2.3 and 3.4 GHz spectrum award:

Consultation on a 3.4 GHz band plan, varying UK Broadband Limited's licence and a call for inputs on other aspects of the award

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Contents

Section 1

Introduction

1.1 This consultation and call for inputs concerns the award of licences to use frequencies in the 2.3 GHz and 3.4 GHz bands. The Ministry of Defence (MoD) is preparing to release 190 MHz of radio spectrum in these bands to Ofcom to conduct an award process[1].

1.2 The spectrum being made available comprises:

- 2.3 GHz band: 40 MHz of spectrum between 2350 and 2390 MHz and
- 3.4 GHz band: 150 MHz of spectrum above 3410 MHz and below 3600 MHz

1.3 The spectrum will be available for civil use in Great Britain only (England, Scotland and Wales, but not Northern Ireland).

1.4 The purpose of this document is to seek views on our current thinking for the award and give interested parties further information on how the bands might be made available. In addition to making specific proposals about the band plan for the 3.4 GHz band, we are seeking early views from those likely to have an interest in acquiring an assignment in these bands on a number of matters. We are particularly interested in understanding likely usage of the spectrum. Our initial view is that trends in European spectrum harmonisation mean the bands are likely to be attractive to communications companies wishing to develop 4G networks. Nevertheless, we are interested in learning of any alternative ideas for the use of this spectrum.

1.5 Section 5 of this document gives some details of our initial views on a number of aspects of a proposed award of frequencies in the 2.3 and 3.4 GHz bands, and invites comments. We have outlined our initial views on the proposed award, including on the competition issues that might arise between competitors in the mobile market if they obtain more spectrum; the method of award, including the size of any blocks of spectrum which might be offered through auction; other non-technical licence conditions and timing. We would welcome views on these issues. In due course, we will publish a formal consultation on our proposals for the award.

1.6 Our intention is to proceed with an award of licences to use these frequencies as soon as is practical - consistent with our duties and obligations, and subject to evidence provided through this consultation of stakeholder interest in acquiring access to these frequencies. We would welcome views from those interested in acquiring a licence on the optimal timing of such an award. The earliest we are practicably likely to be able make an award of this spectrum would be in the financial year 2015-16.

1.7 Spectrum is most useful if it can be as unencumbered as possible. Ofcom is working with existing users to consider the potential impact of new deployments on existing

[1] http://www.publications.parliament.uk/pa/cm201314/cmhansrd/cm130913/wmstext/130913m0001.htm#13091341000004; https://www.gov.uk/government/news/ofcom-to-manage-release-of-mod-radio-spectrum

users in both the release bands and in adjacent bands. These co-existence issues and their implications will be addressed in detail in a further consultation.[2]

1.8 In this particular document we are consulting on two specific proposals:

- a proposal to adopt an unpaired, TDD compatible[3], band plan for the 3.4 GHz band in the UK. Our analysis within the context of global developments and our current understanding of stakeholder views suggests this would support the most efficient use of the spectrum; and

- a proposal to vary UK Broadband's existing licence so that the 150 MHz of spectrum available for award in the 3.4 GHz band is in a single contiguous block. Ofcom believes that such a change would (a) make it easier to accommodate a range of different demands within the spectrum to be awarded, and (b) reduce the number of inter-operator frequency boundaries.

1.9 We are asking these questions about the band plan for the 3.4 GHz spectrum now so that we can progress the award of this spectrum as quickly as possible without having to consult on and consider what we anticipate will be unnecessary complexity (i.e. the need to develop technical conditions for multiple band plans and potentially the need to develop an auction design that leaves the decision over the band plan to the market). Steps are already being taken to harmonise the 2.3 GHz band across Europe for unpaired (TDD-compatible) use only, so in this case there is no decision to be made. The ongoing harmonisation of the 3.4GHz band (described later in this document) includes options for both paired and unpaired use; however, we believe there is a growing momentum in Europe, and more widely, towards unpaired use. While we do not expect a final decision from the Radio Spectrum Committee of the EU on any legally binding European harmonisation measure until March 2014, we should have a clearer picture of the likely direction of travel when the ECC meets to finalise its report to the European Commission in November.

[2] We have already consulted on the impact on amateur radio usage: http://stakeholders.ofcom.org.uk/consultations/public-sector-spectrum-release/

[3] Time division duplex (TDD) is used to separate the outward and return signals in the same frequency channel by time. This differs from frequency division duplex (DTT) which is used to transmit the outward and return signals in different frequency channels, so both signals can be transmitted and received at the same time. FDD requires spectrum channels to be paired to enable this to happen, while TDD is unpaired.

Section 2

Future use of the 2.3 GHz and 3.4 GHz bands

International considerations

2.1 Harmonisation of spectrum can be an important factor in giving industry confidence around the expected availability of spectrum, allowing for greater economies of scale in respect of equipment, and leading to consumer devices that are able to work across national borders.

2.2 Globally there is a mixed picture over the availability and use of these bands, with a variety of technologies used and some harmonisation measures in place, or planned, for both bands.

2.3 Current and ongoing European spectrum harmonisation suggests these bands will be attractive to telecommunications companies wishing to deliver 4G fixed and mobile services.

The 2.3 GHz Band

2.4 The International Telecommunications Union (ITU) World Radio Conference in 2007 (WRC-07) identified the band 2300 to 2400 MHz for use by International Mobile Telecommunications (IMT)[4].

2.5 In Europe there is an ongoing harmonisation process for the 2.3 GHz band. The European Conference of Postal and Telecommunications Administrations (CEPT), working through the Electronic Communications Committee (ECC) has established a project team under its Working Group on Frequency Management (WGFM) to look into harmonisation of the 2.3 GHz band for mobile/fixed communications networks (e.g. mobile and fixed broadband), whilst ensuring current users are appropriately protected. Only an unpaired band plan has been proposed as part of the ongoing CEPT work: CEPT has decided not to consider a paired band plan[5]. Given that the 3GPP standard only contains an unpaired band plan and CEPT are only considering an unpaired band plan, we are proposing to be consistent with these.

2.6 The WGFM is working towards a non-mandatory ECC Decision to make the band available for mobile and fixed communications from March 2014 onwards. ECC Report 172 (published in March 2012) has supported this work by looking into the compatibility between potential use of the 2.3 GHz band on a harmonised basis for wireless broadband systems, such as 4G, and adjacent services.

2.7 A limited number of countries use the 2.3 GHz band for pre-LTE systems, mainly WiMAX and TD-UMTS. More recently the focus has been on TD-LTE use. The following countries have already rolled out TD-LTE: India; Saudi Arabia; Australia;

[4] International Mobile Telecommunications is a term used to describe a suite of technologies, which are predominantly used for the delivery of wireless broadband services to users and described in two documents, ITU-R M.1457 (http://www.itu.int/rec/R-REC-M.1457/en) and recommendation ITU-RM.2012 produced and maintained by the ITU.

[5] Use of the band for supplementary downlink in conjunction with another paired band is not precluded by the adoption of an unpaired band plan.

Russia; Oman; China; South Korea, Sri Lanka, South Africa and Norway. A recent CEPT survey suggested that 16 countries in Europe would consider future use of the band, or part of the band, for 4G networks[6]. In terms of hardware, according to the Global Suppliers Association (GSA), in July 2013, 137 TD-LTE commercial devices supporting use in the 2300 MHz band were available on the market[7]. However, the 2.3 GHz devices available at present are predominantly designed for the larger Asian market and consequently do not currently all support, in a single device, the range of 2G and 3G frequency bands generally used by European mobile network operators (MNOs). There is however a version of the iPhone 5S/5C which does support 2.3 GHz as well as other European bands.

The 3.4 GHz band

2.8 At an international level, the 3.4 GHz band is allocated by the ITU for fixed, mobile, fixed satellite (space to Earth) and radiolocation services. It is also identified for IMT for a defined group of countries around the world, but with omissions including the United States, Canada, and Latin America along with many countries in Asia such as India and China.

2.9 In Europe, CEPT's ECC/DEC (07)02 harmonised the radio frequencies between 3400 and 3800 MHz for implementation of broadband wireless access systems.

2.10 In 2008 the European Commission incorporated elements of this CEPT decision into EC Decision 2008/411/EC. This legally binding decision harmonised the 3400-3800 MHz band for terrestrial systems capable of providing electronic communications services, such as mobile and fixed broadband, across the EU. This was incorporated into UK law under SI 2794 'The 3400-3800 MHz Frequency Band Regulations 2008': http://www.legislation.gov.uk/uksi/2008/2794/contents/made.

2.11 In March 2012 the European Commission sent a mandate to CEPT to undertake studies to support an amendment of the technical conditions in the original Commission Decision. The CEPT's final report is due to be delivered to the European Commission in November 2013 and is expected to state a preference for a TDD-compatible band plan for the 3.4-3.6 GHz band as discussed in the next section.

2.12 The European Commission's Radio Spectrum Committee is likely to consider the CEPT report in December 2013 and make a decision in March, 2014 which will be binding on Member States.

[6] http://www.cept.org/ecc/groups/ecc/wg-fm/fm-51/client/meeting-documents CEPT 19-20 March 2012 meeting input documents: Results of the WG FM QUESTIONNAIRE to CEPT ADMINISTRATIONS on the current and future usage of frequency band 2300-2400 MHz

[7] http://www.gsacom/news/gsa_379.php

Section 3

The band plan for the 3.4 GHz band

3.1 ECC Decision (11)06 provided two harmonised band plans for the 3400-3600 MHz band – an exclusive paired (FDD) option or an exclusive unpaired (TDD) option. The ECC decided that the two band plans should be subject to review no later than the end of 2013 with the aim of identifying a preferred band plan. As noted in section 3, for the 2.3 GHz band - which we intend to award at the same time as the 3.4 GHz band - only an unpaired band plan has been proposed for harmonisation.

3.2 The ECC is expected to make a decision on the 3.4 GHz band plan at an ECC Meeting on 5-8 November 2013. Subsequently we expect the European Commission to include a preference for a TDD channelling arrangement in the amendment of Decision 2008/411/EC at the Radio Spectrum Committee (RSC) meeting on 11-12 December, 2013. The Commission is aiming to achieve agreement at the RSC meeting in March, 2014 on amendment of Decision 2008/411/EC, which is binding on Member States[8].

3.3 Early indications are that stakeholders have a preference for an unpaired band plan. To move forward with our plans for awarding the bands, Ofcom has decided to consult now on a UK approach rather than waiting for the outcome of the ECC meeting in November and subsequent EU meetings. It is likely there will be no mandatory band plan but a strong preference agreed at the ECC.

The proposed band plans

3.4 It is expected that at its next meeting, the ECC will decide to either:

- give preference to an unpaired, TDD-compatible band plan, but with the option of a paired, FDD-compatible band plan as an alternative; or
- recommend that all administrations adopt solely an unpaired, TDD-compatible band plan.

3.5 Figure 1 demonstrates the proposed unpaired, TDD compatible, arrangement in this band, and Figure 2 the proposed paired, FDD compatible, plan option.

3.6 As Figure 2 demonstrates, under the paired option there is a need to split the band into two frequency blocks with an unused duplex gap between them. As a result of military uses in 3400-3410 MHz in a number of EU Member States the paired band plan also has an unused 10 MHz block at the top end of the band. The unpaired band plan (below) gives the potential to utilise all spectrum within the band for 4G services as it does not leave any portions of fallow spectrum - unlike the paired band plan option where 30 MHz (above 3410 MHz) remains unused.

[8] https://circabc.europa.eu/sd/d/11f69ffc-ca8f-4449-9d56-36688d5f7057/RSCOM13-47%20Amendment%20of%20EC%20Decision%20on%20the%203%204-3%208%20GHz%20band.pdf

Figure 1: Frequency arrangement for the 3400-3600 MHz band based on unpaired option

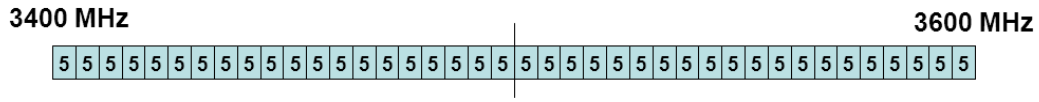
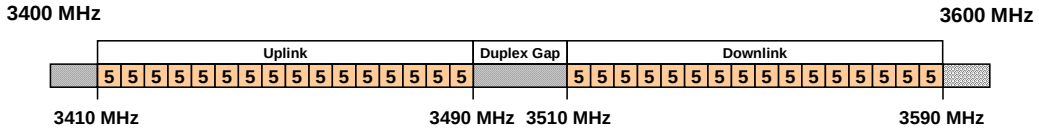


Figure 2: Frequency arrangement for the 3400-3600 MHz band based on paired option



European Harmonisation

3.7 ECC PT1 meeting number 42 (14-18 January 2013) developed a questionnaire to facilitate the discussion on a preferred frequency arrangement in the 3.5 GHz band[9] as requested by the ECC in Decides 3 of ECC Decision (11)06.

3.8 Administrations and companies which replied expressed a range of conflicting views on the proposed frequency arrangements in the 3400-3600 band, with some preferring paired, rather more preferring unpaired and two preferring paired and unpaired on an equal basis. The responses to the questionnaire indicate that to date manufacturers have focussed on the development of TDD equipment for the unpaired band plan.

3.9 Since the launch of the consultation on Draft CEPT Report 49 in June 2013, where the ECC requested views from industry and national administrations on a preference of band plan, there appears to be consolidation of views and an overwhelming support for an unpaired band plan. The preference for an unpaired band plan came from organisations within Europe, and responders from China, Africa, Latin America, Australia and Japan. There were no organisations that expressed a preference for a paired band plan, and only one country (Denmark) which expressed a preference for paired and unpaired band plans to be on equal footing.

3.10 Based on these responses to the consultation, it seems highly likely that the ECC will show a preference for an unpaired band plan with a paired band plan as the alternative option. This is likely to lead to a legally binding decision of the European Commission.

UK Broadband

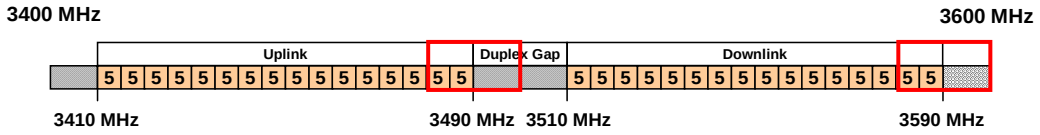
3.11 In considering the options for the wider band we must also consider the potential impact on UK Broadband which is already licensed to use the spectrum between 3480 and 3500 MHz and between 3580 and 3600 MHz. They use this spectrum for TD-LTE systems.

[9] Throughout this document we have referred to the 3400-3600 MHz band as the 3.4 GHz band. In European work this band of frequencies is referred to as the 3.5 GHz band.

UK Broadband's Spectrum holding with a paired Band Plan

3.12 UK Broadband's current spectrum holdings are incompatible with the paired, FDD compatible, band plan option being considered by the ECC. Their existing holdings partially overlap the duplex gap and extend beyond the option's proposed upper boundary. See Figure 3. Adopting this band plan would therefore have at least some impact on UK Broadband.

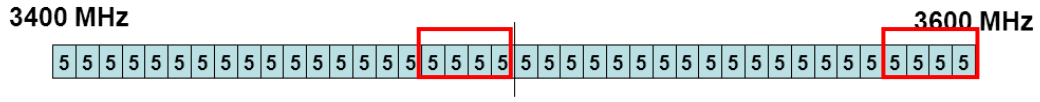
Figure 3: Frequency arrangement for the 3400-3600 MHz band based on a FDD band plan with UK Broadband spectrum holdings



UK Broadband's spectrum holding with an unpaired Band Plan

By comparison, UK Broadband's existing spectrum holdings are entirely compatible with the proposed unpaired, TDD compatible, band plan (see Figure 5 below). UK Broadband's lower block of 20 MHz does however split the remainder of the band into two discontiguous blocks.

Figure 4: Frequency arrangement for the 3400-3600 MHz band based on a TDD band plan with UK Broadband spectrum holdings



Ofcom's Current Proposal

3.13 We currently believe that licence conditions consistent with an unpaired (TDD-compatible) band plan are best suited to realising the most benefit from this spectrum, and that we should proceed on that basis.

3.14 The responses to the European Commission questionnaire and consultation referred to in paragraphs 3.7 to 3.10 above suggest that the majority of equipment manufacturers favour TDD over FDD. This suggests that they have existing TDD equipment for this band or are further forward in their roadmap for developing TDD equipment than they are for FDD. We therefore think that it is likely that the equipment ecosystem and performance may develop faster for TDD based systems than for FDD. The potential for the benefits of these new technologies is therefore likely to be realised faster with a TDD compatible unpaired band plan.

3.15 We believe a number of member states have allocations of existing mobile broadband services (like the UK has with UK Broadband) which will not always be aligned with the proposed paired band plan. An unpaired band plan is likely to provide greater flexibility in managing coexistence or transition with these incumbents.

3.16 While it is possible that the paired band plan may be made available as an alternative band plan, equipment manufacturers may choose to make only TDD equipment,

consistent with the unpaired band plan, as there will be additional costs to accommodate both band plans in equipment.

3.17 We therefore believe that the adoption of an unpaired band plan for the 3.4 GHz band will in practice deliver the greatest benefit to consumers and society. We are also of the view that it would be preferable to make this decision shortly after the close of this consultation (once we have had the opportunity to consider carefully all views expressed in response to this consultation) in order to allow both us and prospective users to focus on a single scenario for future use, rather than to leave the question of the band plan unresolved.

Question

Do you agree with our proposal to award the 3.4 GHz band in a way that is consistent with an unpaired (TDD-compatible) band plan only, and to make this decision sooner rather than later? If not, please set out your reasons and any evidence for your view.

Section 4

Proposal to vary UK Broadband Limited's licence

Introduction

4.1 UK Broadband Limited secured spectrum rights in the 3.4GHz band covering most of the country via auction in 2003. It acquired further rights through spectrum trading after the auction giving it a UK wide licence. The licence is currently made up of two non-adjacent 20 MHz spectrum blocks suitable for both TDD (time division duplex) and FDD (frequency division duplex) modes of use. However, having experimented with both modes, UKB have now concluded that TDD is the better mode for high capacity data networks.

4.2 In the previous section we concluded that an unpaired band plan was likely to secure the most efficient use of the spectrum hence benefits to consumers.

4.3 This section proposes that, if we decide to adopt an unpaired band plan, there would be further spectrum efficiency gains if we were to relocate the lower block in UK Broadband's licence. UK Broadband holds a licence to use two blocks of 20 MHz in the range 3.4 to 3.6 GHz: 3480-3500 MHz and 3580-3600 MHz. We propose to vary UK Broadband's licence so that it has instead a contiguous block of 40 MHz at the top of the band (3560-3600 MHz), allowing the remainder of the spectrum in the 3.4 GHz band to be offered in a contiguous block. This will (a) make it easier to accommodate a range of different demands within the spectrum to be awarded, and (b) reduce the number of inter-operator frequency boundaries which results from the spectrum award process.

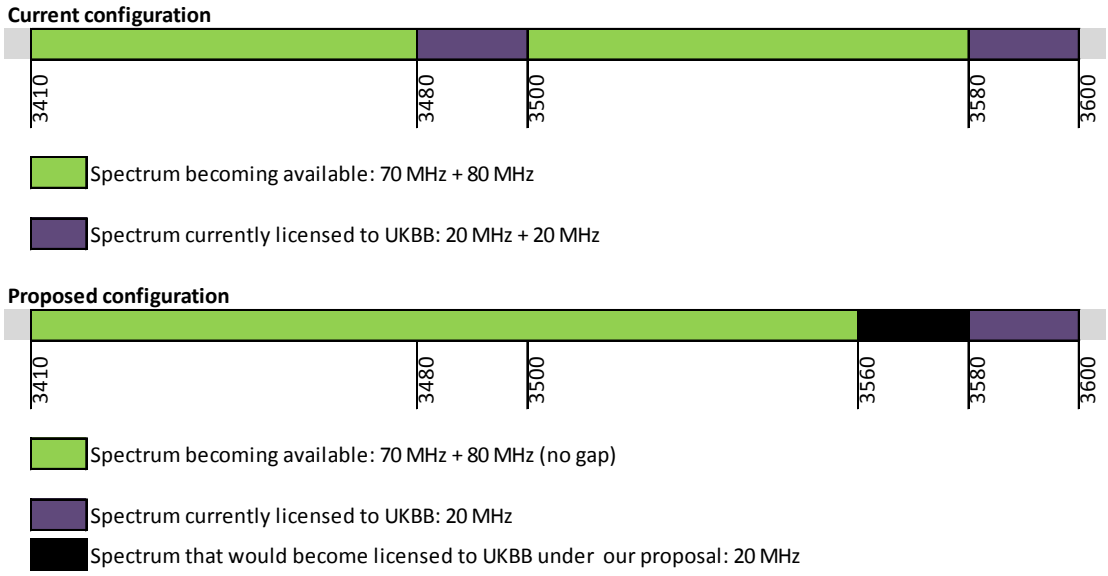
Relocation proposal

Context

4.4 UK Broadband's spectrum allocation within the 3.4 GHz band consists of two separate 20 MHz blocks, one at 3480-3500 MHz and one at 3580-3600 MHz. Their licence is currently valid until 2018, thus in planning our award of the remaining 150 MHz in the release band we must take account of their presence. The current configuration of UK Broadband's spectrum blocks means that we would need to manage three adjacencies with new licensees and that the 150 MHz available for award would be fragmented (with two blocks of spectrum of 70 MHz and 80 MHz being made available in 3410 – 3480 MHz and 3500 – 3580 MHz). We consider the implications of this further below.

4.5 Our proposal is to relocate UK Broadband's lower 20 MHz spectrum block from 3480-3500 MHz to 3560-3580 MHz as illustrated in figure 5 below.

Figure 5: current and proposed spectrum configurations



4.6 The relocation would mean that the 150 MHz of spectrum available for award would be in a single contiguous block of 150 MHz from 3410 to 3560 MHz. It would also mean that UK Broadband would have a single contiguous block of 40MHz at the upper end of the band leaving only one boundary with the rest of the band. To do this, Ofcom would need to amend UK Broadband's Wireless Telegraphy licence having first considered the impact of this change on any other party, in particular any with a specific interest in the 3560-3580 MHz block.

4.7 We consider that all contiguous spectrum assignments of a given size within the 3410-3560 MHz frequency range are likely to be broadly similar in value, irrespective of their location. For example, the whole band is included within the relevant LTE standard and we expect that equipment will be designed to cover the entire band. There could, in principle, be some differences in respect of coexistence with adjacent users above and below the band edges; but, even if this were to be the case, these would only affect the assignments immediately adjacent to the 3410 MHz and 3600 MHz boundaries, neither of which is material in the context of relocating the lower UK Broadband block from 3480-3500 MHz to 3560-3580 MHz.

Benefits of relocation

4.8 The benefits of relocating the block in a TDD environment come from :

- The potential for larger contiguous assignments which, in turn, gives operators the flexibility to deploy larger channel sizes; and
- Reduced technical constraints due to a lower number of spectrum boundaries between licensees.

4.9 These benefits can be illustrated by two examples. The examples show how different assignments of spectrum to new licensees can be fitted within the 3.4GHz band in the case where the UK Broadband assignments stay where they are now (with two separate blocks of 70MHz and 80MHz available for award at 3410-3480 MHz and 3500-3580 MHz respectively); and in the case where the lower UK Broadband 20MHz assignment is relocated as proposed (with one contiguous block of 150MHz available for award from 3410MHz to 3560MHz).

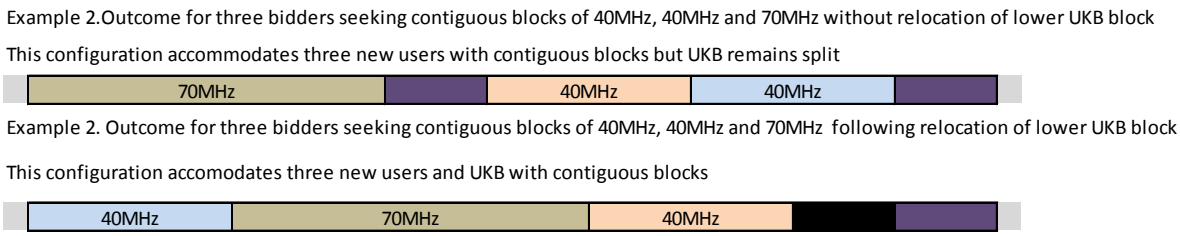
4.10 In the first example, the desired outcome is for three packages of 40MHz, 50MHz and 60MHz to be awarded. The top half of figure 6 below shows that, with the current UK Broadband assignment, it is not possible to fit this combination of packages into the two blocks of spectrum for award without splitting one assignment. UK Broadband itself continues to have a split assignment as well. If, however, the lower UK Broadband 20MHz assignment is relocated as proposed (see bottom half of figure 6) then there is no need to split any assignment to a new licensee; moreover, UK Broadband itself no longer has a split assignment.

4.11 The figure also illustrates that there are two fewer boundaries between different operators within the 3.4GHz band if the lower UK Broadband 20MHz assignment is relocated as proposed (there are 3 boundaries in the bottom half of the figure, compared with 5 in the top half).

Figure 6:

4.12 In the second example, the desired outcome is taken to be the award of three packages of 40MHz, 40MHz and 70MHz. It is possible to make contiguous assignments for each of these packages, even without the relocation of the current UK Broadband assignment, as shown in the top half of figure 7. However, UK Broadband itself continues to have a split assignment. Furthermore, a comparison of the top half and bottom half of figure 7 shows that there is still one less boundary between different operators within the 3.4GHz band if the lower UK Broadband 20MHz assignment is relocated as proposed (there are 3 boundaries in the bottom half of the figure, compared with 4 in the top half).

Figure 7:



4.13 In other words, the relocation of the lower UK Broadband 20MHz block would:

- Reduce the number of operators with a split assignment (UK Broadband itself and, possibly, one of the winning bidders in the forthcoming 3.4GHz auction); and
- Remove one, and possibly two, boundaries between adjacent operators that will exist following the forthcoming 3.4GHz auction.

Flexibility over carriers and channel widths

4.14 Where an operator has a block of contiguous spectrum it has the flexibility to choose the number and size of channels that it uses to provide services. For example, if an operator has a contiguous block of 40MHz then it can choose to deploy two channels of 20 MHz or one aggregated channel of 40MHz. In contrast, if the same operator has an allocation 2x20MHz of spectrum in two separate blocks, then the option of deploying a simple aggregated 40MHz carrier will not be available. We believe the increased flexibility associated with a contiguous block should help support efficient use of spectrum.

Spectrum boundaries

4.15 Where there is a boundary between two blocks of spectrum licensed to different operators this brings some constraints on the deployment of the associated networks. The transmitter and receiver characteristics of all communications systems mean that there is always some interaction between the transmitter in one block of spectrum and the receiver in the adjacent one. In some cases this can lead to some degradation from the theoretical maximum achievable performance of the impacted system.

4.16 The operators may choose to provide additional protection to mitigate this impact through:

- higher performance filtering;
- intelligent scheduling of resources;
- careful location of transmit sites; or
- synchronisation of the networks.

4.17 Each of these mitigation measures are effective in different scenarios and the choice of mitigation may depend on a number of factors related to the adjacent network such as the deployment scenario, business case and typical customer usage profile. Alternatively an operator may choose to accept any performance degradation which

means that they accept the interference environment caused by the adjacent licensee. This is likely to lead to increased interference and thus lower peak throughput and capacity of the particular cells. A licensee might determine that this is a reasonable degradation in their opinion

4.18 Cooperation between adjacent operators is desirable to maximise the benefits of any mitigations. However, all of the above approaches come with some cost, loss of flexibility and / or service degradation. In addition, the interaction between operators adds complexity and may require a degree of compromise which may not always be easy to achieve. The actual cost of these boundaries depends on the approach of different operators and how they decide to deploy and operate their networks in line with their licence conditions.

4.19 The above discussion relates to the case where all of the 150MHz of spectrum available for award is licensed for use without guard bands or restricted blocks between adjacent licensees. We will be consulting on this issue shortly as part of a wider consultation on technical conditions for the award. If, however, this wider consultation were to conclude that restricted blocks between adjacent licensees were necessary, then the effective cost of adjacencies would be very transparent; the amount of spectrum that could be licensed for high power use would be reduced by the size of the restricted block for every additional adjacency (for example, in the case of the 2.6GHz award, the packaging arrangements created a 5MHz restricted block between adjacent licensees).

Spectrum efficiency

4.20 Set against the tangible gains to spectrum efficiency described above, we do not consider that there are any drawbacks to relocating the lower UK Broadband 20 MHz block in the event that we decide to proceed with an unpaired band plan. In particular our current understanding is that the two blocks of 20 MHz of spectrum, 3480-3500 MHz and 3560-3580 MHz, are so highly similar in terms of coexistence and propagation characteristics that third parties would be very unlikely to have a particular preference for the higher frequency block over the lower frequency block, and therefore, all other things being equal, no particular preference for which one of these two blocks is made available for award (i.e. no negative impact on third parties of the proposed relocation). Accordingly, we are consulting on this proposal to vary UK Broadband's licence so as to relocate its lower 20 MHz assignment from 3480-3500 MHz to 3560-3580 MHz in the event that we decide to proceed with an unpaired TDD band plan following this consultation.

4.21 Under the EU Authorisation Directive (2002/20/EC) Member States must make new grants of rights of use of radio frequencies through open, objective, transparent and non-discriminatory procedures. We are therefore seeking information and views now on whether there is any demand or interest in the market for acquiring the 3560-3580 MHz assignment, which we propose to add to the UK Broadband licence, over and above any demand or interest that there might be in acquiring the 3480-3500 MHz spectrum that would become available as a result.

4.22 If any stakeholder does have a particular interest in the 3560-3580 MHz block, over and above their general interest in acquiring spectrum in the 3.4 GHz band, we would ask that they say so in response to this consultation, and set out the reasons for their particular interest. If we receive persuasive evidence that the 3560-3580 MHz block is more valuable than other spectrum in the 3.4 GHz band, and in particular the 3480-3500 MHz block, we may need to reconsider our proposal.

4.23 We note that the dependency of the relocation proposal on the choice of band plan is the reason why we are consulting on both of these proposals together in this document. Under a paired band plan we would need to further consider the implications for UK Broadband as an incumbent user of TDD systems in the band.

Questions

Do you agree with our proposal to vary UK Broadband's licence so that it encompasses the frequencies 3560-3600 MHz instead of 3480-3500 and 3580-3600 MHz?

Do you have any specific interest in the 3560-3580 MHz block in preference to any other 20 MHz block within the available 150 MHz? If so please give your reasons and any supporting evidence.

Section 5

Award process and competition issues

5.1 We are inviting stakeholders with an interest in acquiring access to the available frequencies to notify us of their potential interest and to give views on some aspects of the award, particularly about how they would use the spectrum. The information we receive will assist Ofcom in designing the most appropriate award. We appreciate that answering some of these questions may be difficult when the spectrum will not be awarded until 2015-16. However, early indication of views will help shape our developing policy on the award.

5.2 This Section sets out our initial thinking on how the award process might be conducted, the sort of non-technical licence conditions we might consider applying, and, at a high level, the competition issues we believe we need to consider. At this stage, these thoughts should not be regarded as formal policy proposals - instead, they are intended to generate stakeholder comment ahead of our development of specific policy proposals on which we will consult later. We would welcome views on our thoughts and on any other relevant issues which stakeholders have.

Licensed use of the bands

5.3 Ofcom's analysis of current and future European spectrum harmonisation suggests that the 2.3 and 3.4 GHz bands are likely to be used by telecommunications companies planning to deliver fixed and mobile services using 4G technologies.

5.4 The CEPT's work towards a new and updated harmonisation measure for the 2.3 and 3.4 GHz bands respectively will set out technical parameters that would support its use for high power applications.

5.5 Globally, neither of these bands have been internationally harmonised for general licence-exempt use. We are aware that the USA has a form of non-exclusive low to medium power access in bands around 3.4-3.6 GHz. However, we believe this is a result of the particular situation of continued military use in the USA. This does not apply in the UK – we envisage the bands being offered without significant encumbrance.

5.6 In the 2.6GHz award concurrent low power users had the opportunity to compete collectively with bidders on an individual basis for use at high power. However, there was in practice very little demand for concurrent low power use and concurrent low power users did not gain any spectrum in the award (at least not on a concurrent low power basis).

5.7 For these reasons, we do not currently envisage reserving any of the 2.3 or 3.4 GHz spectrum for low power use. We expect instead to make both the release bands available on an individually licensed basis suitable for high power use. However, we do not intend to preclude alternative uses should winning bidders for the spectrum have appropriate proposals (subject to compliance with technical parameters and licence conditions).

A market-led award

5.8 It is a key statutory duty of Ofcom to ensure optimal use of the radio spectrum. Our general principle is that in most cases the market should be left to determine the optimum use of the spectrum. This would normally be determined through an auction process if it is anticipated that there will be excess demand for the available spectrum.

5.9 In adopting a market-led approach to an award, we support the principle that the award process itself should be 'use-neutral' i.e. any potential users should be free to bid for the spectrum to use as they see fit. However, it is necessary for the technical licence conditions we apply to be consistent with national and international spectrum assignments.

5.10 In terms of the overall auction process, we note that the combinatorial clock auction (CCA) design has worked effectively in a number of auctions held by Ofcom, including the 2013 award of the 800 MHz and 2.6 GHz spectrum (the 4G auction). However, this is not the only option. We welcome any views by potential bidders on the choice of auction design, or more generally on what the appropriate characteristics might be for an auction of 2.3 and 3.4 GHz spectrum.

Competition issues

5.11 The proposed award would release a significant amount of spectrum (190 MHz) that could be used to provide future mobile services (without prejudice to other possible uses). As such, we consider it appropriate for us to assess the potential implications for competition in mobile markets. We will conduct a more detailed assessment of these implications in a subsequent consultation.

Our initial assessment

5.12 We have carried out a very high level assessment of the potential impact on competition in mobile markets caused by the proposed award of spectrum at 2.3 GHz and 3.4 GHz by considering:

- the amount of spectrum being released;
- the likelihood that an auction could result in an asymmetric distribution of spectrum; and
- the magnitude of the risk to competition if the newly released spectrum was obtained by an operator that already held a substantial amount of spectrum.

5.13 In doing so, we have taken into account the competition assessment conducted for the 800 MHz and 2.6 GHz Auction[10], where this is relevant.

5.14 We do not currently believe that the planned release of spectrum at 2.3 GHz and 3.4 GHz poses any risk to the number of national wholesalers of mobile services, since our initial view suggests that none of the existing national wholesalers requires access to this spectrum in order to remain competitive. This is because we believe the spectrum is likely to be of most value in providing additional options for network

[10] Ofcom, *Assessment of future mobile competition and award of 800 MHz and 2.6 GHz*, Statement, July 2012, http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/statement.pdf. In particular see Section 4.

operators facing capacity pressures in other frequencies or for other network deployments (for example rural broadband or backhaul).

5.15 The remaining potential concern relates to the intensity of competition over certain customer segments or services due to an asymmetric distribution of spectrum. Our preliminary view is that it is unclear the extent to which an operator with large existing spectrum holdings would gain a competitive advantage over its rivals if it acquired a large proportion of this spectrum, given the current limitations on the spectrum's usage.

5.16 However, we are aware that technological and market developments over time can affect the importance of holding particular blocks of spectrum and thereby affect the intensity of competition. We intend to further assess this potential risk, consider the likelihood of it arising, and the magnitude of the concerns it may pose in a planned future consultation.

Addressing potential concerns

5.17 If we were to find a potential concern related to the asymmetric distribution of spectrum, then we consider it may be appropriate to design a cap to limit the amount of newly released spectrum that any one operator could acquire in the auction. Our preliminary thinking is that it may be appropriate to set a cap on the amount of spectrum that any operator can acquire in the auction such that no one operator could hold spectrum in excess of 36% of the total in the relevant bands at the end of the auction. This would be proportionately consistent with the overall cap set in the 800 MHz and 2.6 GHz auction. At this stage we have not considered exactly which bands should or should not be included within any such overall spectrum cap. We will consult on this later if we decide that a spectrum cap may be appropriate.

Spectrum packaging

5.18 Our preference is to facilitate flexibility on how the spectrum may be used. In principle, packaging spectrum in the minimum sized blocks allows for the greatest flexibility in use.

5.19 As set out in this paper, within Europe there is an inclination towards the use of TDD within both the 2.3 and 3.4 GHz bands. Band plans based on a minimum block size of 5 MHz are proposed for both bands. We believe such a division makes sense in the case of the 2.3 GHz award as it comprises of only 40 MHz of spectrum in total.

5.20 We could adopt the same approach towards the 3.4 GHz band. However, we have considered whether such small spectrum block allocations may be less practical for an award of a much larger band of spectrum i.e. 150 MHz. There is a possibility, for example, of making an auction over-complicated if such spectrum block allocations are transposed into auction 'lots'. For this reason, we have considered whether 10 MHz blocks may be better suited for the award of the 3.4 GHz band. We would welcome views on whether 5 MHz or 10 MHz blocks should be adopted, or whether an entirely different arrangement may be appropriate.

Non-technical licence conditions

Overview

5.21 Given the potential use of the 2.3 and 3.4 GHz bands for mobile broadband, we expect the non-technical licence conditions to be broadly similar to those used in the

recent 800 MHz and 2.6 GHz award. These were subject to consultation, and our decisions on the various conditions were set out in section 9 of our statement.[11] These include decisions on licence commencement and duration; the payment of licence fees; the tradability of licences etc. We also outline the territorial extent of licences (which differs from the 800MHz and 2.6 GHz award). These are summarised in the table below. We have given specific further consideration to two particular aspects of potential non-technical licence conditions: coverage/roll-out obligations and the application of a 'use it or lose it' clause.

Coverage/Rollout obligations

5.22 The existence of mobile not-spots, alongside other coverage issues, is an area of citizen and consumer concern[12]. We have therefore included a coverage obligation in one 800 MHz licence and all 2100 MHz licences. At 800 MHz, the holder of one of the licences is required to provide coverage to 98% of the population of the UK. The obligation on all holders of 2100 MHz licences is that they cover (by mid-2013) 90% of the UK population. There are no coverage obligations placed on holders of 2.6 GHz licences.

5.23 We have considered whether obligations should be placed on 2.3 and 3.4 GHz licensees. In broad terms, the 2.3 GHz and 3.4 GHz bands have similar characteristics to the 2.6 GHz band, on which no coverage obligations are placed. Additionally, the 2.3 GHz and 3.4 GHz frequency bands are likely to be better suited to providing additional network capacity, rather than coverage. We are therefore minded not to include any coverage obligations in licences issued as part of this award.

'Use it or lose it'

5.24 We have also considered whether or not to apply non-technical licence conditions requiring spectrum holders to make use of the frequencies they acquire - or risk having them taken away. We do not consider that imposing obligations such as these are in the interests of consumers and citizens. This is for a number of reasons:

- We believe that such conditions are very difficult to make workable in practice because of the problem of defining what constitutes 'use' and therefore the trigger for an enforced sale or revocation;
- There may be entirely legitimate reasons for spectrum remaining unused – the licensee may be holding back until it sees a suitable commercial opportunity or until the technology it wishes to use is ready;
- Imposing such an obligation also has the potential to distort and/or chill the incentives to invest in the spectrum, and so reduce the benefits for consumers and citizens which the award would otherwise create.

5.25 In addition to these general considerations, there are specific factors in respect of the 2.3 and 3.4 GHz spectrum which we believe make 'use it or lose it' inappropriate. In particular we believe this spectrum could be used to ease capacity issues for mobile network operators rather than for expanded coverage. As such, it may be used initially only in high density areas where capacity is an issue, with the spectrum left unused in other areas.

[11] http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/statement.pdf
[12] http://www.ofcom.org.uk/files/2013/03/annplan1314.pdf

5.26 That said, as with all awards, the licences awarded by Ofcom are not exclusive. If a key public policy objective could only be met through use of this spectrum, and the licensees were unwilling or unable to meet this objective, but other users could, Ofcom intends to reserve the right to grant additional licences for the use of some or all of these frequencies, with appropriate safeguards to appropriately manage the risk of interference.

Other non-technical licence conditions

5.27 In respect of other non-technical licence clauses, we intend broadly to mirror the conditions set out in the 800 MHz and 2.6 GHz Award statement, subject to consideration of other views expressed by stakeholders. These are summarised in the table below:

Proposed Licence conditions	**2.3 GHz licences**	**3.4 GHz licences**
Licence duration	Indefinite period	Indefinite period
Initial licence period	20 years	20 years
Territorial extent of licences	Great Britain (not Northern Ireland) but possibly excluding Outer Hebrides[13]	Great Britain (not Northern Ireland)
Licence fees	Award fee for initial period. Additional e.g. annual charges for remainder of licence period to be determined at a later date.	Award fee for initial period. Additional e.g. annual charges for remainder of licence period to be determined at a later date.
Spectrum Trading	Fully tradable subject to Ofcom giving its consent to a trade prior to it being implemented. This may require a competition assessment to be conducted.	Fully tradable subject to Ofcom giving its consent to a trade prior to it being implemented. This may require a competition assessment to be conducted.
Providing information	Requirement to provide general information regarding equipment and use of frequencies, or the roll-out of networks.	Requirement to provide general information regarding equipment and use of frequencies, or the roll-out of networks.
Rollout/ Coverage obligations	None	None

[13] 2.3 GHz spectrum may be subject to on-going Ministry of Defence use

Questions

Do you have any specific interest in acquiring a licence to use frequencies in either or both of the bands to be awarded?

How much spectrum would you be interested in acquiring? (What is the minimum and maximum amount of spectrum of interest to you?)

Which of the two bands would you be interested in: 2.3 GHz, 3.4 GHz or both?

Are there specific parts of the bands you are interested in and if so what are they?

What do you envisage using the spectrum for (e.g. 4G services or other applications)?

Where would you expect to use the spectrum (Great Britain-wide or in specific geographical areas)?

What types of device would you want to use the spectrum for, and when would they be available?

When would you expect to make use of the spectrum?

Do you have any comments on the method of award, such as combinatorial clock auction?

Do you have any comments on whether a cap on the amount of spectrum that could be acquired through this award would be appropriate?

Do you have any preference for spectrum packaging, for example block size?

Do you have any views on the non-technical licence conditions discussed in this document, including coverage and roll-out and "use it or lose it"?

What do you consider would be the optimal timing for the award?

Are there any reasons why these bands should be assigned for low-power use? Would such uses be appropriate even if purchasing a licence for low-power use would cost the same as for high- power use?

Will you use this spectrum for backhaul? If so, please state the minimum contiguous block you would require.

Section 6

Next Steps

Responses

6.1 For the reasons outlined in this document, we propose to award this spectrum in the most efficient way, consistent with our statutory duties.

6.2 We are consulting for 6 weeks, and consider that this is an appropriate period which balances both the need to plan the next stage as expeditiously as possible, whilst still providing interested parties with sufficient time to consider our questions.

6.3 If you are interested in these spectrum bands we would request you to:

- Consider the list of questions in Annex 4.
- Respond before the deadline of 27 November, 2013.

6.4 We expect to publish further consultations on our proposals including a consultation on the co-existence issues for spectrum associated with the 2.3 and 3.4 GHz award bands.

6.5 The information we receive from stakeholders in response to this document will assist Ofcom in designing the most appropriate award. We appreciate that answering some of these questions is difficult at a distance in time from likely deployment. However, early indication of views will help shape the developing policy on the allocation. In due course, we will publish a consultation on our proposals for the award.

Annex 1

Responding to this document

How To Respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made by 5pm on 27 November 2013.

A1.2 Ofcom strongly prefers to receive responses using the online web form at https://stakeholders.ofcom.org.uk/consultations/2.3-3.4-ghz/howtorespond/form as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.

A1.3 For larger responses - particularly those with supporting charts, tables or other data - please email pssr@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.

Keith Gibbins
Spectrum Policy Group
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but unfortunately not otherwise.

Further Information

A1.5 If you would like to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Keith Gibbins on 020 7981 3742.

Confidentiality

A1.6 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate Annex.

A1.7 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.8 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/about/accoun/disclaimer/

Ofcom's Consultation Processes

A1.9 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles at Annex 2.

A1.10 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.

A1.11 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Graham.Howell@ofcom.org.uk

Annex 2

Ofcom's consultation principles

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

Before the consultation

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

During the consultation

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

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

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation Response Cover Sheet

A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, www.ofcom.org.uk.

A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.

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

A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.

A3.5 Please put any parts of your response you consider should be kept confidential in a separate Annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover Sheet

BASIC DETAILS

Consultation title: 2.3 and 3.4 GHz spectrum award: Consultation on a 3.4 GHz band plan, varying UK Broadband Limited's licence and a call for inputs on other aspects of the award

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing ☐

Whole response ☐

Part of the response ☐

Name/contact details/job title ☐

Organisation ☐

If there is no separate Annex, which parts?

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

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

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

Name

Signed (if hard copy)

Annex 4

Consultation and Call for Inputs Questions

Question 1: Do you agree with our proposal to award the 3.4 GHz band in a way that is consistent with an unpaired (TDD-compatible) band plan only, and to make this decision sooner rather than later? If not, please set out your reasons and any evidence for your view.

Question 2: Do you agree with our proposal to vary UK Broadband's licence so that it encompasses the frequencies 3560-3600 MHz instead of 3480-3500 and 3580-3600 MHz?

Question 3: Do you have any specific interest in the 3560-3580 MHz block in preference to any other 20 MHz block within the available 150MHz? If so please give your reasons and any supporting evidence.

Question 4: Do you have any specific interest in acquiring a licence to use frequencies in either or both of the bands to be awarded?

Question 5: How much spectrum would you be interested in acquiring? (What is the minimum and maximum amount of spectrum of interest to you?)

Question 6: Which of the two bands would you be interested in: 2.3 GHz, 3.4 GHz or both?

Question 7: Are there specific parts of the bands you are interested in and if so what are they?

Question 8: What do you envisage using the spectrum for (e.g. 4G services or other applications)?

Question 9: Where would you expect to use the spectrum (Great Britain-wide or in specific geographical areas)?

Question 10: What types of device would you want to use the spectrum for, and when would they be available?

Question 11: When would you expect to make use of the spectrum?

Question 12: Do you have any comments on the method of award, such as combinatorial clock auction?

Question 13: Do you have any comments on whether a cap on the amount of spectrum that could be acquired through this award would be appropriate?

Question 14: Do you have any preference for spectrum packaging, for example block size?

Question 15: Do you have any views on the non-technical licence conditions discussed in this document, including coverage and roll-out and "use it or lose it"?

Question 16: What do you consider would be the optimal timing for the award?

Question 17: Are there any reasons why these bands should be assigned for low-power use? Would such uses be appropriate even if purchasing a licence for low-power use would cost the same as for high- power use?

Question 18: Will you use this spectrum for backhaul? If so, please state the minimum contiguous block you would require.

Respondents are encouraged to send relevant supportive evidence alongside their replies.

Annex 5

Impact Assessment

A5.1 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making.

A5.2 At this early stage of the award process for the 2.3 and 3.4 GHz spectrum bands, we are seeking the views of stakeholders on what is the best potential use of these frequencies. This will help us develop more detailed policy proposals. We will then consult in detail on our proposals for the award of the spectrum. At that stage, we will be more able to assess the potential impact of any proposals on citizens and consumers. The further consultation will include detailed assessments of the impact on existing users of the spectrum, and on users of adjacent spectrum.

A5.3 For these reasons, we do not consider it appropriate at this stage to conduct a formal impact assessment in relation to the award.

Equality Impact Assessment

A5.4 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects and practices on race, disability and gender equality. Equality Impact Assessments (EIAs) also assist us in making sure that we are meeting our principal duty of furthering the interests of citizens and consumers regardless of their background or identity.

A5.5 As with the more general impact assessment, we consider it is too early in the award process to fully assess these issues. An equality impact assessment will be completed alongside the further consultation on the award.

A5.6 We have not identified any particular impact of our proposals in relation to the identified equality groups. Specifically, we do not envisage the impact of any outcome to be detrimental to any particular group of society.

A5.7 We have not seen the need to carry out separate EIAs in relation to the additional equality groups in Northern Ireland: religious belief, political opinion and dependants. We do not anticipate that our proposals will have a differential impact in Northern Ireland compared to consumers in general.