	As prices are not required to be uniform across lots in this auction design, strategic demand reduction is unlikely to be of concern with this auction format.

Costs to Ofcom

A3.17 The costs of our decision to award the licences relate mainly to the costs of carrying out the award process. The administrative costs of the award process should be small in relation to the benefit generated to the economy and the award process is very unlikely to have a negative financial impact.

Business sectors affected

A3.18 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.

A3.19 Other business sectors may benefit from a more efficient supply of communications services as a result of this proposal.

Conclusions

A3.20 Having considered the advantages and disadvantages of the options, and in light of all of the responses to the consultation, we have concluded that:

- The spectrum should be licensed rather than licence exempted:
- The spectrum should be awarded using an auction mechanism;
- It should take a technology and service neutral approach;
- The lower 27.5 MHz should be packaged as individual lots each of approximately 1.7 MHz;
- The upper 12.5 MHz of spectrum should be packaged as a single lot;

- The upper 12.5 MHz of spectrum should be awarded simultaneously with the lower 27.5 MHz;
- All of this spectrum should be awarded on a UK wide basis (subject to any international restrictions);
- A simultaneous, multiple round ascending auction process that allows combinatorial bidding should be used to award this spectrum;
- It is appropriate to use specific lots rather than generic lots; and
- The most appropriate SMRA auction format to use is the combinatorial clock auction format.

Inefficient hoarding of spectrum

Background

A3.21 Concerns have been raised in relation to the 1452-1492 MHz award specifically and our spectrum awards more generally on the issue of inefficient hoarding of spectrum by successful bidders. In light of these concerns, we have considered whether, in order to help secure the optimal use of spectrum, it would be appropriate for us to retain the power to revoke the licences to be awarded in the circumstances where there was inefficient hoarding of the spectrum, even if this was within the initial 15 year period.

A3.22 Our general view, set out in the Spectrum Framework Review: Implementation Plan (SFR:IP)[23], is that the market is best placed to secure the optimal use of the spectrum. Moreover, we expect that the market will generally ensure that spectrum is put to good use, as an input to providing services for end-users. As such, we do not expect that spectrum will be left idle or be under-utilised for long periods of time if it is efficient to do so (we recognises that there are legitimate circumstances in which it can be appropriate for spectrum to be left idle or be under-utilised and that this can be beneficial).

A3.23 However some parties have expressed the view that we could fail to meet our statutory duties to secure the optimal use of the spectrum in the event that the 1452-1492 MHz spectrum (and by implication spectrum being awarded in other valuable spectrum bands) is bought by a bidder that is not interested in providing services using the spectrum, but is interested in holding the spectrum for a significant period of time, with the intention of then selling it on the secondary market at a significant profit. If such speculative behaviour were to occur, some have argued that this may not be in the best interests of citizens and consumers.

Proposal

A3.24 This RIA refers to the proposal not to include a licence condition to address inefficient hoarding concerns in the 1452-1492 MHz spectrum award.

The citizen and/or consumer interest

A3.25 If spectrum is left unused then it will not be being used to deliver services that could provide benefits to consumers. However in some cases it may be beneficial for a

[23] http://www.ofcom.org.uk/consult/condocs/sfrip/sfip/sfr-plan.pdf

licensee to choose to leave spectrum unused for a period of time (e.g. while it rolls out a network) and where the service that is ultimately deployed will provide a greater benefit to consumers.

A3.26 As discussed further below, the introduction of a licence condition to address inefficient hoarding concerns would create uncertainty which may mean that services that consumers value (e.g. Mobile TV) may be delayed.

Ofcom's policy objective

A3.27 We have a number of duties and functions that are relevant to the award of this spectrum and these are summarised in Section 3 of an earlier consultation[24] on 1452-1492 MHz band. With respect to this proposal our key policy objective is to secure the optimal use of spectrum.

Options considered

A3.28 The key options open to us are as follows:

- To include a licence condition to address inefficient hoarding concerns in the 1452-1492 MHz spectrum award; or
- Not to include a licence condition to address inefficient hoarding concerns in the 1452-1492 MHz spectrum award.

Analysis of the different options

Potential benefits of the inclusion of such a condition in 1452-1492 MHz licences

A3.29 Such a condition would maintain our power to intervene in specific circumstances to address inefficient hoarding of spectrum, where this was found to be a concern.

Potential costs of the inclusion of such a condition in 1452-1492 MHz licences

A3.30 While the potential benefits of the inclusion of such a condition are straightforward there are also costs associated with such a condition that may lead to an inefficient use of spectrum.

A3.31 The most significant concern is the introduction of regulatory uncertainty; particularly that the inclusion of such a condition will likely introduce significant uncertainty for all bidders, including those that intend to make productive and immediate use of the spectrum. Such uncertainty will increase the risks faced by bidders and likely introduce barriers to potential bidders raising capital. As a result the likelihood of the spectrum being put to efficient use is reduced.

A3.32 A specific consequence of the uncertainty that would likely be created in this award is that it could reduce the likelihood of some services being deployed. The indication that we have received from stakeholders is that the business case for some services is very uncertain. Any increase in the risk associated with the acquisition of this spectrum could quite easily tip the balance against the business case for the deployment of particular services in the UK. We intend this spectrum award to be service and technology neutral therefore any condition that could discourage particular services would need to have a strong justification.

[24] http://www.ofcom.org.uk/consult/condocs/sfrip/sfip/sfr-plan.pdf

A3.33 For example there are some indications from stakeholders that the decision to deploy mobile TV in the 1452-1492 MHz spectrum band may be marginal due to relatively high costs of rolling out a network compared to the comparative costs in the UHF spectrum bands. Introducing a condition that could potentially address inefficient hoarding may lead to a situation where operators choose not to seek to deploy Mobile TV services in 1452-1492 MHz spectrum, preferring to wait until UHF spectrum becomes available.

A3.34 In addition the condition would prohibit behaviour which may be entirely economically rational. Speculative behaviour by financial institutions in asset and commodity markets can provide liquidity to secondary markets and they are often better placed than other potential bidders to manage risks, including the risks associated with market uncertainties. Therefore, regardless of the precise nature of a condition, any prohibition on such institutions playing this role in spectrum markets might jeopardise the efficiency of the markets.

Costs to Ofcom

A3.35 Not including such a condition will have no additional cost to us.

Business sectors affected

A3.36 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.

A3.37 Other business sectors may benefit from a more efficient supply of communications services as a result of this proposal.

Conclusion

A3.38 After weighing up the costs and benefits, we consider that it would not be appropriate to include such a condition within the WT Act licence(s) to be awarded for the 1452-1492 MHz band. For the avoidance of doubt, if such a licence condition were not included then we would not have the power to intervene in cases of inefficient spectrum hoarding. However this would not affect our other statutory powers, including those to address anti-competitive behaviour.

Annex 4

Propagation and Compliance Modelling

A4.1 In the consultation published in July 2007 we proposed that modelling (of the network under consideration) be used for compliance testing using ITU-R Recommendation P.1546 – 3 with appropriate terrain and clutter databases. This proposal was generally agreed by stakeholders, however, some expressed concerns with the proposed model and highlighted that the terrain and clutter databases are vital to provide accurate modelling and therefore have to be readily available and fit for purpose. In order to address the issues raised we carried out further analysis and held discussions with stakeholders. The outcome of this work is summarised below.

A4.2 Several respondents to the July 2007 consultation expressed concerns regarding the choice of the propagation model. After further analysis and discussions we are of the opinion that ITU-R Recommendation P.1546 is the most suitable general point-to-area prediction model for the purpose in hand.

A4.3 We acknowledge that at the time of the consultation Rec P.1546-3 had not been approved and was still a draft revised Recommendation. However, it was felt unlikely that any objections would be received, and that the draft Recommendation would be approved before the award of the band 1452 – 1492 MHz. It should be noted that ITU-R P.1546-3 came into force in November 2007.

A4.4 We will use the Ordnance Survey “Panorama DTM” 50 m resolution digital terrain map for the terrain database.

A4.5 At the present time we have not decided on a suitable clutter database, however, a number of suppliers have been identified and we are evaluating the databases to assess which is most suitable. we will map the clutter database categories to those noted Rec P.1546, namely: urban, dense urban, suburban, sea, open. An example of this is given in the table below.

Code	Example Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	Dense urban	Dense Urban	30
2	Urban	Urban	20
3	Industrial	Suburban	10
4	Suburban	Suburban	10
5	Village	Suburban	10
6	Parks/recreation	Open	10
7	Open	Open	10
8	Open in urban	Urban	20
9	Forest	Open	10
10	Water	Sea	10

Table: Mapping of clutter categories

Calculation methodology

A4.6 To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets discussed above.

A4.7 Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those specified for the relevant percentage of locations. For example, -48 dBW/m²/MHz for 95% of pixels within the test area.

A4.8 The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) NGR of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km^2, 4 km^2, 25 km^2, 100 km^2, 400 km^2, 2500 km^2 or 10000 km^2, which includes at least ten transmitters.

A4.9 All test points that occur over a water feature (eg sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

A4.10 The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP equal to or less than 2 Watts per 1.7 MHz.

A4.11 Detailed specification of the methodology is given below:

- **Pixel Size.** The test area will be divided into square pixels of size 50m by 50m.
- **Summation of signals from transmitters**. The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).
- **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

  The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.
- **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.
- **P.1546 location variability.** Field strengths will be predicted for a 50% location variability
- **P.1546 time variability**. Field strengths will be predicted for a 50% time variability

- **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used

- **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in the licence.

- **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories “dense urban”, “urban” or “suburban environment”, equation *27a* of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories “open” or “sea”, equation *27b* shall be used to determine the correction for receiving/mobile height.

- **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

- **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied

- **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation *6* of P.1546, Annex 5 will be used to determine *h1* in all cases. In using this equation the actual value of path length *d* will be used, including cases when *d* is less than 1 km

- **Transmit antenna gain**. The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height.

A4.12 The above method will be detailed on Schedule 2 of the licences, and will be used when assessing compliance with the licence terms. Draft sample licences have been published in Annex 5.

A4.13 We will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.

Annex 5

Draft licences

Draft licence for a high power network
DRAFT LICENCE

Wireless Telegraphy Acts 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 14xx.xxx to 14 xx.xxx MHz Band

Licence no: **[xxxxxx]**

Date: **[date]**

1. The Office of Communications (Ofcom) grants this licence (the "Licence") to

[company name]
Company Reg No: [xxxxxxxx]
(the "Licensee")
[address 1]
[address 2]
[address 3]
[postcode]

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in the Schedule (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 Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the "Act"), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:

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

(b) in accordance with paragraph 8 of this Licence;

(c) if there has been a breach of a term 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 30(1) and (3) of the Act [25];

(e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the **[Wireless Telegraphy (Licence Award) Regulations 2008]** (the "Regulations");

(f) in accordance with Paragraph 8(5) of Schedule 1 to the 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 of the Act 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 this Licence.

4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

[25] These are regulations on spectrum trading.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act[26].

6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee's name and address from that recorded in the Licence.

Fees

7. The licence fee in respect of this Licence is **[£xxxxxx]**, which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.

8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.

9. 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 sections 12 and 32(2) of the Act 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 15 of the Act any such amount and any such interest is recoverable by Ofcom.

10. 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 sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation XX of the Regulations.

Radio Equipment Use

11. The Licensee must ensure that the Radio Equipment is 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.

12. 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.

[26] See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

Access and Inspection

13. The Licensee shall permit a 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

14. A person authorised by Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment 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 breach of a term of the 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.

15. Ofcom may require any of the radio stations or radio apparatus that comprise 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

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

Interpretation

17. 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 8 of the Act; and

(b) the expressions "undue interference", “station for wireless telegraphy” and “apparatus for wireless telegraphy” shall be construed in accordance with section 115 of the Act.

18. 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.

19. 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

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: **[date]**

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxx MHz Band**

1. Description of Radio Equipment Licensed

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. Interface Requirements for the Radio Equipment use

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068[27] for "Spectrum Access in the band 1452 – 1492 MHz band"

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

(a) During the period that this Licence remains in force and for six (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 one hundred (100) metres resolution);

c) antenna height (above ground level) and type, bearing east of true north; and

d) radio frequencies used by the Radio Equipment; and

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

(iii) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

and the Licensee must produce these records if requested by a person authorised by Ofcom.

[27] Available from the Ofcom website at http://www.ofcom.org.uk

(b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.

(c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.

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

(e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

(a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).

(b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.

(c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:

(i) Efficient frequency use of the radio spectrum;

(ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;

(iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;

(iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

(d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.

(e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom

shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

(f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.

(g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must immediately be provided to Ofcom. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is 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 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

(i) 14xx.xxx MHz – 14xx.xx MHz

7. Maximum permissible EIRP

None.

8. Maximum permissible transmitter density

The number of transmitters in any 50km x 50km square centred on the intersection of 1km OS grid lines within the licensed area must not exceed 150.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed -48 dBW/m^2/MHz at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. Permissible Out-of -Block aggregate PFD

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from relevant block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level (dBW/m^2/MHz)
0.0 to 0.2 MHz	-77
0.2 to 0.4 MHz	-101
0.4 to 0.6 MHz	-110
0.6 to 0.8 MHz	-119
0.8 to 1.0 MHz	-127
1.0 to 4.2 MHz	-128

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

Where: Δ_F is the frequency offset from the relevant block edge (in MHz)
The lower block edge being 14xx.xxx MHz
The upper block edge being 14xx.xxx MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km^2, 4 km^2, 25 km^2, 100 km^2, 400 km^2, 2500 km^2 or 10000 km^2, which includes at least ten transmitters.

All test points that occur above a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

(a) "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);

(b) “ERP” means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.

(c) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliWatt (i.e. a value of 0 dBm is 1mW);

(d) “dBW” means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBw is 1 W).

(e) “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.

(f) “Base station” means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.

(g) “Mobile station” means a radio transmitter intended to be used while in motion or during halts at unspecified locations.

(h) “PFD” means power-flux density and is a measure power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units dBW/m^2/MHz.

(i) “aggregate PFD” means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.

(j) “Notified Licensees” means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: **[date]**

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxx MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey "Panorama DTM" 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by [X][28] shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Example Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	**Dense urban**	Dense Urban	30
2	**Urban**	Urban	20
3	**Industrial**	Suburban	10
4	**Suburban**	Suburban	10
5	**Village**	Suburban	10
6	**Parks/recreation**	Open	10
7	**Open**	Open	10
8	**Open in urban**	Urban	20
9	**Forest**	Open	10
10	**Water**	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

[28] At the current time the supplier of a suitable clutter database has yet to be chosen. Ofcom have identified a number of candidates and is undertaking an evaluation of the most suitable supplier. This will be specified in the final resultant licence conditions. Table A1 assumes the database of an example supplier.

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.

b) **Summation of signals from transmitters**. The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).

c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

   The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.

e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability

f) **P.1546 time variability**. Field strengths will be predicted for a 50% time variability**.**

g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.

h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10

i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation *27a* of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation *27b* shall be used to determine the correction for receiving/mobile height.

j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.

l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation *6* of P.1546, Annex 5 will be used to determine *h1* in all cases. In using this equation the actual value of path length *d* will be used, including cases when *d* is less than 1 km.

m) **Transmit antenna gain**. The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. Operational details of transmitting stations

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP equal to or less than 2 Watts per 1.7 MHz. These details may include:

(a) the National Grid Reference to ten (10) metres resolution of each transmitting site;

(b) the height above ground level of each transmitting antenna to an accuracy of 1 metre;

(c) the azimuth of each transmitting antenna on each site;

(d) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);

(e) the down-tilt (physical and electrical) of each transmitting antenna;

(f) Class of Emission of the radiated signal;

(g) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and

(h) the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna.

Draft licence for low power network

DRAFT LICENCE

Wireless Telegraphy Acts 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 14xx.xxx to 14xx.xxx MHz Band

Licence no: **[xxxxxx]**

Date: **[date]**

2. The Office of Communications (Ofcom) grants this licence (the "Licence") to

[company name]
Company Reg No: [xxxxxxxx]
(the "Licensee")
[address 1]
[address 2]
[address 3]
[postcode]

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

Licence Term

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

Licence Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the "Act"), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:

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

(b) in accordance with paragraph 8 of this Licence;

(c) if there has been a breach of a term 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 30(1) and (3) of the Act [29];

(e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the **[Wireless Telegraphy (Licence Award) Regulations 2008]** (the "Regulations");

(f) in accordance with Paragraph 8(5) of Schedule 1 to the 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 of the Act 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 this Licence.

4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act[30].

[29] These are regulations on spectrum trading.
[30] See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee's name and address from that recorded in the Licence.

Fees

7. The licence fee in respect of this Licence is **[£xxxxxx]**, which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.

8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.

9. 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 sections 12 and 32(2) of the Act 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 15 of the Act any such amount and any such interest is recoverable by Ofcom.

10. 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 sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation XX of the Regulations.

Radio Equipment Use

11. The Licensee must ensure that the Radio Equipment is 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.

12. 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

13. The Licensee shall permit a person authorised by Ofcom:

(b) 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

14. A person authorised by Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment 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 breach of a term of the Licence has occurred; and/or

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

15. Ofcom may require any of the radio stations or radio apparatus that comprise 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

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

Interpretation

17. 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 8 of the Act; and

(b) the expressions "undue interference", “station for wireless telegraphy” and “apparatus for wireless telegraphy” shall be construed in accordance with section 115 of the Act.

18. 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.

19. 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

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: **[date]**

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxxMHz Band**

1. Description of Radio Equipment Licensed

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. Interface Requirements for the Radio Equipment use

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068[31] for "Spectrum Access in the band 1452 – 1492 MHz band"

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

(a) During the period that this Licence remains in force and for six (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 one hundred (100) metres resolution);

c) antenna height (above ground level) and type, bearing east of true north; and

d) radio frequencies used by the Radio Equipment; and

(iv) a statement of the number of subscribing customers;

(v) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

[31] Available from the Ofcom website at http://www.ofcom.org.uk

and the Licensee must produce these records if requested by a person authorised by Ofcom.

(b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.

(c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.

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

(e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

(a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).

(b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.

(c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:

(i) Efficient frequency use of the radio spectrum;

(ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;

(iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;

(iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

(d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.

(e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as

required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

(f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.

(g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must immediately be provided to Ofcom. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is 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 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

(i) 14xx.xxx MHz – 14xx.xxx MHz

7. Maximum permissible EIRP

The mean operational EIRP of any transmitter deployed in the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed 6kW within a single 1.7MHz channel.

8. Maximum permissible transmitter density

None.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed -48 dBW/m^2/MHz at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. Permissible Out-of -Block aggregate PFD

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from relevant block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level (dBW/m^2/MHz)
0.0 to 0.2 MHz	-77
0.2 to 0.4 MHz	-101
0.4 to 0.6 MHz	-110
0.6 to 0.8 MHz	-119
0.8 to 1.0 MHz	-127
1.0 to 4.2 MHz	-128

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.
The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

Where: Δ_F is the frequency offset from the relevant block edge (in MHz)
The lower block edge being 1465.8 MHz
The upper block edge being 1467.512 MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km^2, 4 km^2, 25 km^2, 100 km^2, 400 km^2, 2500 km^2 or 10000 km^2, which includes at least ten transmitters.
All test points that occur over a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

(a) "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);

(b) “ERP” means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.

(c) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliWatt (i.e. a value of 0 dBm is 1mW);

(d) “dBW” means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBw is 1 W).

(e) “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.

(f) “Base station” means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.

(g) “Mobile station” means a radio transmitter intended to be used while in motion or during halts at unspecified locations.

(h) “PFD” means power-flux density and is a measure power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units dBW/m^2/MHz.

(i) “aggregate PFD” means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.

(j) “Notified Licensees” means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: **[date]**

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxx MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey "Panorama DTM" 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by [X][32] shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Example Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	**Dense urban**	Dense Urban	30
2	**Urban**	Urban	20
3	**Industrial**	Suburban	10
4	**Suburban**	Suburban	10
5	**Village**	Suburban	10
6	**Parks/recreation**	Open	10
7	**Open**	Open	10
8	**Open in urban**	Urban	20
9	**Forest**	Open	10
10	**Water**	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

[32] At the current time the supplier of a suitable clutter database has yet to be chosen. Ofcom have identified a number of candidates and is undertaking an evaluation of the most suitable supplier. This will be specified in the final resultant licence conditions. Table A1 assumes the database of an example supplier.

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.

b) **Summation of signals from transmitters**. The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).

c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

   The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.

e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability

f) **P.1546 time variability**. Field strengths will be predicted for a 50% time variability**.**

g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.

h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10

i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation *27a* of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation *27b* shall be used to determine the correction for receiving/mobile height.

j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.

l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation *6* of P.1546, Annex 5 will be used to determine *h1* in all cases. In using this equation the actual value of path length *d* will be used, including cases when *d* is less than 1 km.

m) **Transmit antenna gain**. The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. Operational details of transmitting stations

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP equal to or less than 2 Watts per 1.7 MHz. These details may include:

(a) the National Grid Reference to one ten (10) metres resolution of each transmitting site;

(b) the height above ground level of each transmitting antenna to an accuracy of 1 metre;

(c) the azimuth of each transmitting antenna on each site;

(d) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);

(e) the down-tilt (physical and electrical) of each transmitting antenna;

(f) Class of Emission of the radiated signal;

(g) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and

(h) the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna.

Draft licence for 1479.5-1492 MHz

DRAFT LICENCE

Wireless Telegraphy Acts 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 1479.500 to 1492.000 MHz Band

Licence no: **[xxxxxx]**

Date: **[date]**

3. The Office of Communications (Ofcom) grants this licence (the "Licence") to

[company name]
Company Reg No: [xxxxxxxx]
(the "Licensee")
[address 1]
[address 2]
[address 3]
[postcode]

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

Licence Term

4. This Licence shall continue in force until revoked by Ofcom in accordance with Paragraph 3 below or surrendered by the Licensee.

Licence Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the "Act"), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:

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

(b) in accordance with paragraph 8 of this Licence;

(c) if there has been a breach of a term 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 30(1) and (3) of the Act [33];

(e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the **[Wireless Telegraphy (Licence Award) Regulations 2008]** (the "Regulations");

(f) in accordance with Paragraph 8(5) of Schedule 1 to the 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 of the Act 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 this Licence.

4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act[34].

[33] These are regulations on spectrum trading.
[34] See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee's name and address from that recorded in the Licence.

Fees

7. The licence fee in respect of this Licence is **[£xxxxxx]**, which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.

8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.

9. 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 sections 12 and 32(2) of the Act 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 15 of the Act any such amount and any such interest is recoverable by Ofcom.

10. 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 sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation XX of the Regulations.

Radio Equipment Use

11. The Licensee must ensure that the Radio Equipment is 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.

12. 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

13. The Licensee shall permit a person authorised by Ofcom:

(c) 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

14. A person authorised by Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment 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 breach of a term of the Licence has occurred; and/or

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

15. Ofcom may require any of the radio stations or radio apparatus that comprise 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

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

Interpretation

17. 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 8 of the Act; and

(b) the expressions "undue interference", “station for wireless telegraphy” and “apparatus for wireless telegraphy” shall be construed in accordance with section 115 of the Act.

18. 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.

19. 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

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: **[date]**

Licence Category: **Spectrum Access Licence 1479.500 to 1492.000 MHz Band**

1. Description of Radio Equipment Licensed

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. Interface Requirements for the Radio Equipment use

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068[35] for "Spectrum Access in the band 1452 – 1492 MHz band"

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

(a) During the period that this Licence remains in force and for six (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 one hundred (100) metres resolution);

c) antenna height (above ground level) and type, bearing east of true north; and

d) radio frequencies used by the Radio Equipment; and

(vi) a statement of the number of subscribing customers;

(vii) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

[35] Available from the Ofcom website at http://www.ofcom.org.uk

and the Licensee must produce these records if requested by a person authorised by Ofcom.

(b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.

(c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.

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

(e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

(a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).

(b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.

(c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:

(i) Efficient frequency use of the radio spectrum;

(ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;

(iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;

(iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

(d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.

(e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as

required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

(f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.

(g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must immediately be provided to Ofcom. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is 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 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

(i) 1479.500 to 1492.000 MHz

7. Maximum permissible EIRP

None.

8. Maximum permissible transmitter density

None.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed -96.7 dBW/m^2/MHz at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. Permissible Out-of -Block aggregate PFD

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level (dBW/m^2/MHz)
6.250 to 6.000 MHz	-121
6.000 to 5.400 MHz	-120
5.400 to 5.000 MHz	-119
5.000 to 4.600 MHz	-118
4.600 to 4.200 MHz	-117
4.200 to 3.800 MHz	-116
3.800 to 3.400 MHz	-115
3.400 to 3.000 MHz	-114
3.00 to 2.800 MHz	-113
2.800 to 2.600 MHz	-112
2.600 to 2.200 MHz	-111
2.200 to 2.000 MHz	-110
2.000 to 1.800 MHz	-109
1.800 to 1.600 MHz	-108
1.600 to 1.400 MHz	-107
1.400 to 1.200 MHz	-106
1.200 to 1.000 MHz	-105
1.000 to 0.800 MHz	-104
0.800 to 0.600 MHz	-102
0.600 to 0.400 MHz	-101
0.400 to 0.200 MHz	-99
0.200 to 0.000 MHz	-97

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

Where: Δ_F is the frequency offset from the block edge (in MHz)
The lower block edge being 1479.500 MHz
The upper block edge being 1492.000 MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km^2, 4 km^2, 25 km^2, 100 km^2, 400 km^2, 2500 km^2 or 10000 km^2, which includes at least ten transmitters.

All test points that occur over a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

(a) "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);

(b) “ERP” means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.

(c) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliWatt (i.e. a value of 0 dBm is 1mW);

(d) “dBW” means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBw is 1 W).

(e) “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.

(f) “Base station” means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.

(g) “Mobile station” means a radio transmitter intended to be used while in motion or during halts at unspecified locations.

(h) “PFD” means power-flux density and is a measure power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units dBW/m^2/MHz.

(i) “aggregate PFD” means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.

(j) “Notified Licensees” means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: **[date]**

Licence Category: **Spectrum Access Licence 1479.500 to 1492.000 MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey "Panorama DTM" 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by [X][36] shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Example Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	**Dense urban**	Dense Urban	30
2	**Urban**	Urban	20
3	**Industrial**	Suburban	10
4	**Suburban**	Suburban	10
5	**Village**	Suburban	10
6	**Parks/recreation**	Open	10
7	**Open**	Open	10
8	**Open in urban**	Urban	20
9	**Forest**	Open	10
10	**Water**	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

[36] At the current time the supplier of a suitable clutter database has yet to be chosen. Ofcom have identified a number of candidates and is undertaking an evaluation of the most suitable supplier. This will be specified in the final resultant licence conditions. Table A1 assumes the database of an example supplier.

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.

b) **Summation of signals from transmitters**. The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).

c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

   The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.

e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability

f) **P.1546 time variability**. Field strengths will be predicted for a 50% time variability**.**

g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.

h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10

i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation *27a* of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation *27b* shall be used to determine the correction for receiving/mobile height.

j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.

l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation *6* of P.1546, Annex 5 will be used to determine *h1* in all cases. In using this equation the actual value of path length *d* will be used, including cases when *d* is less than 1 km.

m) **Transmit antenna gain**. The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. Operational details of transmitting stations

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP equal to or less than 2 Watts per 1.7 MHz. These details may include:

(i) the National Grid Reference to ten (10) metres resolution of each transmitting site;

(j) the height above ground level of each transmitting antenna to an accuracy of 1 metre;

(k) the azimuth of each transmitting antenna on each site;

(l) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);

(m) the down-tilt (physical and electrical) of each transmitting antenna;

(n) Class of Emission of the radiated signal;

(o) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and

the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna