OFFICE OF COMMUNICATIONS

Award of available spectrum: 412-414 MHz paired with 422-424 MHz

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

Statement

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Contents

Section 1

Executive summary

1.1 Ofcom's Spectrum Framework Review: Implementation Plan ('SFR: IP')[1], issued on 13 January 2005, included provisional proposals for awarding a wireless telegraphy licence with rights to use the spectrum available in the band 410-415 MHz paired with 420-425 MHz. The spectrum available for award in the band was subsequently modified following discussions with MOD and Ofcom's decision to make spectrum available in exceptional circumstances for the emergency services. (The emergency services have been assigned 410-412 MHz paired with 420-422 MHz and the remaining one MHz pair (414-415 MHz/424-425 MHz) will be for defence use under MOD's management.) As a result, the band 412-414 MHz paired with 422-424 MHz ('the Band') is now being made available for commercial use. This band is the subject of the award process covered by this document.

1.2 Following consideration of the responses to the proposals in the SFR:IP, Ofcom published, on 13 October 2005, a consultation document setting out its detailed proposals for awarding a wireless telegraphy licence to use the Band (the "October Consultation"). It has now considered carefully the responses received to that consultation, the feedback it received during a public seminar held on 7 November 2005 relating to its proposals and a further seminar held on 10 February 2006 at which Ofcom presented its preliminary conclusions in respect of the consultation responses. This statement sets out Ofcom's conclusions on the wide range of matters raised in the October Consultation. Ofcom has decided to amend its proposals in a number of ways, the key ones being:

- the spectrum packaging. The proposal in the October Consultation was for a single UK licence of 2x2 MHz. This has been modified so that four spectrum lots each of 2x500 kHz will be auctioned. Each lot will be for UK coverage.
- the auction design. The auction will be a modification of the proposal in the October Consultation for a single round sealed bid auction. It will be designed to allow bidding for combinations of lots that meet bidders' different requirements. Each winning bidder will be awarded a licence for the combination of lots for which it has submitted a winning bid.

1.3 Ofcom is publishing, at the same time as this statement, the following documents that are also relevant to this award process:

- an Information Memorandum, which sets out relevant information that interested parties should take into account when considering their possible participation in the award process. It includes a description of the spectrum packaging and the auction format and rules; and
- a Notice of Ofcom's proposal to make four statutory instruments in relation to the award process in accordance with sections 394 and 395 of the Communications Act 2003. These statutory instruments include the auction regulations, regulations

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

extending spectrum trading to the band, regulations to allow for publication of the identity and terms of the licences in the band and an order limiting the number of licences in the band.

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

1.5 Ofcom intends to start the award process in mid-2006.

Section 2

Introduction

2.1 This statement sets out Ofcom's decisions on various matters relating to the award of wireless telegraphy licences for the use of the spectrum band 412-414 MHz paired with 422-424 MHz. It sets out various amendments to proposals in the October Consultation document. These have been made following careful consideration of the responses to that consultation. It also takes into account the feedback received at a seminar held on 7 November 2005 at which Ofcom presented its proposals for the award process and a further seminar held on 10 February 2006 at which Ofcom presented its preliminary conclusions in respect of the consultation responses.

2.2 Further details of Ofcom's plans for the award, including application instructions, are given in documents published alongside this Statement, specifically the Information Memorandum and the proposed auction Regulations.

2.3 In the case of conflict or ambiguity between this statement, the Information Memorandum and the proposed auction Regulations, precedence shall be given to each of the following in the order set out below:

- first, the provisions of the auction Regulations;
- second, the Information Memorandum; and
- third, the provisions of this statement.

2.4 Ofcom intends to start the award process in mid-2006.

Overview of responses to the October Consultation

2.5 Ofcom received 14 responses to the October Consultation. A summary of the responses is included in Annex 1. There was some support for the proposal to auction one UK national licence but also a range of suggestions for offering more than one licence. There was no consensus amongst respondents as to the number of licences to be offered, with suggestions ranging from two to six licences. There was concern expressed that auctioning only one licence of 2x2 MHz would make it difficult for small organisations, some business radio users and some users with potentially innovative applications to gain access to the spectrum.

2.6 The transmission rights detailed in the October Consultation document drew a range of comments relating to:

- technology neutrality;
- power limits; and
- the need for clarification of some technical details.

2.7 The proposal to hold an auction for awarding the spectrum was generally supported, though some comments were received by Ofcom on the auction design. Two respondents suggested that a multi-round ascending auction was preferable to a single round sealed bid auction. It was also suggested that a multiple round ascending auction design could be standardised for a variety of future awards. Two

respondents suggested that bidder identities should be published prior to an auction and that this would benefit the auction's efficiency.

2.8 A range of enquiries were received in respect of the Fylingdales co-ordination tool, including requests for information on the assumptions used, the interference budget and reference charts to illustrate the potential for interference from the radar.

2.9 Ofcom's suggestions relating to potential use of the spectrum for a band manager drew a variety of comments. One respondent agreed that Ofcom should make no specific provision for a band manager and another suggested that regulation should be imposed on anyone acting as a band manager to deal with any competition concerns.

2.10 A limited number of respondents expressed concern in relation to other elements of the proposals including:

- one respondent who argued that the Band should be used to facilitate the band reversal of the 450-470 MHz band.
- a small number of respondents who argued that proceeding with the proposals could give rise to undue discrimination against existing licensees.

2.11 Ofcom has carefully considered all the points made. Sections 3 to 5 below and Annex 1 set out its conclusions.

Associated documents

2.12 Ofcom is publishing alongside this statement the following documents:

- The 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 Ofcom's proposal to make four statutory instruments in relation to the award process in accordance with sections 394 and 395 of the Communications Act 2003. 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 17 May 2006.

Document structure

2.13 In addition to the Executive Summary (section 1) and this Introduction (section 2), this statement comprises:

- Section 3 – which considers issues relating to the packaging of the Band;
- Section 4 – which considers the auction format and rules;
- Section 5 – which considers issues relating to wireless telegraphy licence conditions and other spectrum rights and obligations;
- Section 6 – which sets out the next steps for this award process; and
- Annex 1 – which summarises the main points made in the responses to the October consultation.

Section 3

Spectrum packaging

Number of licences

3.1 In the October Consultation Ofcom proposed that one UK licence should be awarded for the Band. In the 14 responses to the October Consultation there was some support for this proposal but a significant number of respondents indicated a preference for the Band to be divided into a number of smaller lots, though there was no consensus on the size or number of these lots.

3.2 Four responses (Airwave, BT, Fleetcom and Ventura) supported the proposal for a single UK licence. Six respondents argued that the Band should be divided into smaller lots of spectrum. AirRadio/Team Simoco believed that a single licence would unfairly discriminate against SMEs, and instead suggested that two to four national licences be made available which could meet both the need for additional UHF spectrum for on-site and wide area business radio and demand from Airwave for additional spectrum. BAA believed that competition and innovation would be better encouraged by awarding more than one licence and expressed a preference for the licences to be allocated on a localised basis. FCS considered that the proposal would effectively exclude on-site users and SMEs and make it too easy for a single entity to create a monopoly and block competing systems or technologies. It proposed awarding a minimum of three different sized spectrum lots, such as 1.5 MHz, 300 kHz and 200 kHz, to take account of diverse needs and stimulate innovation. JRC was concerned that a single licence would fail to promote competition and small innovative companies. It suggested that a number of packages of national channels in differing sized blocks would allow for the existence of both a viable national network and smaller innovative ventures. It recommended that the spectrum should be split into lots such as 2x1.5 MHz plus five lots of 2x100 kHz, with bidders being allowed to bid for up to three of the lots. Another company disagreed with Ofcom's proposal because of concerns over market dominance and the potential for the Band to remain unused. Its preferred approach was to split the Band split into two lots (e.g. 2x1.5 MHz and 2x500 kHz). Another company also preferred dividing the Band into smaller lots and proposed a combinatorial auction to enable bidders to select whether to bid for smaller segments or a combination of them.

3.3 Ofcom has considered carefully these responses and whether the differing requirements represented might be accommodated within the award process (this issue is considered in more detail in the next section). Ofcom considers that it is important not to inhibit the use of the spectrum on a national basis. In the October Consultation it identified no basis for geographic divisions and considered that the award of licences with arbitrary regional boundaries could impede the efficient use of the spectrum and would impose a need for co-ordination between licensees. Ofcom considers that where there are no strong grounds for limiting the geographic scope of licences. Licences should, in general, be for the whole of the UK as this reduces complexity and the risk of error in setting licence boundaries. This approach was generally supported in responses to the consultation where there was a clear desire for national licences.

3.4 Ofcom's main concern has been to explore ways of reconciling the demand for a single licence for the 2x2 MHz available in the Band with the demand for smaller assignments. The award of the Band to a single licensee could support either an operator wishing to employ wideband technology or an organisation wishing to

operate as a band manager. The bandwidth available, together with the technical restrictions needed to protect adjacent users, may make it difficult to use wideband technology but it remains a feasible option and one that was promoted by some interested parties. Ofcom would not want to preclude this possibility.

3.5 The case for a spectrum management organisation (SMO) acquiring the Band is based on catering for the variety of potential uses of the Band and the large number of potential users with varying requirements. Ofcom considers, on the basis of the market analysis provided by independent consultants, that in order to be commercially viable an SMO is likely to need access to at least 2x1 MHz in the Band. Ofcom does not intend to make specific provision for the creation of a band manager but it believes that the award process and wider regulatory framework should allow an organisation wishing to act as a band manager to acquire suitable spectrum and to use it for that purpose.

3.6 Responses to the October Consultation have shown that there is clear demand for spectrum in the Band from users requiring considerably less than the full 2x2 MHz available. Those seeking smaller amounts of spectrum have expressed concern about their ability to do so at reasonable prices through the secondary market in a situation where a single entity acquires the whole 2x2 MHz (whether an SMO or an operator with the intention of offering national services). They wanted the opportunity to acquire rights to a part of the spectrum through the auction. Ofcom has considered how the Band might be divided to meet the various requirements expressed by interested parties in responses and the various suggestions for lots of spectrum. There is no consensus amongst the suggestions received as to a package that would meet all stated requirements. From those responses that offered concrete suggestions there seems to be a need for at least two blocks.

3.7 A way of reconciling the differing requirements for a single licence and a number of smaller licences would be to divide the Band into a number of lots and design an auction that would allow these lots to be awarded either individually or in combination, including acquiring all the lots to form a single national licence. This option was suggested by two respondents.

3.8 Ofcom believes that this approach offers the most suitable way of meeting the range of demands while allowing interested parties, through the auction mechanism, to determine the most appropriate packaging of the Band. In order to avoid over-complicating the auction while providing sufficient latitude for bidders, Ofcom believes a relatively small number of spectrum lots should be offered. This approach would be consistent with many of the responses received to the October Consultation. For the same reason, Ofcom believes that the lots should be of equal size: this will allow bidders not wanting the whole 2x2 MHz to make multiple alternative bids that meet their requirements. Division of the available spectrum into four 2x500 kHz lots will meet these considerations. Although not meeting all demands identified in responses this could satisfy many of them, including a single paired national block, and blocks of 2x500 kHz and 2x1.5 MHz.

3.9 The auction design options suitable for allowing the spectrum lots to be awarded individually or in combination are discussed in section 4. In the auction, bidders may bid for one or more of the fifteen different licence combinations of these four lots. Following the auction, Ofcom will award each winning bidder one licence in respect of the spectrum lots for which it has submitted a winning bid.

Competition issues

3.10 FCS considered that hoarding spectrum in order to gain a dominant position would not lead to efficient spectrum use. As Ofcom has not defined markets relevant to the use of spectrum, it is not clear in which market a dominant position would be reached and whether such a position is likely to cause competition concerns. However, Ofcom considers that concerns could only potentially exist if there was an adverse effect on competition for services offered and/or on consumers utilising the services in a 'downstream market'. As the award is technology (and hence service) neutral, it is not presently possible to identify the services which winning bidders may ultimately offer to consumers. Consequently, there is no basis for imposing any *ex ante* requirements under competition law.

3.11 Another respondent considered that there was a need for Ofcom to clarify the principles by which it would and would not take into account competition issues prior to any spectrum award. One of Ofcom's objectives in awarding the spectrum through an auction process (set out in the SFR:IP), is to promote competition in the provision of electronic communications services, in addition to promoting the efficient management and use of the spectrum. Ofcom considers that this objective sets out clearly that, in the design of the award, Ofcom will consider all those issues that might impact on competition in downstream services, including incentives for participation, rules prohibiting collusion and bidder association, and technology neutrality.

3.12 Ofcom set out in the October Consultation its consideration of whether there were any particular competition issues that should influence the design of the award (see paragraphs 4.46-4.53 of the October Consultation document). It considered in particular that:

- the potential for anti-competitive effects if a single band manager acquired the band was not significant given the amount of spectrum available for award;
- the variety of downstream uses of the Band undermined the case for designing an award to address competition issues in downstream markets; and,
- there were benefits to competition by releasing the spectrum.

3.13 Ofcom considers that it has adequately considered all competition issues in relation to its design of the auction and does not consider that the responses raise any new issues.

Band management

3.14 In the October Consultation, Ofcom suggested that the Band might be acquired by an organisation intending to take on the role of assigning spectrum within it to individual users as a commercial proposition. Band management could be particularly relevant to this Band as there is a variety of potential uses and potentially there may be many small users. Ofcom has undertaken work on clarifying the potential role and responsibilities of such an organisation, in response to feedback from some discussion of the idea in the SFR: IP. The results were set out in an Annex to the October Consultation, in which Ofcom stressed that it did not intend to make specific provision for the creation of a band manager but instead intended to ensure that the framework existed to allow a band manager to emerge where there was a suitable

commercial opportunity. It invited comments on the ways in which it envisaged a band manager might operate.

3.15 There were a wide variety of responses to the band manager proposal. AirRadio believed the relationship between a band manager and Ofcom would need to take particular account of enforcement matters. Airwave noted that the award of spectrum to a band manager would be likely to bring benefits in terms of reduced co-ordination costs among participants in the market. FCS saw virtually no interest from any organisation taking on the band manager role. Fleetcom believed that the band manager concept was the only practical alternative to direct control of the Band by Ofcom. Transfinite saw the band manager model set out in the October Consultation as overly complex. Ventura saw merit in the band manager concept but recognised the need for an organisation without any vested interest taking on the role. Another respondent suggested that a band manager should be obliged to ensure fair and equitable access to spectrum. Another response agreed that Ofcom should make no specific provision for the creation of a band manager. It considered that Ofcom had described the possible operation of a band manger in an overly bureaucratic form: in reality band managers were more likely to rely on leases and licences of geographically defined packages than on partial or concurrent transfers. It pointed out that in doing this in a legally effective manner they would need to be clear what rights they were granting short of transfers.

3.16 None of the responses received suggested that Ofcom's suggestions in the October Consultation were not feasible options (although Ofcom recognises that there are also other models for a band manager). A licensee who wished to take on the role would be free to agree specific arrangements with each of its customers, subject only to the requirement that use of the spectrum was properly authorised. Ofcom continues to believe that the auction need not make specific provision for the creation of a band manager, but should ensure that a framework exists to allow a band manager to emerge where there is a suitable commercial opportunity.

Link to 450-470 MHz band

3.17 One respondent suggested that the availability of the 410-415 MHz/420-425 MHz band offered a 'once in a lifetime' opportunity for reversing use of the 450-470 MHz band, which is out of line with the rest of Europe. Ofcom has already addressed this point in the October Consultation. The Radiocommunications Agency had for a number of years been developing plans to migrate users in the 450-470 MHz band to a configuration consistent with use of the band across Europe. Ofcom had re-considered the plans and, recognising the significant costs and considerable risks which a complex centrally planned move would impose, decided not to proceed with the project. Rather than imposing band alignment changes on the users, Ofcom believes that it is preferable for the market itself to make the necessary changes using, for example, trading and liberalisation.

Spectrum for the emergency services

3.18 In the October Consultation Ofcom explained that it had decided to make available 2x2 MHz in the Band to meet the requirements of the emergency services and 410-412 MHz paired with 420-422 MHz would be assigned for this purpose. It was not at that time certain that the emergency services would require all of this spectrum and if they did not then surplus spectrum would be included with the Band subject to auction. In response to the October Consultation JRC suggested that any surplus spectrum should be awarded separately from the 2x2 MHz proposed. Airwave sought

an early statement that 410-412 MHz/420-422 MHz would be made available for the emergency services.

3.19 Ofcom can now confirm that the full 2x2 MHz will be assigned to meet the needs of the emergency services and that the auction will therefore be in respect of spectrum at frequencies between 412-414 MHz paired with 422-424 MHz.

Further spectrum awards

3.20 One response to the October Consultation pointed out that potential bidders need to be aware of any related spectrum award, particularly in the 400-470 MHz region, and of the timescales for the award of 872-876 MHz/917/921 MHz.

3.21 The Ofcom website contains information on future spectrum awards - see http://www.ofcom.org.uk/radiocomms/spectrumawards/.

Section 4

Auction format and rules

4.1 In the October Consultation Ofcom proposed to award the available spectrum by a single round sealed bid auction. The key features of the auction were:

- The winning bidder would be the one which submitted the highest bid;
- The winning bidder would pay the amount of the second highest bid made for the licence, or the reserve price if there were no other valid bids;
- There would be a registration process for participation in the auction. The identities of all those registered would not be made public;
- There would be specific rules to prohibit collusion but no bidder association rule;
- A reserve price of £50,000 would be set for the licence;
- Bidders would be required to submit a deposit at the same time as their bid. The deposit would have to equal 50% of the bid made. An initial deposit of 50% of the reserve price might be required on registration for the auction;
- Winning bidders would be required to pay 100% of the fee by the date set in the Regulations, before the licence was issued; and
- If the licence remained unsold, either through absence of bids or default, Ofcom would reconsider its approach to the release of the spectrum, and would choose whatever course of action it considered appropriate at that time.

4.2 Responses to the October Consultation were overwhelmingly in favour of an auction for the award of the spectrum, although there were comments on the specifics of the auction format and rules. AirRadio believed that a single licence would allow a large player to gain the spectrum below its valuation, given the second price rule. BT considered that a multiple round auction would be preferable because of uncertainty over valuations. It considered that the second price rule was reasonable in some limited circumstances. BT also believed that bidders' identities should be disclosed in advance of the auction. FCS believed that auctioning a single licence favoured financially strong bidders. It also saw the second price rule as encouraging over-bidding. Ventura believed the auction design discriminated against SMEs and should include measures to favour new entrants. Similar points to those above were made in other responses, in particular on the superior efficiency of a multiple round auction, deficiencies with the second price rule and disclosure of bidders' identities. In addition, comments were made on the impact assessment not including a cost-benefit analysis of auction options and on the need for Ofcom to publish the independent advice it received on auction design.

4.3 Some of the points raised in the responses have been overtaken by Ofcom's decision to auction the available spectrum in four equal lots rather than as a single licence. Ofcom's consideration of the specific points made is set out in Annex 1.

4.4 The auction rules are contained in regulations which are published in draft alongside this statement. The regulations provide a full description of the auction rules for this award. Section 4 of the Information Memorandum also provides a summary of these rules and a description of the process.

Sealed bid combinatorial auction format

4.5 Ofcom has considered the consequences for auction design of moving from awarding the available 2x2 MHz as a single national licence, to offering the Band in four frequency lots, each of 2x500 kHz and allowing bids for licences comprising any combination of those lots, up to and including all of them . The shift to multiple lots creates a number of issues in relation to the auction format that need to be addressed:

- Are the new lots sufficiently similar to allow an auction with 'generic' lots or is it necessary to define 'specific' lots?[2]
- Should the lots be auctioned simultaneously or in sequence?
- Is it still appropriate to use a sealed bid format or should Ofcom switch to an open multiple round format?
- Would it be appropriate to allow bids for combinations of lots (combinatorial bidding) as well as individual lots?

Specific versus generic lots

4.6 The four lots occupy adjacent frequencies and have identical bandwidths. However, Ofcom recognises that there are reasons why their respective values could vary. These include possible variation in co-ordination requirements related to MOD use in the Band and proximity to other spectrum which may be available to some bidders.

4.7 Consequently, Ofcom considers that it is necessary to construct an auction format that will allow bidders to express their preferences between the four lots.

Simultaneous or sequential auction

4.8 With multiple spectrum licences, it is necessary to consider the structure of demand. Lots can be substitutes or complements for different users or even for the same user in different situations (e.g. wanting to obtain the two cheapest lots or none at all). Typically, simultaneous auction formats are preferred unless either demand for the different lots is unrelated or all bidders have the same hierarchy of preferences between the lots.

4.9 The comments of respondents pointed to at least three possible categories of demand:

- PMR users that may only require a single lot. For example, a large user might buy one lot to serve its own needs and then offer third parties access to the spectrum via trading or provide managed PMR services elsewhere.
- PMR and PAMR providers that may wish to aggregate two or more lots. Some respondents were happy with the original proposal of a single national licence, so it would be reasonable to assume that there could be a number of such bidders interested in acquiring all of the available lots. Also, a band manager might want to

[2] 'Specific' lots constitute a right to use a specific frequency block (e.g. 412-412.5 MHz paired with 422-422.5 MHz). 'Generic' lots constitute a right to use a frequency block as yet undetermined within a larger band (e.g. a 500 kHz block within the band 412-414 MHz paired with 422-424 MHz); in this case, actual spectrum endowments are assigned after the auction.

have the ability to offer services to more users in a given geographical area than a single lot could afford.

- Wideband operators who may require all the available spectrum.

4.10 It is apparent that these three categories of bidder would face different risks in an auction. The first category will be solely concerned about substitution risks between the lots. The second category may face both substitution and aggregation risks, although aggregation risks may be muted because while they may have a preference for larger numbers of lots, they could still make use of a single lot if necessary. The third category face significant aggregation risks, as failure to acquire all lots would result in stranded licences that could not be used to deploy a service.

4.11 Therefore, the auction format needs to allow for:

- some bidders seeking one or more lots, but wishing to substitute across the available lots in search of the cheapest; and
- other bidders wishing to combine lots, some of whom may face aggregation risks.

4.12 Such a combination of substitution and aggregation risks can only be accommodated through a simultaneous process.

Sealed bid or open multiple round process

4.13 Both sealed bid and open processes have been widely used for awarding multiple frequency lots. Academic literature on spectrum auctions has traditionally favoured multi-round processes over single round contests.[3] This reflects concerns that single round, sealed bids may not produce an efficient outcome:

- in a common value setting, there is no opportunity for bidders to learn from the behaviour of competitors, so the winner's curse risk is not controlled.
- where there are multiple licences that are close but not identical substitutes, bidders will have a better idea of how much and which licences to bid for if they have knowledge of competitors' relative valuations.
- where there are multiple licences that are complements, bidders face pronounced aggregation risks in a simple sealed bid, as they cannot be sure how many and which licences they will win.

4.14 However, more recent academic analysis (especially in relation to the European 3G auctions) has highlighted two practical advantages of single round, sealed bid auctions, that in certain circumstances, may outweigh the theoretical efficiency benefits of multi-round contests[4]:

- Sealed bid auctions may encourage participation in situations where there are perceived bidder asymmetries, which in turn may lead to more competitive auctions. In open contests, it is apparent that 'weak' bidders may be discouraged from participating if they fear simply being overbid by a perceived stronger rival (e.g. an incumbent operator). By contrast, in a sealed bid, 'weaker' bidders perceive their

[3] See, for example: Cramton, P, February 2001, 'Spectrum Auctions', from 'Handbook of Telecommunications Economics', Cave, M, Majumdar, S and Vogelsang, I, Eds., Amsterdam: Elsevier Science B.V., Chapter 14, 605-639

[4] See Klemperer, P, 2002, 'How (not) to run auctions: the European 3G Telecom auctions', European Economic Review, 46(4-5), 829-845.

prospects of winning to be greater because 'strong' rivals face greater uncertainty over what to bid.

- Sealed bids may be less susceptible to collusion, either before or during an auction. It is harder for potential applicants to fix the level of demand in a sealed bid, as there is no opportunity to observe and counteract opponents' behaviour, as may be the case in a multi-round contest.

4.15 In this award, either a sealed bid or a multiple round process are possible. Having considered carefully the relative merits of both approaches, Ofcom believes that the advantages of a sealed bid are particularly relevant to this auction and that its disadvantages, relative to an open process, are either of low importance or can be overcome by using appropriate auction design. The reasons for this are as follows:

- common value issues do not seem strong enough to suggest significant benefit from an open (multiple round) format. Most bidders are likely to wish to deploy PMR or PAMR; therefore uncertainty over business cases should be much less than were the spectrum primarily targeted for an entirely new use. Further, many potential bidders are self providers who would glean little information from observing rival bids.
- the lots are sufficiently close substitutes that information about rivals' relative valuations across lots is likely to be of limited relevance to bidder strategy.
- although some bidders may face significant aggregation risks, this could be addressed by using a sealed bid format which allowed combinatorial bids. In a simultaneous multiple round auction, bidders could aggregate lots through making multiple bids. However, given that there might be some bidders with strong complementarities and others without, there would likely to be efficiency benefits from allowing combinatorial bidding.
- Concerns about bidder asymmetries and participation are highly relevant to this auction. As the October Consultation responses reveal, there is concern about the presence of one or two bidders that may be viewed by others as particularly 'strong'.
- single round, sealed bid auctions are also simple, quick and cheap to administer. There is no need to co-locate bidders, or to set up complex electronic or paper-based procedures to run the auction, as might be required with an open process.

Package bidding

4.16 Given the preference for a sealed bid approach, it is essential that bidders be allowed to make combinatorial bids (i.e. bids for a licence comprised of combinations of lots). Otherwise, bidders seeking to combine lots would be exposed to the risk of stranded licences and therefore may bid unduly cautiously.

4.17 One concern often raised with respect to combinatorial auctions is the potential complexity for bidders, owing to the many bidding options created. However, in the case, with four specific lots there are only 15 possible combinations. This is a relatively modest number of licence options, which can easily be accommodated on a single bid form. The bidding rules for this auction are explained in paragraphs 4.21-4.32.

4.18 Another possible concern with the use of combinatorial bidding is the introduction of 'threshold risks' for smaller bidders, which are the flipside of efforts to reduce aggregation risks for other bidders. These relate to the inability of bidders seeking licences comprised of individual lots (or smaller combinations) to displace

aggregators seeking many or all lots, even though it may be efficient to do so. The problem arises because in a combinatorial auction a group of single lot bidders need to bid more *in total* than an aggregator to win. When one single lot bidder raises its bid, this could displace an aggregator and so benefit other single lot bidders (though this benefit is not taken into account by the single lot bidder). In effect, if single lot bidders could co-operate, they could displace the aggregator, but they have an incentive to free-ride, relying on the bids of other single lot bidders to displace the aggregator.

4.19 A related concern is the possibility that a 'strong' bidder – especially in a low competition scenario – might seek to exploit its bid options strategically to block competitors. For example, it might strategically withhold bids for licences comprised of smaller combinations of lots, so as to cut off options for such bids to be linked with others, thus increasing the likelihood that it will win all the lots.

4.20 In general, the introduction of threshold risks is an unavoidable outcome of using combinatorial bidding. Ofcom considers these risks to be modest relative to the benefits of addressing aggregation risks. Threshold risks should anyway be less acute in a single round context rather than in a multiple round one, as bidders have no opportunity to revise their strategy in response to the behaviour of their rivals. Further, as explained in paragraph 4.37, eligibility and transparency rules can further diminish such risks.

Auction rules

4.21 Ofcom's original proposed format for this award involved a sealed bid for a single licence, with very simple ancillary rules. In particular, the combination of a single licence and the use of a second-price rule would have allowed for an auction with no transparency and no rules on bidder association. However, with the shift to multiple lots and a combinatorial auction format, more detailed rules are required.

4.22 In this section, appropriate rules covering the following areas are explained:

- bidding rules;
- pricing rule;
- transparency;
- payment rules, deposits and penalties; and
- bidder association and collusion.

4.23 Apart from the introduction of package bid options, the most significant changes include a shift to a pay what you bid (PWYB) pricing rule, transparency in relation to participants and the introduction of bidder association rules.

Bidding rules

4.24 The introduction of multiple lots and combinatorial bidding requires rules governing the bidding process in the auction, including rules on eligibility, package bidding, bid forms and winner determination.

Eligibility

4.25 Bidder eligibility refers to the maximum number of lots that a bidder is permitted to bid for. For this auction, all bidders will start with the same eligibility and be allowed

to bid for licences comprised of up to all four lots. With all bidders having the possibility to bid for all lots it may be harder for 'strong' bidders to attempt to exploit threshold risks, as described in paragraph 4.18.

Package bidding

4.26 When designing a combinatorial auction, a key decision is whether to allow bidders to bid for all possible packages of lots, or to restrict these in some way. Bidders could be restricted from bidding on certain specific combinations or limited in the number of lots that they can bid for. Such restrictions may be appropriate in order to simplify the auction for bidders and/or because certain combinations from lots may be undesirable from a regulatory or bidder perspective.

4.27 As previously discussed, with four lots there are 15 possible licence combinations. This is illustrated in Table 1, with the four lots labelled as A, B, C and D. 15 options is clearly a manageable number for bidders, especially in the context of a single round auction, where they have a long period of time to decide their bids. There is therefore no need to impose restrictions on package bidding in order to simplify the auction. Put differently, bidders should be allowed to make mutually exclusive bids for all licences comprised of all combinations of lots that are available.

Table 1: Description of packages in a combinatorial auction with four lots

Types of package	Description of packages	Number
One lot only	A, B, C, D	4
Two lots	AB, AC, AD, BC, BD, CD	6
Three lots	ABC, ABD, ACD, BCD	4
Four lots	ABCD	1
TOTAL:		**15**

4.28 Ofcom has considered whether there may be a case for prohibiting bids on certain combinations of lots in order to avoid outcomes that unnecessarily fragment spectrum or preclude others from winning contiguous spectrum. However, it is feasible that bidders may see substantial differences in the value of certain lots that may lead them to prefer certain non-contiguous combinations. This points to the desirability of leaving open the possibility of bidding for any of the 15 possible combinations. The award process will determine the identity of the ultimate licensees, the number of licences to be awarded (up to a maximum of four) and the frequencies in respect of which those licences are granted.

Bid forms

4.29 In order to simplify bidding, all bidders will be supplied with a bid form containing all fifteen licence options. Bidders will then make mutually exclusive bids for as many of the licence options as they wish to bid for, but will be limited to one bid per licence.

4.30 Bids must be made in whole pounds sterling. The prospect of the auction resulting in tied bids will be significantly reduced where bidders do not bid in round figures.

Winner determination

4.31 The winning combination of bids will be the combination of valid bids for licences with the highest total value of amounts bid, where within that combination;

- there is at most one valid bid from any one bidder; and
- each frequency lot is included at most once.

4.32 Where there is a tie between two or more combinations of bids, the winning combination will be that which will see the greatest number of frequency lots awarded. If there is more than one such combination the winning combination will be selected from amongst those combinations using a method of random selection.

Pricing rule

4.33 There are essentially two approaches to price determination that Ofcom could adopt for this auction[5]:

Pay-what-you-bid (PWYB). Each winning bidder pays the amount of their winning bid and is granted the licence in respect of which they made that winning bid. This is equivalent to a first price rule in a single unit, sealed bid auction.

Opportunity cost pricing. Each winning bidder pays the opportunity cost of its bid, i.e. the minimum amount that its bid would have needed to have been to prevent another combination of package bids from displacing its winning combination. An opportunity cost pricing rule is an example of a so-called Vickrey-Clarke-Groves (VCG) mechanism.[6] These are a general class of mechanisms that elicit truthful statement of preferences by getting participants to pay the opportunity cost of their actions. A second-price auction is the VCG mechanism when there is just one item.

4.34 A simple example is provided at Table 2 of an auction with three bidders for four lots (each bidder being limited to the nine package options to illustrate the different payment outcomes under the two different pricing rules). The winning bids from Tom and Harry, which together total 34, are shaded. The pricing under the two approaches are calculated as follows:

- With PWYB, Tom would pay his bid of 10 for lot A and Harry would pay 24 for lots B, C and D.
- With opportunity cost pricing, the next best alternative bids need to be considered. Considering Tom first, the best alternative excluding his winning bid would be to award lot A to Dick who bid 9, with Harry still winning the other lots with his bid of 24. Harry and Dick's total bids equal 33, 1 less than Tom and Harry. Therefore, Tom would pay 9, i.e. the amount of his bid (10) minus the difference between the winning combination and the next best one excluding his winning bid (1). In the case of Harry, the next best combination excluding his winning bid is to award lots A

[5] In principle, there are a range of other pricing options between these two approaches but none offer any great advantages.

[6] See Fudenberg and Tirole, Game Theory, Chapter 7.

& B to Tom (17) and C & D to Dick (15). Their bids totalled 32. Therefore, Harry would pay 22, i.e. the amount of his bid (24) minus the difference between the winning combination and the next best one excluding his winning bid (2).

Table 2: Simple example of bids with three bidders

Package options:	Tom	Dick	Harry
A	10	9	-
B	10	11	-
C	10	11	-
D	10	10	-
AB	17	14	-
CD	17	15	-
ABC	-	-	21
BCD	-	-	24
ABCD	-	-	30

4.35 Ofcom intends to use a PWYB pricing rule, as:

- PWYB is more likely to promote participation in the auction in a situation where there may be potential bidder asymmetries. This is because with opportunity cost pricing, 'strong' bidders can simply bid their full value in the knowledge they will only pay the opportunity cost of their rivals' valuations. This in turn may discourage participation by 'weaker' bidders who may perceive (not necessarily correctly) that they have little chance of winning unless 'strong' bidders face uncertainty over what to bid.
- PWYB is less susceptible to collusion than opportunity cost pricing. To illustrate this point, consider the following simple example. There are three bidders for a single licence, Tom, Dick and Harry, none of whom knows the others' values. Tom and Dick collude in advance of the auction such that Dick drops out of the auction because his value is lower than Tom. With opportunity cost pricing, Tom will benefit from this in all cases where Dick's valuation exceeds Harry's valuation, as the opportunity cost of its winning bid falls. Meanwhile, Tom's likelihood of outbidding Harry is unchanged, as he still submits the same bid. By contrast, with PWYB, in order to gain any pay off from eliminating Dick from the auction, Tom would have to reduce his bid. However, this will increase his likelihood of losing to Harry. Therefore, the gains from collusion are strictly lower with PWYB than with opportunity cost pricing.
- Opportunity cost pricing theoretically offers greater efficiency benefits than PWYB. This is because bidders' optimal strategy is simply to bid their own value, removing

the risk that a bidder with the highest valuation might lose because it shades down its bid too much in the hope of extracting surplus. However, in the case of this auction, such efficiency benefits may be more than offset by the detrimental effect of bidder asymmetry and collusion concerns.

- PWYB is simple for bidders to understand and for Ofcom to implement. By contrast, opportunity cost pricing in a combinatorial auction is relatively complex to determine. As can be seen even from the simple example in Table 2 above, the pricing solution with a VCG mechanism may not be particularly clear.

Transparency

4.36 Transparency in a sealed bid auction concerns the type of information released to bidders before and after the auction. Ofcom will publish the identity of bidders in advance of the auction and once the auction is complete will publish details of all bids submitted.

4.37 Having transparency in relation to the number and identity of bidders is important in the case of PWYB pricing. In this type of auction, bidders shade down their bids below their true valuation, depending on their perceptions of their own strength relative to other bidders. Without disclosure of the number and identity of other bidders in advance of the sealed bid, it would be difficult for bidders to judge how much to shade down their bids. This significantly increases the risk of an inefficient outcome in which bids do not accurately reflect relative values and thus licences are not awarded to those bidders with the highest valuations.

4.38 Once the auction is complete, Ofcom will release information about all valid bids submitted, not just the results. Releasing full information will allow bidders to validate for themselves the auction results and aid public confidence in the auction process. Bid revelation may also aid the functioning of a secondary market in the spectrum.

Payment rules

Minimum bid price

4.39 The primary purpose of a minimum bid price in this case is to ensure that the auction only attracts serious bidders and to encourage participation. Therefore, it would be appropriate to set a minimum bid price at a low but non-trivial level. Ofcom will set the minimum bid at £50,000 per frequency lot.

4.40 The minimum price for package bids will reflect the sum of minimum prices for the individual lots included in the bid. Hence, with a uniform minimum bid price of £50,000 per lot, the minimum bid price for a licence comprising any two lots would be £100,000; for any three lots would be £150,000; and for all four lots would be £200,000.

Deposits

4.41 Deposits help to deter frivolous bidders in a manner similar to reserve prices. They also reduce strategic incentives for default. Deposits will be required in cash at the point of application and at the time of bidding.

4.42 An initial deposit of £25,000 will be required from each applicant, to be submitted with its application. Each bidder will then be required to increase this deposit at time of bidding to an amount equal to 100% of the highest amount bid for any licence option. If a bidder does not provide a sufficient deposit for its bid (by the relevant deadline),

its bid will be declared invalid and the bidder will be excluded from the award process.

Penalties

4.43 As proposed in the October Consultation, a bidder's deposit may be forfeited in full or in part if it breaches any of the auction rules, which cover such things as the submission of false or misleading information and collusive behaviour. A bidder breaching the activity rules may also be excluded from the auction.

Payment terms

4.44 As set out above, Ofcom is proposing to require 100% deposits from bidders at the time of bidding. Winning bidders will therefore have paid upfront for their licence and provided that their bid deposit has not been forfeited in accordance with the auction rules, winning bidders will receive a refund equal to the difference between their licence fee and their bid deposit (where the licence fee equals the bid deposit, no refund will be made).

Default

4.45 In the October Consultation Ofcom proposed that if default occurred the single licence would be offered to unsuccessful bidders in rank order of their bids.

4.46 Implementing such a rule would be complex and difficult to cater for in a transparent way in a combinatorial auction. Ofcom has consequently decided to require a deposit equal to 100% of the highest bid made. This removes the possibility of a bidder defaulting on payment of its licence fee by ensuring that a winning bidder has effectively paid for its licence before it has an opportunity to default.

Unsold spectrum lots

4.47 If any frequency lots remain unsold at the end of the auction, Ofcom may award those lots in a separate process. In deciding what and how such a process will be conducted, Ofcom will choose whatever course it considers appropriate at the relevant time.

Bidder association and collusion

4.48 In Ofcom's October Consultation it proposed to make auction rules that expressly prohibited collusion between bidders and Ofcom intends to include such rules in the revised auction format. Given the design of the original proposed auction and the fact that only one licence was to be awarded, Ofcom did not consider it necessary to preclude associated organisations from bidding. With the change in auction design and the move to multiple lots, it now considers it prudent to introduce rules prohibiting associations between bidders.

4.49 Without rules prohibiting multiple bid vehicles, it is possible that a party might submit multiple applications under different names in an attempt to confuse other bidders about the competitive landscape. This could undermine some of the benefits of having transparency of participation associated with a PWYB pricing rule. Therefore, bidder association will be prohibited in the auction.

4.50 An applicant may not qualify to bid in the auction if a member of its bidder group is also a member of another bidder group. A bidder group includes the applicant or

bidder, each associate of the applicant or bidder and all other members in respect of whom the applicant or bidder has submitted appropriate documentation to Ofcom in accordance with the Regulations . An associate is defined as a person who has a material interest in the applicant or bidder. Material interest is defined in the Regulations as including all parties with an interest (whether held directly or indirectly) in shares carrying more than twenty five per cent of the votes entitled to be cast at a general meeting of the applicant or bidder and all parties with an interest in shares, the consent of whose holder is required for the conduct of any business of the applicant or bidder. It also includes any party with the right to appoint or remove a majority of the board of directors of the applicant or bidder.

4.51 Ofcom proposes to require each applicant to notify Ofcom whether any member of its bidder group is also a member of another bidder group.

Section 5

Licence rights and obligations

5.1 In sections 5 and 6 of the October Consultation Ofcom set out its proposals for the technical and regulatory conditions that would be contained in the licences for the Band and the requirements for co-ordinating with military and other users. The main technical conditions were:

- A maximum effective isotropic radiated power for any base station transmitter of 50 watts (17 dBW) measured in any 25 kHz, for bandwidths up to 200 kHz. The maximum effective isotropic radiated power for a base station is 400 watts (26 dBW).
- Out of block emissions from the radio equipment must not exceed the following:

For the band 422.0-424.0 MHz the unwanted emission at both the upper and lower edge of the sub-band and the individual blocks shall not exceed the following:

Frequency Separation (kHz)	EIRP (dBm/25 kHz)
12.5	-8
37.5	-23
62.5	-23
87.5-237.5	-33
237.5-487.5	-38
>487.5	-43

Below 420 MHz the out-of-block emissions will not exceed -53 dBm/25 kHz.

For the band 412.0-414.0 MHz the unwanted emission at both the upper and lower edge of the sub-band and the individual blocks within the sub-band shall not exceed the following:

Frequency Separation (kHz)	ERP (dBm/25 kHz)
12.5	-15
37.5	-30
62.5	-30
87.5-237.5	-40
237.5-487.5	-45
>487.5	-50

- Emissions shall be no more than -38 dBW in the first 25 kHz below 422 MHz or -45 dBW in the first 25 kHz below 412 MHz. In the second and third 25 kHz channels below 422 MHz the transmitted power will not exceed -53 dBW. In the second and third 25 kHz channels below 412 MHz the transmitted power measured in 25 kHz will not exceed -60 dBW. Outside of these frequencies the permitted power is as described in Annex 9 of the October Consultation document.

- In the 412-414 MHz band the maximum effective radiated power shall be 10 Watts.

These values assume the use of FDD technology; the consequences of using TDD technology were discussed in Annex 9 of the October Consultation document.

- Aeronautical use will not be allowed.
- The radio equipment shall be operated in accordance with any co-ordination procedure that Ofcom notifies in writing to the licensee to ensure that the equipment's operation does not cause undue interference to the radar located at RAF Fylingdales or other MOD uses.
- There are a number of military assignments in the licensed frequency bands 412-414 MHz paired with 422-424 MHz which licensees will have to protect.
- The radio equipment shall be operated in compliance with such cross-border co-ordination and sharing procedures as may be considered necessary and notified to the licensee by Ofcom.
- The licence will have an indefinite duration, with a minimum term of 15 years during which Ofcom's powers to revoke will be limited. Ofcom will have the power to revoke for spectrum management reasons on not less than 5 years' notice after the minimum period which could lead to the licence being terminated the day after the expiry of the 15 year minimum period or any time thereafter.
- The auction will determine the fee payable for the licence. After the expiry of the minimum period, if the licensee continues to hold the licence, there may be additional charges in line with Ofcom's policy on spectrum pricing at that time.
- The licences will be tradable. All types of trade (partial or total; and concurrent or outright) will be permitted.
- Ofcom's intends to invite the licence holders to participate on a voluntary basis in providing information about their base stations for inclusion on Sitefinder where they are using one of the technologies currently covered (i.e. GSM, UMTS or TETRA).

5.2 Numerous points were raised about the spectrum usage rights and technical restrictions and other licence obligations set out in the October Consultation. They fell under the following broad headings:

- Technology neutrality, power limits and out-of-band emissions
- Licence changes and liberalisation
- Terminology, discrepancies and points for clarification
- ECC Decisions
- Licence conditions
- Undue discrimination
- Co-ordination with military users
- Cross border co-ordination
- Sitefinder

Applicability and scope of technology neutrality

5.3 Ofcom's intention is to award spectrum with technology and usage restrictions which are the minimum necessary for the efficient management of the radio spectrum and the avoidance of undue interference and which comply with Ofcom's statutory duties and international obligations. As recognised in the Spectrum Framework Review, even under a technology and usage neutral approach there is a requirement to specify the technical characteristics of the licences available in an auction. It is important that likely uses of the spectrum are taken into account in specifying any

technical parameters to the usage rights. However, this can be done without requiring that the uses considered are those that must be made of the spectrum.

Methodology

5.4 In developing transmission rights for the Band, Ofcom has proposed in-band and out-of-band power limits that should be sufficient to prevent undue interference into the adjacent band use(s) based on the existing technology currently deployed and the frequency duplex arrangements.

5.5 The lower adjacent band use below 412 MHz/422 MHz paired boundary is the emergency services (410-412 MHz/420-422 MHz) and Ofcom has worked on the basis that these services will be using narrowband (25 kHz) TETRA. The upper boundary at 414 MHz/424 MHz has MOD as the adjacent band user. The assumption made, based on knowledge of the existing MOD use, is that an assessment of undue interference based on the 25 kHz TETRA specification (ETS 300-392-2) would also be a reasonable proxy for the MOD services. The MOD may use systems that exceed the levels for out of band emissions specified by the TETRA mask within MOD training areas, details of which are set out in Annex 3 of the Information Memorandum.

5.6 In determining the appropriate transmission rights, Ofcom has taken into account existing CEPT, ITU-R and associated international reports and recommendations into adjacent band compatibility and will normally use such material as the basis for its proposals. Ofcom has carefully considered these factors in determining the transmission rights for the spectrum to be awarded. In summary, it will:

- retain the conventional duplex direction for the paired bands;
- base the ‘emission mask’ on TETRA for the four blocks as the most appropriate option given the adjacent use and limited bandwidth available;
- not mandate a particular technology. Within the constraint of meeting the in-block and out-of-block emissions limits, the spectrum can be used for any technology. Ofcom considers that trading will provide the opportunity to negotiate revised emission limits with adjacent users.

Sharing and adjacent band compatibility studies

5.7 In conducting sharing and compatibility studies, the CEPT and the ITU-R have developed detailed technical reports that form a body of reference material for planning radio systems based on a wide range of technologies and scenarios In conducting these studies, typical characteristics of the mobile and base station transmitters are assumed together with the duplex directions of actual or planned systems.

Modelling mobility

5.8 An essential element in conducting compatibility studies is to agree how mobility is to be characterised for a particular system. These characteristics are normally stated in terms of antenna height, maximum transmitter power, active interferer density and environment. The most fundamental characteristic is the presumption that the mobile devices will predominantly be mobile. This explicit assumption is the justification for the use of a statistical simulation tool to evaluate the sharing or compatibility issues.

5.9 If the services under consideration are both fixed, as would be the case if the duplex direction were changed in one of the sub-bands, the result would be base station to base station interference that is static in nature. This would consequently be much more difficult to mitigate and the interference would be continuous, rather than intermittent as indicated by statistical probability.

5.10 Taking a typical example, CEPT SE7 - the specialists in sharing studies for mobile systems - define a mobile system, on a case-by-case basis, as a combination of a base station and mobile or group of mobiles which form a cell. The dimensioning of these cells will be based on existing industry practice wherever such information exists or the application of appropriate parameters when modelling planned systems. These assumptions typically mean that the network is normally designed such that, in a noise limited environment, they will yield a call success rate of 97% across the cell. This method results in a consistent manner of determining the relative interference. Whenever there is a choice of duplex direction SE7 will normally choose, and model, the direction which minimises the interference.

Why align the duplex direction with the adjacent band use?

5.11 In this particular case, the adjacent band use is configured as mobile transmit in the lower sub-band and base transmit in the upper sub-band.

5.12 Radio systems in which the duplex directions are aligned, coupled with the general principle of trying to arrange for similar mobile systems to be the adjacent service, has benefits, particularly where those systems are broadly homogeneous in their technical characteristics. This arrangement allows co-existence with the absolute minimum requirement for guard bands or co-ordination.

5.13 Key to the process of minimising guard bands is that the duplex direction will need to be the same and, where technologies are reasonably close, the transmitted powers and user densities will be broadly comparable. Examples of mobile technologies which are optimised for different purposes but which are broadly comparable are GSM, narrowband FM and TETRA. The CDMA technologies differ from GSM and TETRA in that, while GSM and TETRA are designed to minimise the interference to neighbouring channels, CDMA systems create more interference but they are also more tolerant of it. In spite of the difference in philosophy aligning the duplex direction results in more efficient use of the spectrum.

5.14 When duplex directions are not aligned, or when time division duplex technologies are used in spectrum adjacent to frequency division duplex systems, there is a very high probability that one or both of the networks will suffer interference from a base station transmitter into the base station receiver of the neighbouring technology. This problem will be exacerbated by:

- height of the antennas, which will tend to result in the base station receiver being in line of sight of the interfering transmitter;
- increased antenna gain of the base station, which will result in the interference being detectable at a greater range;
- increased sensitivity of the base station receiver, which will be affected by interference at a lower field strength; and
- higher power of the base station transmitter relative to the mobile transmitters.

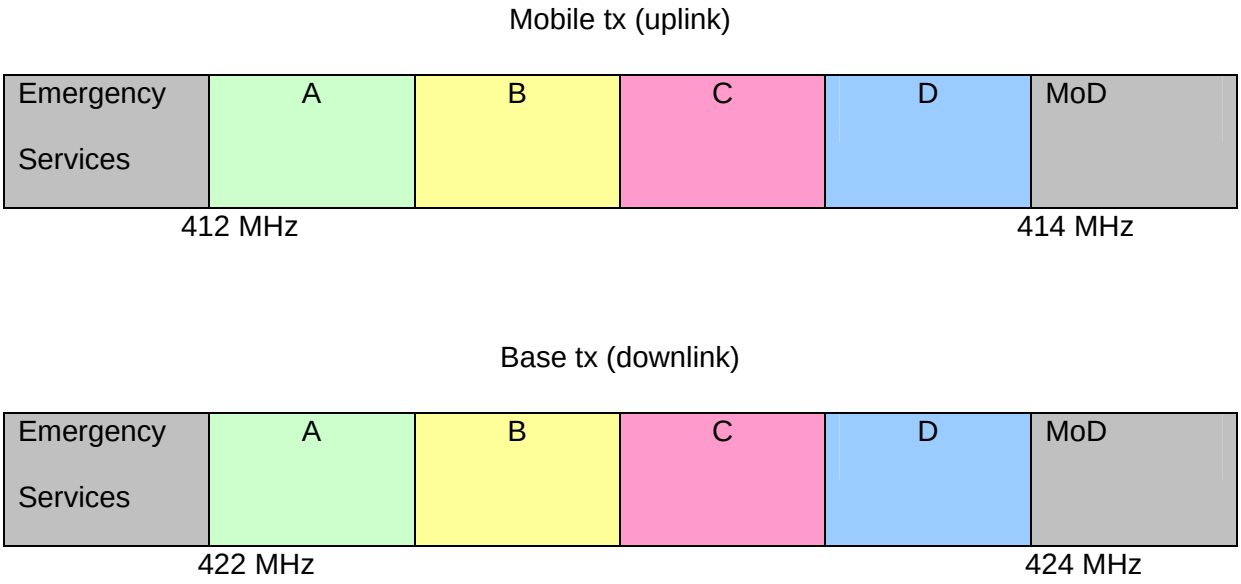
5.15 If duplex directions are reversed it would normally be necessary to apply either larger guard bands or very large separation distances in order to provide protection, or to impose very low transmit power constraints.

5.16 In this Band, if the duplex direction were changed the 412-414 MHz band would be used for the base station transmit leg and, immediately adjacent (410-412 MHz) would be the mobile leg of the emergency services. This would produce a base station to base station interference scenario that would yield a high probability of blocking in the base receivers of the emergency services that would require either large separation distances or a considerable frequency separation to prevent undue interference.

5.17 In the light of these considerations Ofcom proposes that the conventional duplex direction and assumptions regarding sub-band use will apply, i.e. the sub-band 412-414 MHz is assumed to be used for the uplink leg (mobile transmit) with the upper paired sub-band 422-424 MHz used for the downlink (base transmit).

Impact of four spectrum lots

5.18 As explained in section 3, Ofcom will offer the available spectrum in four lots. Each lot is identical in terms of the bandwidth (2x500 kHz) and technical characteristics, e.g. in-band and out-of-band power limits. They are illustrated in the diagram below as lots A, B, C and D:



5.19 The ‘external’ boundaries at 412, 414, 422 and 424 MHz have been modelled on the basis of ensuring that the adjacent band (emergency services and MOD) users will not suffer undue interference.

5.20 Given that the transmission rights for the external boundaries have been established with respect to TETRA usage in the adjacent band, Ofcom considered whether it was practical to define transmission rights for the internal boundaries that differed from those for the external boundaries. Ofcom has considered the options of basing these emissions on other technologies such as GSM and CDMA. Concerning CDMA,

Ofcom has concluded that this is not an obviously attractive option given that this technology would require all four blocks. Concerning GSM, only two channels per block would be possible, both channels could not be used at the same site due to leakage between the channels and while it is possible to use GSM as the adjacent service to be protected for blocks B and C in practice the blocks are too small to effectively handle asymmetric out-of-band emission profiles. If GSM were employed in any of the sub-blocks, it would be necessary to provide additional filtration to both the mobiles and the base stations in order to protect the adjacent emergency services band and the MOD Band.

Power limits

5.21 A number of respondents commented on the power limits proposed in the October Consultation. BT believed that, in relation to technology and application neutrality, further work was needed to clarify the in-block power and out-of-block emission limits. The Interface Requirement should address power limits. Maximum power limits should be the same for each of the two sub-bands. Separate power limits for base stations should not be necessary in the licence. Separate limits for mobile transmitters should only be set if there are additional sound reasons for this. One respondent said that Ofcom needed to specify the power limit of the mobile terminal with a reference to bandwidth. Another suggested that Ofcom investigate means to increase the maximum power, even if this might vary regionally to protect the operation of Fylingdales. Another suggested that the erp values for the Band should be adjusted to a similar level to that proposed for the 917-921 MHz band.

5.22 Ofcom has considered these comments and has reached the following conclusions.

In-block

5.23 The maximum permitted power for the 422-424 MHz band shall be an eirp of 47 dBm/25 kHz. The maximum eirp from any site shall be 56 dBm. These are representative of typical base station power levels and have been frequently used in sharing and compatibility studies.

5.24 The maximum permitted power in the band 412-414 MHz shall be an erp of 10 Watts.

Out-of-block emissions

5.25 Some respondents also commented on the out-of-block emissions proposed in the October Consultation. BT believed that out-of-block emissions limits should be the same for both sub-bands. One respondent said that Ofcom needed to ensure that the limits are clearly stated and cover the whole range of spectrum in this area. It believed that the limits would effectively preclude the operation of 1.25 MHz CDMA as it could not fit within the available spectrum; a combination of additional filters and lower power transmit would be required to enable this technology in the Band. Another respondent believed the out-of-band emissions were too stringent to allow standard technology to be used and urged Ofcom to allow operation in conformance with Draft ETSI EN 301 449 V1.1.1.

5.26 The block edges are at 412, 414, 422 and 424MHz. Sub-block edges are those specified as the four spectrum lots of 2x500 kHz identified as A, B, C and D in the figure at paragraph 5.18. The unwanted emissions mask will be the same for all sub-block edges within the same block. The unwanted emissions mask within the blocks reflects the probability that a mobile transmitter in the lower block will employ a lower

transmitted power than a base station in the higher block. The unwanted emissions mask has separate values for the upper and lower blocks.

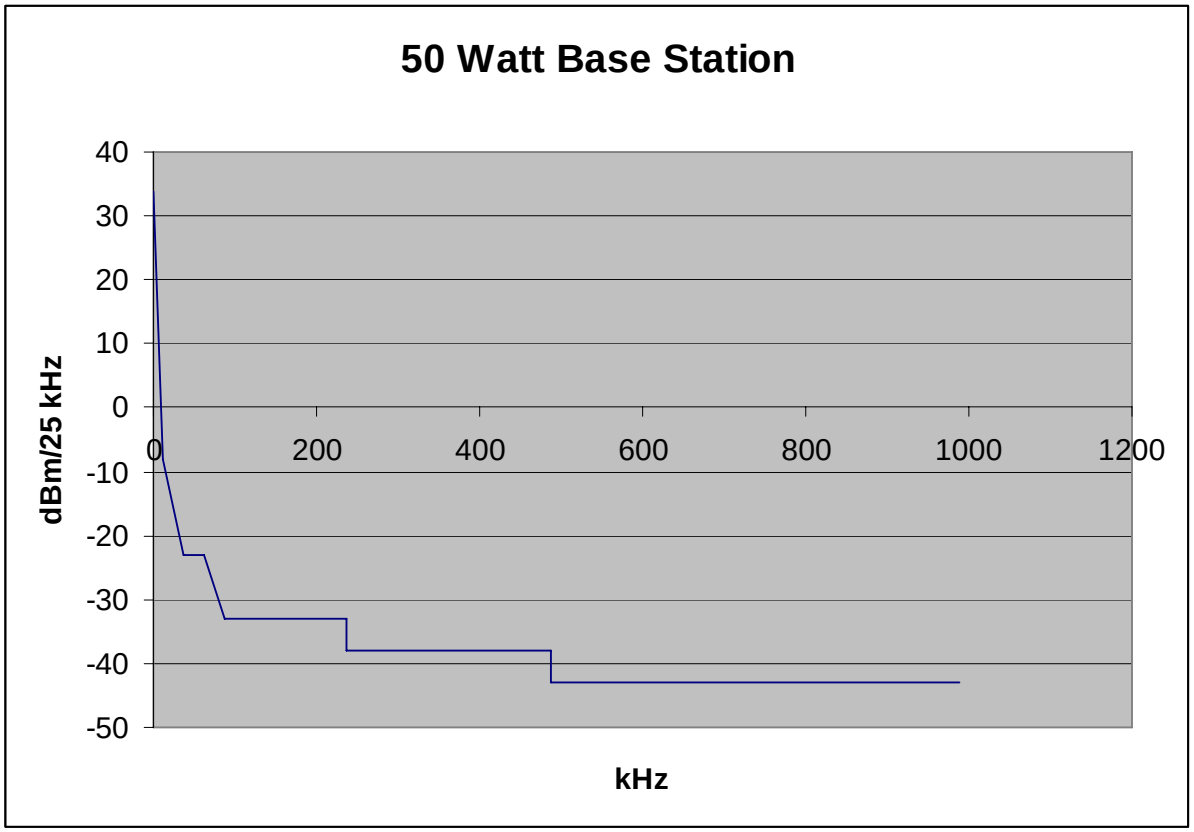
Detailed conclusions

422-424 MHz sub-band

5.27 For the band between 422 MHz and 424 MHz the unwanted emission at both the upper and lower edge of the sub-block and the individual blocks within the sub-block shall have the form:-

Frequency Separation (kHz)	eirp (dBm/25 kHz)
12.5	-8
37.5	-23
62.5	-23
87.5 – 237.5	-33
237.5 – 487.5	-38
>487.5	-43

5.28 These figures are shown diagrammatically below



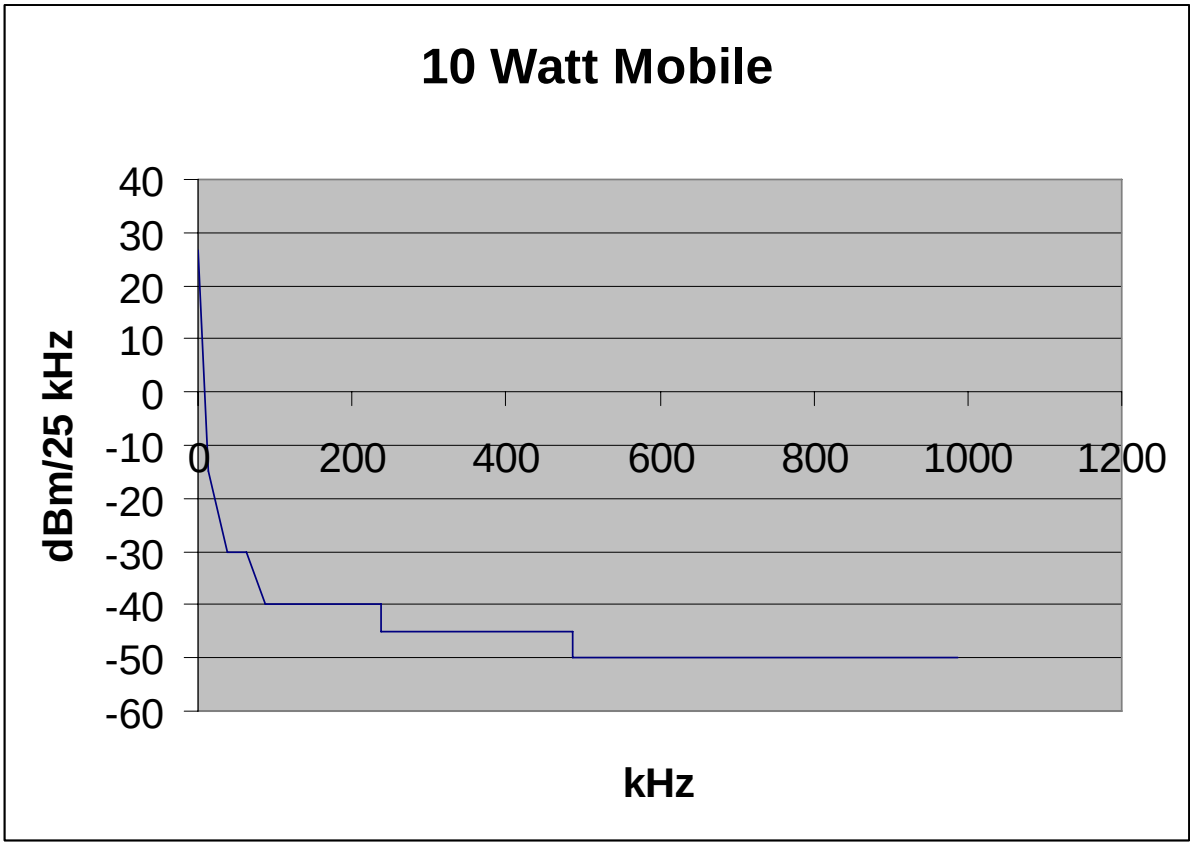
For frequencies below 420 MHz the eirp shall be less than -53 dBm/25 kHz.

412-414 MHz sub-band

5.29 For the band between 412 MHz and 414 MHz the unwanted emission at both the upper and lower edge of the sub-Band and the individual blocks within the sub-band shall have the form:-

Frequency Separation (kHz)	e.r.p. (dBm/25 kHz)
12.5	-15
37.5	-30
62.5	-30
87.5 – 237.5	-40
237.5 – 487.5	-45
>487.5	-50

These figures are shown diagrammatically below;



Licence changes and liberalisation

5.30 BT sought confirmation that full spectrum liberalisation would apply to the Band. Another respondent suggested that, given that Ofcom's work on spectrum property rights was ongoing, it should clarify in what circumstances it could change commitments made at the time of the auction. Another respondent said that Ofcom had not made clear whether a change of power limit would be allowed.

5.31 As noted above, the licences to be awarded do not place any technology or usage restrictions on the licensee, other than restrictions on power level and out-of-band emissions that are the minimum necessary for the efficient management of the radio spectrum and the avoidance of interference. It will be open to a licensee to seek Ofcom's approval for the variation of its licence. Ofcom will consider the evidence provided by the licensee and assess the request in accordance with its statutory duties at the relevant time. Further information is available in Ofcom's Spectrum Liberalisation Guidance Notes - http://www.ofcom.org.uk/radiocomms/ifi/trading/libguide/

Terminology, discrepancies and points for clarification

5.32 BT identified within the October Consultation document some inconsistencies and ambiguities on in-band power limits and out-of-band emissions. One respondent pointed to inconsistent use of ERP and EIRP values and discrepancies between references to power limits. It also suggested that the terms 'base station' and 'mobile station' in the licence should be replaced with the frequencies of operation, though it thought it unlikely that an operator would decide to operate in the non-standard duplex direction. Futurepace suggested that the term 'block' should not be used, and pointed to differences in the definitions used in the October Consultation document of the term 'out-of-block' emissions. Corrections or clarifications, where necessary, have been made to the technical details published in this Statement and in the Information Memorandum.

ECC Decisions

5.33 FCS pointed out that although Ofcom intended to issue a technology neutral licence, the ECC had designated the band for narrowband digital PMR/PAMR; they were interested in the legal opinion. Ofcom addressed this point in paragraph 4.38 of the October Consultation, where it stated that the UK was not implementing any of the relevant Decisions. Implementation of ECC Decisions is not mandatory.

Interface Regulation 2044

5.34 IR 2044 currently refers to PMR and PAMR use but the IR will be updated in order to allow for a more technology neutral use of the spectrum. Ofcom plan to submit a revised IR 2044 prior to the award process. The IR shall be notified to the European Commission and the process usually takes three months if there are no comments received regarding the UK proposal.

Licence conditions

5.35 BT had some concerns that the licence fees for which a licensee would be liable beyond the minimum 15 year licence term was totally open-ended. As Ofcom explained in the October Consultation document, its general approach to fees for the use of spectrum at that time would determine whether an annual licence fee would apply after expiry of the minimum term. It is neither necessary nor appropriate to specify at this stage the level of the annual licence fees, if any, that might apply. Ofcom would expect to bring forward proposals on this matter to a timescale that gave the licensee reasonable notice of any relevant fees before they became payable.

5.36 One respondent suspected that the most likely outcome of the auction of a single licence for the whole band would be hoarding of spectrum by the licensee to prevent the deployment of services by others. It suggested that the licence should include an obligation to roll out a minimum of service within a given timescale. In general Ofcom

believes that it is unlikely that roll out or 'use it or lose it' conditions are required in order to meet the objective of ensuring that spectrum is used efficiently. Spectrum trading and liberalisation and administrative incentive pricing provide or enhance incentives for licensees to use spectrum efficiently. As indicated in Ofcom's Spectrum Trading Statement[7], concerns about spectrum hoarding may be addressed *ex post,* for example through competition law.

5.37 One respondent suggested that Ofcom should clarify what the 'spectrum management grounds' were that could lead to revocation of the licence after the minimum period. Ofcom has powers under Section 1(4) of Wireless Telegraphy Act 1949 to revoke wireless telegraphy licences. It would only revoke licences for spectrum management reasons where there was a pressing need to do so, taking account of its statutory duties and only after careful consideration and consultation with the stakeholders affected.

Undue discrimination

5.38 Two respondents identified what they regarded as discriminatory aspects of the proposals in the October Consultation. One was concerned that Ofcom's proposed spectrum awards raised serious issues of consistency with Ofcom's spectrum management policy as set out in the SFR and SFR: IP, and that not resolving these issues led to uncertainty and regulatory risk. In particular, it believed that Ofcom's arguments for not placing any restriction on 3G use by licensees were not sufficiently developed. Another considered that Ofcom had failed to recognise that the existing restrictions on mobile operators should be imposed on new spectrum that would enable the provision of competing services. A level playing field should be adopted so that the most efficient operators are the ones that end up supplying the services.

5.39 Ofcom addressed the issue of undue discrimination in paragraphs 5.24-5.26 of the October Consultation document. Its consideration of the points made in responses is set out in Annex 1.

Co-ordination with military users

5.40 A number of comments were made in responses to the October Consultation about co-ordination with the Fylingdales radar. BT recognised the need to co-ordinate with MOD use but wished to know what propagation models would be used in determining interference into Fylingdales and other MOD sites. Transfinite similarly said it would be helpful if there were more information on the assumptions used for the calculation of aggregate interference. One respondent believed it would be necessary to make available the co-ordination tool in advance of the auction to allow potential bidders to check whether their planned networks could be accommodated. Another respondent suggested that the aggregate interference baseline for the 420-424 MHz band should be allocated in a way that prevented a single user from using it all and denying others the opportunity to develop their businesses. Airwave requested that Ofcom's assessment of the potential for the radar to interfere with licensed users should include TETRA. Airwave also requested an early sight of further information on military use within the Band. Another respondent requested information on the restrictions that these sites would impose and the likely costs of their relocation.

[7] http://www.ofcom.org.uk/consult/condocs/spec_trad/statement/sts.pdf

5.41 The co-ordination tool incorporates the 1546 propagation model (modified by Ofcom). The model to be used is P.1546-2 with a modification as proposed by the UK at ITU SG3K in submission document 3K/85 (2005). Further, the decision has been made to compute path loss assuming that the radar is the base station (as meant in P.1546) and the proposed station is the terminal. This is because the radar environment and height is close to that assumed for a base station in P.1546 (for example, it is above the height of the surrounding clutter). It should be noted that the interference baseline represents both a measured and predicted level. This means that predicted interference levels are compared to those for a known deployment whose interference levels have been measured (the 'reference' network). The same model is used for both the reference network and a licensee's proposed new configuration. Although a safety margin is likely to be included, the method should not be unduly conservative. The interference from any one base station will be predicted for 50% of the time using P.1546-2 adapted to include the proposed modification submitted to the ITU by the UK as document 3K/85 (2005). The aggregate interference will be predicted by performing a power summation.

5.42 Ofcom will be giving potential bidders the opportunity in advance of the auction to use the co-ordination tool to check whether the networks they are planning could be accommodated within the interference baseline. It plans to offer sessions on its premises at which potential bidders will be instructed on the use of the tool and given hands-on access to input network information tool for checking against the baseline. Ofcom will facilitate these sessions over a two week period. Each potential bidder will be offered a half-day session. More sessions may be available, depending on demand.

5.43 The aggregate interference baseline will be allocated equitably to each licensee in the Band and each will need to work within its own baseline (it is likely that licensees will be able to negotiate the re-allocation of the baseline between themselves. Ofcom will need to be informed of any re-allocations that are negotiated).

5.44 In the October Consultation Ofcom included an assessment of the potential for the radar to interfere with licensed users based on their use of TETRAPOL systems. It has commissioned further work based on other technologies and is publishing the results on its website.

5.45 There are a number of military assignments in the Band. Licensees will have to protect each assignment at a level of 7.5 dBuV/m in 25 kHz measured at a height of 10 metres, except for three assignments in Scotland, west Wales and the west of England around which there are geographical restrictions. (Bidders should note that the MoD channels have a 12.5 kHz offset from the 25 kHz TETRA raster and that protecting them would mean that two 25 kHz channels would be unavailable at these locations.) As stated in the October Consultation, Ofcom is providing in the Information Memorandum details of the military assignments in the Band. In summary, there are 32 assignments in Great Britain, nine of which should be discontinued before the issue of Licences or soon thereafter. The remaining 23 are at locations outside urban areas. There are also some military assignments in Northern Ireland. Precise details of these assignments will not be disclosed to Licensees due to security considerations and Licensees will have to accept any interference caused by MOD use in Northern Ireland. However, the MOD has indicated that it might migrate to a new radio system in Northern Ireland that will significantly reduce the military requirement in the Spectrum Bands. If use of this new radio system is approved by the MOD, migration out of the Spectrum Bands is expected to begin toward the latter part of 2006.

Cross border co-ordination

5.46 One respondent believed that the cross border co-ordination requirement would constrain CDMA use of the Band, particularly in south east England and Northern Ireland. Ofcom are in the early stages of negotiating MOUs with the French and Irish administrations. Licensees will be invited to participate in the negotiations before finalisation of the MOUs.

Sitefinder

5.47 Airwave and another respondent considered that others besides MNOs should provide information for Sitefinder. Ofcom sees no reason to deviate from the proposal outlined in paragraph 5.39 of the October Consultation. This would however be reviewed in the light of any change in position by the Government.

Section 6

Next steps

6.1 Ofcom's intends to hold this award as soon as possible. The key next step in the award process is for Ofcom to make the statutory instrument which sets out the auction rules. A draft of these regulations is one of the documents published alongside this statement; it is subject to a statutory consultation period of at least one month. After the closing date for responses to this statutory consultation, Ofcom will consider responses and assess whether it should amend the proposed regulations. It will then make the regulations and they will come into force on the date specified in them, which is likely to be about one month after the date they are made.

6.2 The timing cannot be finalised before the statutory consultations have closed and Ofcom has considered responses. Subject to this, Ofcom expects the auction regulations to be in force by a date that would allow the auction process to start in July 2006. An indicative timeline for the process from the application date is set out in Section 4 of the Information Memorandum. This may be updated nearer the time.

Further seminars

6.3 Ofcom is planning to hold a further seminar with interested parties explaining the auction rules, probably including a test auction, after the regulations are made.

Annex 1

Summary of responses to the 13 October 2005 consultation

A1.1 Ofcom received 14 responses to the October Consultation. There was a wide measure of support for its proposals. The responses also provided detailed comments on a number of aspects, including among other things the number of licences, the auction design and technical licence conditions.

A1.2 This Annex sets out a summary of the responses and Ofcom's view on the main points raised. Some of the issues are discussed in detail in the main body of this statement.

Issue raised	Comments	Ofcom's response
Number of licences	Six respondents were in favour of more than one national licence being awarded. Their suggestions ranged from between 2 to 6 licences of varying sizes being offered.	After careful consideration of the responses, Ofcom has concluded that there is potential demand for users requiring less than the 2x2 MHz available. It therefore proposes to offer the spectrum on a national basis in four 2x500 kHz lots (see section 3 paragraphs 3.1 to 3.9 of this Statement).
Local licences	BAA suggested that licences should be offered on a localised basis.	Ofcom considers that licensing on a localised or regional basis could impede efficient use of the spectrum and increase co-ordination requirements. In their report titled *Allocation options for selected bands* dated February 2005, DotEcon and Analysys Mason Group concluded that there was no clear basis for geographical division of the spectrum.
450-470 MHz	One respondent felt that the 410-412 MHz/422-424 MHz spectrum should be used to band reverse the 450-470 MHz band.	Ofcom considered the plans for realignment and recognizing the significant costs and considerable risks which a complex, centrally planned move would impose on the band, decided that the project was not in line with its policy of encouraging market management of the spectrum, and the band alignment project was withdrawn. Rather than imposing band alignment changes on the users. Ofcom would prefer the market itself to make the necessary changes using, for example, trading and liberalisation.
Single round auction design	BT and another respondent supported a simultaneous multi-round auction (SMRA) design	In re-considering the auction design Ofcom examined again the case for a SMRA and concluded that the practical advantages of a sealed bid process outweighed the theoretical efficiency advantages of an SMRA (see section 4 paragraphs 4.13 to 4.15 of this Statement.
Second price rule	FCS felt that a second price rule encourages over bidding.	Ofcom considers that for the award proposed in the October Consultation a second price rule would have encouraged bidders to bid their valuation.

Bidder identity	BT and another respondent felt that the identities of prospective bidders should be made public prior to the auction taking place.	The auction design proposed in the October Consultation (single-round, sealed-bid, second-price auction) did not require bidders to know whom they were competing against in order to bid appropriately. In the revised combinatorial auction format, which entails bidders paying what they bid, publishing bidders' details before the auction will be necessary to assist bidders in deciding how to bid.
Reserve price not met	FCS enquired what would happen if the reserve price were not met.	Bids will have to be submitted at or above the reserve price otherwise they will be invalid. If no valid bids are received Ofcom will choose the course of action for releasing the spectrum that it considers appropriate at that time.
Payment default	One respondent asked whether, in the case of a winning bid defaulting, the second highest bidder would then have to pay the third highest price.	The revised auction rules require payments of 100% deposits on submission of the bid and, unlike those proposed in the October Consultation, will require winning bidders to pay what they bid.
Premia for new entrants and SME bidders	Ventura suggested that the auction design be modified to include explicit premia for new entrants and SMEs.	Ofcom's intention is to use the auction design most appropriate for meeting the objectives of each award. It believes that including premia for new entrants/SMEs would be discriminatory and might deter others from participating in the auction, so adversely affecting the efficiency of the outcome.
Auction advice	A respondent suggested that Ofcom should publish for consultation the advice they receive on auctions.	Advice relating to auction packaging and format was included in the report prepared by DotEcon and Analysys Mason Group *Allocation options for selected bands*, which was published by Ofcom at http://www.ofcom.org.uk/consult/condocs/SFR:IP/band/?a=87101. This advice formed the basis of Ofcom's proposals in the October Consultation. The advice it has received on the appropriate auction design where numerous lots are on offer is reflected in section 4 of this statement.
Future spectrum auctions	A respondent asked Ofcom to confirm that the current proposed awards do not constitute a valid precedent for any future spectrum awards	Ofcom's intention is to use the auction design most appropriate for meeting the objectives of each award.
Regulatory Impact Assessment	A respondent asked that Ofcom include a cost-benefit analysis of different auction mechanisms.	Ofcom has based its assessment of the auction mechanism on a robust analysis of the options. It does not believe that a cost-benefit analysis would enhance its assessment. Regulatory impact assessments have been prepared in respect of each of the statutory instruments Ofcom is proposing to make in connection with the award and copies can be seen at http://www.ofcom.org.uk/radiocomms/spectrumawards/

Band management – auction design and spectrum packaging	One respondent felt that the auction design and packaging was motivated by a desire to encourage band managers.	Ofcom has not made specific provision for the creation of a band manager. It considered the auction design proposed in the October Consultation as the one most appropriate for awarding a single national licence, taking account of such factors as efficiency of outcome, incentives to participation and simplicity of administration and participation. These were the considerations that also applied to the choice of a combinatorial auction.
Band management - regulation	BT asked whether Ofcom will be introducing supporting regulations for band managers or spectrum management organisations and, if so, whether this might be available prior to the auction of this spectrum. Ventura felt that the band manager should be a new organisation without any vested interests. One respondent felt that there should be regulation to ensure that a band manager provides access to the spectrum on a fair and equitable basis.	Ofcom does not intend to introduce specific provisions for band management. Its aim is rather to ensure that there is an appropriate, generic framework that allows band managers to emerge, and to operate commercially, to the extent that market circumstances allow it. Ofcom believes that it would be discriminatory to place restrictions upon bidders who wish to become band managers and the aim of the auction will be to encourage entry by all who have sound business plans for using the spectrum. In the event that the user(s) of this band engage in anti-competitive behaviour Ofcom has a wide range of powers to intervene (see paragraph 4.53 of the October Consultation document).
Band management – procedures	One respondent considered that band managers were more likely to rely on leases and licences of geographically defined packages than on partial or concurrent transfers. It pointed out that in doing this in a legally effective manner they would need to be clear what rights they were granting short of transfers.	Ofcom set out in the October Consultation some illustrative models of how a band manager might operate under the spectrum trading regime. A licensee who wishes to operate as a band manager is free to agree specific arrangements with each of its customers, subject only to the requirement that use of the spectrum is properly authorised.
Spectrum usage rights	A respondent commented that the proposed technical conditions contained some technology specific elements. For example, the need to co-ordinate with military users would favour certain types of use and that the proposed emission mask is based on a specific technology – TETRA. A number of respondents sought clarification regarding power limits and clarification regarding other technical issues.	Ofcom sets out in section 5 of this Statement the considerations it has taken into account in developing spectrum usage rights for the band. Ofcom believes that basing the emission mask on TETRA technology is appropriate. It took the actual technology currently in use as the basis for assessing the potential impact on the adjacent band users, and the existing duplex arrangements for these services was a prime consideration . A prospective licensee intending to use a mesh topography should contact Ofcom to

	BT asked what power limits would be available for use of a mesh topography. A respondent felt that the technical limits precluded operation of 1.25 MHz CDMA technology. A respondent noted that 1.25 MHz CDMA technology would be unable to fit within the available spectrum without additional filters and a lower transmit power. A respondent asked whether licence variation would be allowed in order to change the power limit. A respondent asked under what circumstances Ofcom could change the spectrum usage rights.	discuss how they would comply with terms of the spectrum licence. Ofcom understands that while existing CDMA mobiles may not meet the technical constraints they could be improved to meet the requirement. It will be open to a licensee to seek Ofcom's approval for the variation of a licence in order to change the spectrum usage rights. Ofcom will consider the evidence provided by the licensee and assess the request in accordance with its statutory duties at the relevant time.
Power limit proposed for 917-921 MHz band	One respondent argued that the ERP values for the 422-424 MHz band should be adjusted to a similar level to those in the 917-921 MHz band to avoid discrimination.	The 422-424 MHz band is distinct from the 917-921 MHz band and different considerations apply in determining the technical conditions that should apply to each. Ofcom does not therefore consider that ERP values for the 422-424 MHz band should be linked to those for the 917-921 MHz band.
ECC Decisions	FCS understood that the ECC had designated the band for narrowband digital PMR/PAMR.	A number of ECC Decisions refer to this band. However the UK has not implemented any of these Decisions (see paragraph 4.38 of the October Consultation document for further details).
Fylingdales co-ordination tool	Transfinite asked whether Ofcom could provide further information on the assumptions used for calculation of the aggregate interference in the example scenario. BT asked whether Ofcom could advise which propagation model it would use in its determination of interference into Fylingdales and other MOD locations. One respondent suggested that the interference budget should be distributed fairly between the licensee and the emergency services. A respondent felt that the co-ordination tool should be made available in advance of the auction to facilitate network planning. Airwave requested that Ofcom	Details of the propagation model and assumptions used in the tool are contained in paragraph 5.41 of this Statement. The interference baseline will be divided equally between the emergency services' allocation and the band to be awarded. Thereafter, the baseline for each will be managed separately and it would be re-allocated only with the agreement of users. The interference baseline will also be distributed equally between each spectrum lot to be awarded. Ofcom will be giving potential bidders the opportunity in advance of the auction to use the co-ordination tool. The requirement on Licensees will be to comply with the co-ordination procedures in the Licence, which include clearing

	produce reference charts to illustrate the potential for interference from the radar into TETRA systems. One respondent suggested that clarity was required concerning whether the licence had been legally complied with if Ofcom's co-ordination tool was used	each new assignment in 422-422 MHz through the co-ordination tool.
MOD usage	BT felt that prospective bidders should have the opportunity to have discussions with MOD prior to an auction. Airwave and another respondent asked that Ofcom provide further information on the MOD sites and also the likely relocation costs.	Ofcom has provided information on military assignments within the band and a broad estimate of the cost of their relocation in the Information Memorandum (to the extent that security considerations allow). All prospective bidders should have similar access to information relevant to the auction. Individual discussions with MOD are unlikely to be possible.
Cross border co-ordination	A respondent suggested that cross border co-ordination could impose a constraint on CDMA use.	Ofcom are in the early stages of negotiating MOUs with the French and Irish administrations. Licensees will be invited to participate in the negotiations before finalisation of the MOUs.
Licence conditions	BT felt it was unclear what was encompassed by the definition of 'the equipment' and whether mobiles and outstations would be exempt.	In the licences to be awarded the radio equipment covered means any station or apparatus that transmits in accordance with the terms of the licence.
Licence fees	BT expressed concern that the potential licence fees, after the initial period, were open-ended.	Ofcom's general approach to licence fees at that time would determine whether an annual fee would apply after the expiry of the minimum term. It does not believe that it is necessary or appropriate to specify now the level of licence fees, if any, that may be applied. Ofcom would expect to bring forward proposals on this matter to a timescale that would give licensees reasonable notice of any relevant fees before they became payable.
Roll-out obligations	A respondent suggested that any licence should contain a roll-out clause.	As described in paragraph 3.34 of the SFR:IP - Interim Statement, Ofcom does not believe that such licence conditions are likely to meet the objective of ensuring that this spectrum is used efficiently.
'Spectrum management grounds'	A respondent suggested a definition of 'spectrum management grounds' for licence revocation was important for long term decisions by users.	Ofcom has powers under Section 1(4) of Wireless Telegraphy Act 1949 to revoke wireless telegraphy licences. It would only revoke licences for spectrum management reasons where there was a pressing need to do so, taking account of its statutory duties and only after careful consideration and consultation with the stakeholders affected.
Discrimination	A respondent felt that Ofcom had not recognised concerns relating to discrimination and risks distorting competition through advantaging new licensees in a number of ways.	Ofcom considers 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.

	Another respondent felt that there should be restrictions on use for 3G services in order to ensure investment certainty and competitive neutrality.	For the reasons given on page 69 of Annex 6 of the October Consultation document Ofcom does not consider that differences between the terms of the proposed licences and any existing classes of licence are such as to result in undue discrimination between the various classes of licence holder. Neither does it consider that there is a risk of distorting competition. Ofcom does not believe that there should be restrictions on the use of 3G services in the Band. Even if it were the case (which remains unproven) that allowing the provision of mobile services in new spectrum could undermine investment in 3G services by the incumbents or hamper their ability to recover their costs, it is not clear how this could arise in the case of this award given the characteristics of the Band, in particular the quantity of the spectrum involved and the technical limitations.

Emergency services	JRC felt that if any additional spectrum became available as a result of the emergency services procurement decision then it should be awarded separately and not aggregated. A respondent felt that the reasons for allocating part of the spectrum by administrative allocation and part by market mechanisms (i.e. auction) had not been explained in sufficient detail to allow an understanding of when spectrum will or will not be allocated by market mechanisms. A respondent felt that the subsequent setting of fees for the emergency services spectrum based upon market information provided by the auction was not consistent with the setting of spectrum fees for 2G spectrum.	Additional spectrum will not be available as the amount of spectrum required by the emergency services has been confirmed as 2x2 MHz. In the October consultation Ofcom made it clear that the decision to assign the spectrum to the emergency services was made in the light of a specific set of circumstances prevailing at the time and should not be taken as a precedent for assigning spectrum for emergency services administratively rather than through a competitive process. The question of how public services should access spectrum has recently been considered by Professor Martin Cave in the *Independent Audit of Spectrum Holdings* which was prepared on behalf of the Government and published in December 2005. http://www.spectrumaudit.org.uk/. This report also considered pricing for public sector spectrum users.
Further spectrum awards	A respondent asked that Ofcom provide information on any further future spectrum awards.	The Ofcom website contains information on future spectrum awards – see http://www.ofcom.org.uk/radiocomms/spectrumawards/
Competition	A respondent suggested that Ofcom should clarify the principles by which it will and will not take into account competition issues prior to a spectrum award.	In performing its duties Ofcom must have regard to the desirability of promoting competition. It will take into account competition issues whenever it is considering a spectrum award.
Ofcom spectrum vision	A respondent was unclear how elements of the Ofcom spectrum vision were being implemented. In particular what justification would be required for 'policy constraints' and of what they might consist and the interpretation of 'as far as possible'.	The Ofcom spectrum vision was included within the Spectrum Framework Review consultation of 23 November 2004 and subsequent Statement of 28 June 2005. Ofcom does not believe that it would be appropriate to devise hypothetical examples of implementation of that vision. The above documents explained that there would inevitably be circumstances when Ofcom cannot fully achieve this vision. In these cases it will explicitly explain why it has not done so.
Sitefinder	Airwave and another respondent felt that provision of information for the Sitefinder database should apply to all technologies.	Ofcom sees no reason to deviate from the proposal outlined in paragraph 5.39 of the October Consultation. This would however be reviewed in the light of any change in position by the Government.