Enabling mmWave spectrum for new uses

Making the 26 GHz and 40 GHz bands available for new technology

BT's response to Ofcom consultation and statement issued 13 March 2023

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BT Group

Executive summary

1. BT supports Ofcom's plans to enable use of mmWave spectrum for mobile in 2024. We welcome the progress made to date on design of the award of licences by auction. We are content with Ofcom's timetable and broadly agree with Ofcom's plans. However, we have concerns about some aspects of Ofcom's consultation proposals and provide our comments and suggestions as to how these could be further refined to achieve the best possible outcome for UK consumers.

2. BT is content with the proposed clock auction format and the assignment round proposals for the licences for the high density areas. We agree that all high density areas should be grouped together and made available as a single auction lot: disaggregating any high density areas would require considerable changes to the auction design and the problems arising from such additional complexity would outweigh any benefits. However, we have some concerns on the detail of the auction format we think Ofcom should address:

    - The spectrum at 26 GHz and 40 GHz should be awarded in 200 MHz rather than 100 MHz blocks. This would be more compatible with likely use cases; is a requirement in legislation; would be consistent with awards in other countries; and would be more likely to deliver an efficient auction outcome.
    - Enhancements should be made to the way eligibility points reduce round by round, to avoid unpredictable reductions in points when switching demand between bands. Safeguards against unexpected events preventing a bid submission are also needed.
    - The full results from the clock auction round should be published to enable bidders to better prepare for the assignment round(s).
    - We agree with two separate 26 GHz lot categories, although we are open to changes should the situation in relation to remaining links or their coordination constraints be further clarified (i.e. so that there is no longer any significant interference to planned mobile services).

3. The proposed 15 year fixed term auction licences, with no presumption or mechanism for extension, will not secure optimal and efficient use of the spectrum. By virtue of setting a short duration fixed term licence, Ofcom appears to favour short-term investments without having made the case for this. Furthermore, Ofcom signals a wide range of options for re-farming the spectrum at the end of the licence period, including by auction, and potentially in different combinations of lots (geographic, shared, etc): there is a need for greater certainty and stability over the (much longer) timescales needed to recoup investments necessary to make efficient use of this spectrum. Ofcom is allowing 5 years to clear fixed links before use for mobile; then further time will be needed for the mmWave mobile ecosystem to develop and for networks to be deployed. 15 year fixed licences are also inconsistent with Ofcom's past policy for other mobile spectrum licences that have been auctioned.

4. We believe Ofcom should opt for indefinite licences, with a 20 year initial term coupled with greater support for market mechanisms, including voluntary (commercial) leasing. If Ofcom persists in its proposal for a fixed licence duration it should at a minimum provide certainty that it would expect to renew the licence unless there is evidence of materially inefficient use. This is likely to assist in achieving more efficient use of the spectrum (supporting mitigation of the risks of longer licences Ofcom identifies e.g. that spectrum is left inefficiently used for a long time) and has limited downsides compared with its potential benefits.

5. Regarding power levels, BT requests that Ofcom allows slightly higher in-band levels for the auction licences to be compatible with expected equipment capabilities and use cases anticipated for future use of the licences. We propose a maximum in-band power limit of 36 dBm TRP per 200 MHz for base stations. For devices, a separate and higher power level should be permitted for fixed wireless access equipment.

6. Regarding Ofcom's proposal on fixed links in the 26GHz and 40GHz bands, we consider: (i) Ofcom should consult on fees for links remaining after the 5 year revocation period nearer the time (this is important to ensure they can be set at a more efficient level, reflecting forward looking market conditions at that point in time); and (ii) of the possible options for coordination of new mobile use in the auction areas during the 5 year fixed links revocation period, currently our preference is a combination of Ofcom undertaking this in a timely manner and supplying indicative maps to assist licensees in their planning.

7. The proposals for Shared Access licences outside the auction areas at 26 GHz, and after 5 years also at 40 GHz, appear to be a reasonable approach, but we note these could later be refined in the light of experience as use of mmWave bands increases.

1 Introduction

BT[1] welcomes this opportunity to provide its views on Ofcom's further proposals[2] to make the 26 GHz and 40 GHz bands available for new technology.

We support Ofcom's aim to make mmWave spectrum available by early 2024 and appreciate the further work Ofcom has undertaken to take on board some of the suggestions made in our response to the previous consultation. In particular, we welcome the modification of the designated high density geographic areas and their inclusion in sub-national auction lots.

Whilst we broadly support Ofcom's approach to awarding mmWave spectrum, we identify some aspects of the latest proposals where further improvements are recommended or are necessary, including the duration of auction licences; certain details of the auction process design; and technical and non-technical licence conditions.

Our response is structured around the sections of the consultation document and their associated consultation questions.

2 Authorisation of 40 GHz band

Question 1 (section 3): Do you have any further comments on the approach we are minded to take to authorising the 40 GHz band?

In response to the previous consultation, BT explained why it considered that the option of revoking the existing 40 GHz licences would not be appropriate and is unlikely to secure optimal and efficient use of the spectrum[3]. Ofcom has nevertheless decided to go ahead and re-auction the spectrum in high density areas and authorise its use outside these areas using shared access licences.

Outside of the high traffic areas that are to be included in newly auctioned licences, Ofcom proposes to make low and medium power shared access licences available after the end of the 5 year notification period for revocation of existing 40 GHz licences. We agree with this proposal.

We agree that the 26 GHz band should be sufficient to meet initial demand for Shared Access licences. Waiting until the end of the 5 year period before issuing 40 GHz shared access licences would help manage Ofcom's resources and reduce possible coordination burden on the existing 40 GHz licensees. We are therefore in agreement with Ofcom's plans in relation to timescales for making 40 GHz shared access licences available.

We support Ofcom's proposal to allow existing 40 GHz fixed links to continue under new individual licences where they do not conflict with the new spectrum use in the high traffic areas.

3 Fixed links in 26 GHz band

Question 2 (section 5): Do you agree with the method that we have outlined in annex 16 for identifying which licences authorising the use of fixed links around high density areas will be subject to revocation on the basis that the authorised links would be likely to suffer interference from new users in the high density areas? If not, please give reasons.

BT agrees with the analysis in Annex 16 that has been used to determine which fixed links may suffer interference from mobile technology deployments in the high density areas and would therefore be required to move.

We agree that the dominant interference scenario would be from mobile into the fixed links. On a point of detail, concerning Table A16.3 of the consultation document, we question whether for the fixed link to mobile interference assessment the "Bandwidth adjustment factor" should be 0 dB rather than 5.5 dB if considering interference from a single fixed link of 56 MHz with a mobile receiver of 200 MHz.

[1] BT plc, including its mobile subsidiary EE Ltd.

[2] https://www.ofcom.org.uk/__data/assets/pdf_file/0015/255030/03-23-statement-and-consultation-mmwave.pdf

[3] See section 7.3 of BT's response to Ofcom's first consultation on "Enabling mmWave spectrum for new uses", July 2022 https://www.ofcom.org.uk/__data/assets/pdf_file/0028/243586/BT-EE.pdf

4 Approach to existing 40 GHz licensees

Question 3 (section 7): Do you agree that the licence fee for fixed links that we allow to remain in the 40 GHz band should be the same as the fee in place for the 26 GHz band? If not, please give reasons.

We understand that Ofcom proposes to apply annual fees for retained 40 GHz fixed links, commencing after the end of the 5 year notice period, i.e. at the point when they would cease to operate under the existing spectrum access licence and would be authorised under a new licences for the specific links that may remain. We agree that is appropriate given the circumstances of the existing spectrum access licence revocation.

Ofcom should only consult and decide nearer the end of the 5 year revocation period what the appropriate fees for the retained 40 GHz fixed links should be. In 5 years' time the extent of demand for mobile use should be more apparent, given knowledge of the auction bids as well as the volume of shared access licence requests (that cannot be agreed due to the presence of the remaining links) and other market intelligence about the value of the spectrum on a forward looking basis. In this way it will be possible to more accurately assess what the opportunity cost of operating the retained links might be.

Ofcom currently proposes that the fees for the retained 40 GHz links would be set at the level used for 26 GHz fixed links. However, we note that the 26 GHz fees were originally set long ago on the basis of encouraging use of the most efficient fixed link technology. In the case of the retained 40 GHz links there is no opportunity to move to more efficient technology as Ofcom says it will not allow the links to be reconfigured. There is therefore no reason to apply administrative incentive pricing to 40 GHz that is set on the basis of promoting use of more efficient technology. Cost based fees would be more appropriate in the circumstances where the band is not proposed to be open to new fixed link licences.

In summary, Ofcom should decide on any annual fees for retained 40 GHz links only in 5 years' time given that the level of demand for mobile use should be more apparent, then.

5 Auction design

5.1 Auction rules

Question 4 (section 9): Do you have any comments on the proposed rules of our auction?

5.1.1 Auction format

We are content with Ofcom's proposal to use a clock auction format and in general are satisfied with the various rules that are proposed as part of Ofcom's detailed implementation of this auction format for this award. We do, however, have some comments on the details of Ofcom's proposals as set out in the following sections.

5.1.2 Eligibility points

We agree with the use of eligibility points to constrain bidding and manage ability to transfer demand between bands. We consider the proposed ratio of eligibility points in the 26GHz and 40 GHz bands to be reasonable. However, if Ofcom were to carve out specific geographic areas into separate lot categories, then we believe bidders would need the ability to transfer demand between geographic areas (see next sub-section), which will necessitate different eligibility points to reflect the differences between geographic lots.

5.1.3 Sub-national licences

BT welcomes Ofcom's proposal to make all high-density areas available in a single lot category. This is an important simplification of the auction and will support more efficient use of the spectrum.

We are concerned that if specific urban areas were removed from the sub-national licences and auctioned separately, this might lead to a consequential need to add significant complexity beyond just awarding the areas as separate lots. For example, to allow switching demand not just between the three lot categories in the areas that are separately auctioned (i.e. lower 26 GHz, upper 26 GHz and 40 GHz, respectively), but between areas, would have implications for necessary grace periods, activity rules etc. This is because bidders might want to shift demand between areas depending on how prices in those areas move, particularly where bidders' budgets are limited. As we understand the present proposal, if some urban areas were carved out, these would essentially be awarded under separate parallel auctions. The inability to switch demand

between those areas and between those areas and the sub-national licence may impede efficient allocation of spectrum, which would not be in line with Ofcom's objectives and statutory duties. For example, a budget limited bidder might want to swap its demand between urban areas if the cost in one area became unaffordable whereas another area turned out to be cheaper than expected, or spectrum might even be unsold if demand could not be transferred.

There is likely to be some complementarity between the sub-national licence areas and any disaggregated areas, which increases complexity for bidders when preparing for the award as well as when bidding. For example, as the auction progresses, if it transpires that a bidder might be able to afford more of a band in one area than expected[4], then this bidder might also want to increase its demand for the same band in another area (if these two lot types are complements). To increase its demand for the same band in this 'other' area, the bidder may wish to transfer a small amount of its eligibility points from *all* other lot types, not just lot types in the same geographic area. However, Ofcom's proposals would prohibit the bidder from transferring eligibility points from other areas in this way, and in doing so prevent the bidder from accurately expressing its true demand. This could lead to an inefficient auction outcome, which would not be in line with Ofcom's objectives and statutory duties to promote efficient use of spectrum.

Complexities could also potentially arise in the assignment round process, for example: the large uncertainty as to what in aggregate the second price payment will be when bids are placed in numerous assignment rounds and the possibility of getting very different frequency assignments in each geographic area. This increased uncertainty may discourage a budget-limited bidder from expressing its true value for each assignment stage option (even more so than otherwise for a budget-limited bidder), which again could lead to an inefficient auction outcome in conflict with Ofcom's objectives and statutory duties to promote efficient spectrum use.

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To be clear, we do not advocate disaggregation of some urban areas from the sub-national licences: our point is that if Ofcom were to do this it could lead to a need to introduce significant complexity to the auction procedure, which is undesirable.

In summary, the additional complexity if areas are disaggregated from the sub-national licences is significant in terms of costs of preparing for and participating in the auction, as well as risks of errors being made in bidding. These costs are likely to outweigh any efficiency benefits that may arise (and in any event we do not consider there to be any such benefits), especially when considering that the spectrum is tradable and any party interested in a specific deployment area would have multiple potential options to get access to spectrum by commercial arrangement post-auction.

5.1.4 Reserve prices

We are content with the reserve prices that Ofcom proposes on the basis that they are below market prices observed in other European auctions and so are not likely to lead to unsold spectrum. At the same time, they represent a significant financial commitment and should deter frivolous bidders, which presumably is one of Ofcom's purposes for setting reserve prices.

5.1.5 Lot sizes

Ofcom proposes to use a lot size of 100 MHz in the auction of high density area licences in the 26 GHz and 40 GHz bands. We maintain the view we expressed in the earlier consultation where we argued for 200 MHz lots. Not only do we consider this to be more appropriate for the technology and applications that we could deploy in these bands, we also believe that in the case of the 26 GHz band it is a legal requirement according to the EC Decision on 26 GHz that is part of UK law[5]. This clearly states that "The assigned block size shall be a multiple of 200 MHz". The provision in the regulation for smaller block sizes is intended to deal with any odd remaining spectrum amount at the band edge where the portion of the band awarded is not a multiple of 200MHz. We further note that other EU countries that have awarded the 26 GHz band spectrum have awarded 200 MHz blocks or multiples thereof[6] and see no reason why the UK should adopt a different practice.

A further concern is that the proposed 100 MHz lot size might make strategic bidding easier as it could (i) lower the cost of strategic investment and (ii) create ability to leave an odd number of 100 MHz lots available.

[4] For example, because this lot type turns out to have less excess demand than expected, suggesting that it might turn out to be cheaper than expected.

[5] See Section 2 (2) of Annex to Commission Implementing Decision (EU) 2019/784 https://www.legislation.gov.uk/eudn/2019/784/annex

[6] For example, Croatia (2021), Slovenia (2021), Spain (2021), Denmark (2021), Finland (2020), Greece (2020), Italy (2018).

We would prefer that the 40 GHz is also awarded in 200 MHz blocks, to be consistent with 26 GHz and recognising the even larger bandwidth available in that band for award. The harmonised European frequency plan for the 40GHz band[7] is based on "Use of a 200 MHz block size approach which is in line with the mobile systems foreseen to be used in the 40.5-43.5 GHz band".

5.1.6 Grace rounds to stop bidders unintentionally losing eligibility

We are concerned that Ofcom's proposals allow bidders to unintentionally lose eligibility when switching between bands; and believe that grace rounds would help to mitigate this. By way of illustration:

- In the example below, say Bidder A wants to move from its current processed demand (PD) of (2, 2, 3) to a new PD of (1, 1, 6)
- Bidder A's current eligibility points (EP) are 9, and its bids also add up to 9.

Bids submitted:

Category	Supply	EP	Opening Price	Clock Price
26 GHz lower	14	1.5	**100**	**110**
26 GHz upper	10	1.5	**100**	**110**
40 GHz	30	1	**50**	**55**

Sum EP = 9

Bidder A:

PD (last round)	Bid 1	Price 1	PD (this round)
2	**1**	101	**1**
2	**1**	101	**2**
3	**6**	54	**4**

Sum EP = 8.5

- Bidder A's first bid in the queue is 26 GHz lower (may be as a result of a tie) and Bidder A's drop in demand is accepted in full. Bidder A's PD goes to 1.
- Bidder A's second bid in the queue is in 26 GHz upper (may be as a result of a tie) but the drop is not accepted. There was insufficient excess demand, perhaps because others dropped prior to Bidder A in the round. Bidder A's PD remains 2.
- Bidder A's final bid is for the 40 GHz upper. In this case the bid cannot be accepted in full since the bid would require 6 EP but Bidder A has only 4.5 EP remaining. The bid is then partially accepted; and Bidder A's PD goes to 4.
- So Bidder A's total processed demand is (1x1.5 + 1x1.5 + 4x1) = 8.5 which equals their EP for the next round.

This means that as a result of differences in EP between bands that are imperfect substitutes (i.e. lower vs higher value bands), EP differences (even if calibrated correctly at the outset) could cause bidders to *unintentionally* lose eligibility points when switching between lot types, which is concerning because it could prevent bidders from expressing (the latest) demand for the spectrum they seek, potentially leading to an inefficient auction outcome in conflict with Ofcom's objectives and statutory duties to promote efficient spectrum use.

The situation above doesn't just arise when bidders are moving from two lots to one; it also arises in many other cases. And it can't always be prevented by using all or nothing bids. For example:

- In the example below, say Bidder B wants to move from its current processed demand of (5, 3, 6) to a new demand of (2, 2, 12).
- Bidder B's current EP is 18, and its bids also add up to 18.
- Bidder B could make its two bids to reduce demand by placing bids for (3, 1, 12) or (1, 3, 12) with the bids to reduce demand being all or nothing bids, in which case Bidder B cannot unintentionally lose eligibility.

[7] https://docdb.cept.org/download/4179

- But this doesn't work if the drops are not both for an even number of lots (i.e. Bidder B genuinely want to go to (2, 2, 12).

Bids submitted:

Category	Supply	EP	Opening Price	Clock Price
26 GHz lower	14	1.5	**100**	**110**
26 GHz upper	10	1.5	**100**	**110**
40 GHz	30	1	**50**	**55**
				Sum EP = 18

Bidder B:

PD (last round)	Bid 1	Price 1	PD (this round)
5	**2**	101	**2**
3	**2**	101	**3**
6	**12**	54	**10**
			Sum EP = 17.5

- Say Bidder B's first bid in the queue is 26 GHz lower (may be as a result of a tie) and the drop is accepted in full. Bidder B's PD goes to 2.
- Bidder B's second bid in the queue is 26 GHz upper (may be as a result of a tie) but the drop is not accepted. There was insufficient excess demand, perhaps because others dropped before Bidder B in the round. Bidder B's PD remains at 3.
- Bidder B's final bid is for the 40 GHz upper. In this case the bid cannot be accepted in full since the bid would require 12 EP but Bidder B has only have 10.5 EP remaining. Bidder B's bid is then partially accepted and Bidder B's PD goes to 10.
- So Bidder B's total processed demand is (2x1.5 + 3x1.5 + 10x1) = 17.5 and this is Bidder B's EP for the next round.

Once again, a bidder has unintentionally lost eligibility points when switching between lot types, and the use of all or nothing bids would not prevent this. This is concerning because it could prevent bidders from expressing (the latest) demand for the spectrum they seek, potentially leading to an inefficient auction outcome in conflict with Ofcom's objectives and statutory duties to promote efficient spectrum use.

To mitigate the risk of bidders unintentionally losing eligibility points, we believe Ofcom should incorporate grace rounds into its proposed auction format, as per the below.

$EP(t+1)$ *is the smaller of*:

$$EP(t)$$

$$\frac{Max\,\{PA(t),\ \ Min[PA(t-1),\ \ SA(t)]\}}{AR(t)}$$

where:

EP = Eligibility Points
PA = Eligibility points associated with Processed Activity (Processed Demand)
SA = Eligibility points associated with Submitted Activity (Submitted Demand)
AR = Activity Requirement
t = round number

This grace round formula is explained in more detail in paragraphs 177 – 180 of the Canadian 3500 MHz auction's rules.[8] It allows for the processed activity to drop for one round without affecting the eligibility for the next round. However, if the processed activity does not increase sufficiently after the next round, the eligibility will be permanently reduced.

Therefore, this formula helps prevent a bidder from unintentionally losing eligibility points when switching between lot types: if the eligibility points associated with a bidder's processed demand falls from one round to the next, but the bidder didn't intend this, then the bidder can seek the same spectrum again in the next round because it wouldn't have immediately

[8] Available at https://ised-isde.canada.ca/site/spectrum-management-telecommunications/sites/default/files/attachments/2022/SLPB-001-20-a3-2021-04EN.pdf

lost the eligibility points associated with its drop in processed demand. This would give the bidder another chance to express demand for the spectrum it seeks, which could lead to a more efficient auction outcome consistent with Ofcom's objectives and statutory duties to promote efficient use of spectrum.

Having AR(t)<1 in the formula above gives the bidder a couple of chances to do this and more generally creates a little more flexibility (for example, if Ofcom were to allow switching between geographic lots but there was a large eligibility point difference between geographic lots). However, if Ofcom is concerned that this formula will obscure bidders' demand or add significant complexity, then it could set the AR(t) always equal to 1 in the formula above, *provided that* it does not carve out specific geographic areas (e.g. London) when defining lots (because then bidders may need more wiggle room to transfer demand without losing eligibility).

Alternatively, Ofcom could explore other ways of stopping bidders from unintentionally losing eligibility points, such as considering 'switch bids' as used by the FCC.[9] We are open to this and other suggestions to stop bidders from unintentionally losing eligibility points.

We acknowledge that grace rounds aren't a perfect solution (e.g. if there is a lack of excess demand it is not possible to back out of a previous bid anyway and therefore a bidder could still unintentionally lose eligibility). However, we still consider that grace rounds would offer some (potentially significant) benefits, without in our view adding significant complexity.

5.1.7 Automatic round extensions in case of technical or other issues

In paragraph A9.36, Ofcom states "*where bidders fail [...] to submit a bid for a lot category for which they had positive demand in the previous round, the system would process the "missing bid" as if the bidders had requested a quantity of 0 lots at the opening price. The missing bid would be processed like any other bid*". While this does not necessarily mean that eligibility would be dropped, it may be. We interpret this as there will be no waivers for this action, in contrast with Ofcom's recent auctions. We are concerned by this, as technical issues and practical difficulties (such as fire alarms etc) can affect bidders at any point in an auction and, if such an issue were to occur very close to the closing time for a round, then it may not be possible to contact Ofcom about the situation before the round closes. As a result, the bidder could unavoidably lose eligibility points, which could distort the outcome of the auction.

Therefore, we ask Ofcom to allow for a limited number (e.g. three) of automatic round extensions per bidder. This would mean that, if a bidder fails to submit a bid by the round closing time, then the bidder would automatically be given more time to help resolve its technical/other issue and/or contact Ofcom, instead of immediately losing eligibility points if Ofcom doesn't realise that a technical/other issue has occurred. This should allow bidders to always express demand for the spectrum they seek, leading to a more efficient auction outcome, consistent with Ofcom's objectives and statutory duties to promote efficient spectrum use. It would also be consistent with Ofcom's approach in previous auctions when it did make formal provisions for technical or other issues, by allowing three waivers per bidder.

We acknowledge that Ofcom might devise other safeguards for the situation of technical failure, but these would need to be formalised and made clear in the auction rules.

5.1.8 Assignment rounds

Assuming the 26GHz is awarded in two lot categories as is proposed, we agree with the proposed initial assignment rounds for the two 26 GHz lot categories and the 40 GHz lot category followed by a further assignment round for the final 26 GHz band arrangement if necessary. However, the need to potentially re-tune equipment after 5 years to conform with the final band arrangement underscores our concern over the proposed fixed 15 year licence period, where the eventual frequency assignment would then only be available for 10 years (see also our response on licence duration below).

We also note that, based on Annex 9, it seems Ofcom does not plan to publish the principal stage results in full (covering each bidder individually) before the assignment stage(s). We are concerned about this, because it could prevent bidders from expressing a preference to be next to another bidder for legitimate reasons (for example, network sharing). In addition, not publishing the full principal stage results (covering each bidder individually) could limit bidders' ability to prepare for the assignment stage(s), by limiting their understanding of what any subsequent assignment stages could look like when they bid in the first assignment stage. For example:

- When bidding in the first assignment stage, bidders will not know what their assignment options in later assignment stage(s) might be and who they could be bidding against, which could make it more difficult for budget-

[9] See page 3 of the Federal Communications Commission's "Auction 108 Clock-1 Auction Format Technical Guide" available at https://www.fcc.gov/file/22647/download

constrained bidders to know how much they can afford to bid in the first assignment stage and still have enough budget for the later assignment stage(s).

- Bidders who win encumbered and unencumbered 26 GHz lots and wish for their assignments to be within a certain 'distance' of each other (to use carrier aggregation) will find it more difficult to value assignment options in the first assignment stage if they have less knowledge of possible assignment options in the second assignment stage.

This could have a significant impact on assignment stage outcomes and, ultimately, prevent an efficient assignment of spectrum. We therefore urge Ofcom to publish the principal stage results in full (for each bidder individually) before scheduling the first assignment stage.

5.1.9 Other comments

In reviewing the examples in the Annex 9 to the consultation, we have the following comments:

Ofcom states:

> "A bidder may only bid for a quantity of spectrum that is greater than 0 and less than or equal to the available supply" (Para A9.33)

We question whether it should say "is greater or equal to 0…" as it is possible to have a bid to decrease demand going down to zero.

5.2 Interest in specific high density areas

Question 5 (section 9): Do you have an interest in bidding for specific high density areas in this award? If so, please provide evidence that you have a credible intention to do so.

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See also our concerns in response to Question 4 above in relation to the increased auction complexity that may be needed if some areas are disaggregated and awarded separately to the sub-national licences.

5.3 26 GHz Lot categories

Question 6 (section 9): Do you consider it appropriate to have one or two 26 GHz lot categories?

We observe that even since the consultation document was issued the number of 26 GHz licences has reduced and it seems likely it will continue to do so in the period up to the auction itself and potentially beyond.

Nevertheless, at a high level it does seem that unless the decline in the number of 26 GHz links accelerates and the number of links that need to be cleared within 5 years substantially reduces, two 26 GHz lot categories are appropriate given the significant constraints that legacy 26 GHz fixed links will place on mobile use in the auction areas until the end of the proposed 5 year fixed link licence revocation period.

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6 Coexistence and coordination

Question 7 (section 10): Do you agree with our proposed approach to coordinating Shared Access users in the 26 GHz band? If not, please give reasons.

Yes, Ofcom's approach to coordinating Shared Access users seems reasonable, but could be refined over time as experience is gained in use of the mmWave bands.

BT notes that at Para 10.29 a coordination distance of 115 km is proposed for medium power base stations on the basis that it is the same as used for other shared access bands in OfW 590, section A2[10]. We note that this reference is in relation to the 1.8 – 4.2 GHz range and that at 26/40 GHz the propagation conditions are very different. On this basis we question whether shorter re-use distances might be appropriate.

Question 8 (section 10): Do you agree it would be appropriate to coordinate Shared Access users in the 40 GHz band in a similar way to the 26 GHz band if we make it available in 5 years' time (noting we would consult on the detail of this coordination). If not, please give reasons.

Yes, BT agrees with this approach.

Question 9 (section 10): Which of the proposed options for coordinating award winners and existing licensees during the (5-year) revocation period do you think would be most appropriate? Do you think alternative approaches to coordination would be more appropriate?

Ofcom has set out four options in relation to coordination of deployments of mobile systems by auction winners with respect to existing fixed links. None of these options in isolation is favoured by BT and we think that some combination could be the best approach of those presented.

We do not favour **Option 4** as that would prevent any medium power use for the spectrum in the first 5 years, which is hard to justify on spectrum efficiency grounds as there must be locations where deployments could be made on certain frequencies in certain places in the auction areas without impacting 26 GHz fixed links.

Option 3, where Ofcom takes on the coordination of new mobile base stations in auction areas with existing fixed links, is attractive as it avoids multiple licensees developing coordination tools and ensures rules are applied consistently by all licensees. However, if the timescales to obtain coordination decisions are lengthy, this option is likely to be problematic. We would need to understand the detail of the coordination calculations and what factors are taken into account, but in principle the procedures ought to be able to take into account detailed information about the technical parameter values of the proposed new mobile deployments, including any interference mitigation measures that are employed. This should mean that the detailed coordination should give more granular and precise results than just relying on pre-determined maps of permitted EIRP in given Pixels (Option 2a) or separation distance vectors (option 2b).

Option 2a and Option 2b have the advantage of immediate visibility of whether a deployment is allowed, but will not provide granularity for non-default mobile power levels, particular orientation of antennas, local shielding etc.

Option 1, where auction winners are responsible for coordination their deployments using rules set by Ofcom, could in principle have the same advantages over Option 2a/b that Option 3 has, but would not have the benefit of consistency of decisions and implementations. It would however potentially have advantage over Option 3 in terms of speed of decisions.

Overall, BT favours Option 3. But we think Ofcom should also produce and provide the Option 2a and 2b information as this would be a useful quick look-up solution for licensees to determine whether a more detailed coordination is necessary or likely to be successful if non-default parameters used to produce the charts are used.

Question 10 (section 10): Do you agree with our proposal to protect the radio astronomy site at Cambridge (42.5-43.5 GHz) from new mobile users using the 40.5-43.5 GHz band using technical assignment coordination? If not, please give reasons.

BT has no comments on Ofcom's proposed approach in relation to coordination of mobile use with Radioastronomy.

Question 11 (section 10): Do you agree with our proposed approach to coordinating at the boundary of high and low density areas? If not, please give reasons.

In principle, we have no objection to this approach to coordination at the boundary, but we reserve our position on this question until the proposed field strength limits at the boundary are known and assessed.

[10] https://www.ofcom.org.uk/__data/assets/pdf_file/0027/183744/Shared-Access-technical-frequency-assignment-criteria.pdf

Question 12 (section 10): Do you agree with our proposed approach to international coordination? If not, please give reasons.

Yes, we agree with Ofcom's proposed approach to international coordination.

7 Award licences: non-technical conditions

Question 13 (section 11): Do you agree with the non-technical conditions that we propose to include in the award licences to be issued following the award of the 26 GHz and 40 GHz bands? If not, please give reasons.

7.1 Authorisation of mobile devices

BT is concerned that both the draft auction licences and the draft shared access licences are not suitable to provide the necessary Wireless Telegraphy Act authorisation for mobile devices operated on public mobile networks by the general public (e.g. the record keeping, access and inspection and other provisions imposed on the licensee could not realistically be complied with). It is normal practice that such user devices would be operated on a licence-exempt basis and not operated under the mobile network operator's spectrum licence. There is no mention of this in the draft licences or elsewhere in the consultation document, so far as we have been able to ascertain. We believe that Ofcom should make clear in the licences that devices used by the general public when connected to the 26 GHz or 40 GHz network of a national public mobile network operator will be covered by licence-exemption regulations. Ofcom should commit to producing those regulations prior to awarding the mmWave spectrum.

7.2 Leasing

Ofcom discusses the potential benefits versus the downsides of permitting leasing and concludes that leasing will not give rise to net benefits over and above what can already be achieved by trading licences or through the Shared Access Licensing framework.

We would like to clarify that our comments on leasing are not a suggestion to mandate leasing (as suggested by some to enable continued fixed link use[11]), or to replace the auction mechanism as a way to allocate mmWave spectrum by other mechanisms, such as a club model. Setting those issues aside, it seems to us that the remaining reasons not to permit leasing within the new mmWave licences awarded in the auction are not compelling.

Ofcom notes that the Local Access licensing framework would provide an alternative to leasing as a means of allowing fixed links to continue with agreement of the auction winners. However, commercial leasing that involves a payment to the auction winner rather than a payment to Ofcom might provide more incentive to reach agreements, particularly beyond the 3 year timeframe of a local access licence. Thus we do not see availability of Local Access licences as making leasing superfluous.

Leasing is another commercial mechanism to transfer the right of use of spectrum from one use to another, albeit with a different risk profile for the lessee (and lessor). We believe that allowing leasing could address some of Ofcom's concerns around longer licence durations: it would give spectrum owners greater flexibility to make commercial use of their licence while retaining ownership of the licence and hence the option to make use of the spectrum later on. The spectrum owner would retain the opportunity to invest in propositions and monetise the spectrum later, while mitigating the risk to be left with a stranded asset if third parties turn out to have innovative commercial uses for the spectrum (giving for example flexibility for localised use cases to be tested and emerge if promising). For the lessee the advantage of leasing over outright purchase is equally that their risk is lower: leasing should be possible at any point in time throughout the licence duration as agreed commercially, and the time period of the lease would also be agreed commercially, depending on the timeframe of the lessee's investment and the opportunity cost of the owner of the licence. The lessee would therefore not have to buy spectrum in an auction before they have a solid specific business case.

Even if the licensee retains the licence obligations and liability associated with fulfilling the conditions of the licence, back-to-back contracts (common in many commercial environments) should be straightforward to implement, and Ofcom would still be able to enforce against breaches by pursuing the licensee not the lessee. There are a number of examples of where mobile spectrum leasing has been successful:[12]

[11] Consultation §5.30-5.32

[12] GSMA, Spectrum leasing in the 5G era, January 2022 Spectrum-Leasing-5G-Era.

- In the US, spectrum leasing is part of the FCC's secondary market initiatives designed to remove regulatory barriers and increase access to spectrum. Licensees that hold "exclusive use" licences can lease spectrum to third parties using two arrangements: spectrum manager leasing and de facto transfer leasing[13].
- In Germany, Deutsche Telekom leased a 2×1.25 MHz channel in the 450 MHz band on a regional basis until the spectrum usage rights expired at the end of 2020. It has also leased part of its 2.1 GHz holding on a local and temporary basis to competitors or vendors in its domestic mobile market.
- In May 2019, 3 Sweden signed an agreement to sub-lease 50 MHz of 2.6 GHz spectrum to specialist vertical micro-operator Edzcom (then known as Ukkoverkot) for use in private LTE networks.
- At least one spectrum lease has been a result of merger conditions: 1&1 Drillisch will lease 2×10 MHz in the 2.6 GHz band from Telefónica until the end of 2025, with the deal part of Telefónica's regulatory obligations arising from its acquisition of E-Plus in 2014.

We also note that leasing is permitted in the current 40 GHz licences and in some other licences such as 28GHz and 32 GHz licences. Our preference would be to allow it in the proposed auction licences in case scenarios arise when it would be useful to the licensees to make use of the option.

We ask Ofcom to consider the specific reasons why it is not planning to allow leasing in the 26 GHz and in the 40 GHz band, if, for example leasing was only allowed for mobile use. What are the obstacles and risks Ofcom is concerned about which lead it to conclude future licensees should be denied the commercial freedom to lease spectrum they acquire? We would welcome further discussion to explore solutions to any challenges Ofcom might see.

7.3 Licence variation and revocation

The licence provisions 3 (b) (i) and 3 (b) (ii) seem to be unrelated to 3 (b) – presumably this is an error in the numbering scheme used that needs to be corrected.

8 Award licence duration

Question 14 (section 12): Do you have any comments on our proposal to award fixed term licences with a 15 year term?

BT advocates indefinite licences with an initial term of 20 years

Indefinite duration licences with an initial term of 20 years, that are tradable and leasable, are likely to be more consistent with Ofcom's policy objectives and duties. They are also more consistent with a market-based approach to spectrum management.

A similar approach is used and works well in the US where spectrum licences have an initial term with a high expectation of renewal (and can therefore be considered indefinite) and where there is a fully functioning secondary trading market.

As we set out below, Ofcom's proposal of a fixed duration licence of 15 years is less likely to secure optimal and efficient use of spectrum and indeed likely to be detrimental to optimal investment in this band. This is particularly acute in the mmWave bands because the device and use case eco-system is still evolving, so any investments will likely be monetised iteratively over the next 20 years or so.

Should Ofcom consider that the risk of market mechanisms failing is too high with indefinite licences of 20 years initial term, we ask Ofcom to grant at a minimum indefinite licences with an initial term of 15 years with an explicit condition in the licence that allows Ofcom to revoke it at any point after 15 years with 5 years notice should it have clear evidence of inefficient use (as per Schedule 1, paragraph 8 of the WTA).[14]

We observe that evidence and arguments are put forward by Ofcom for why 10 years is too short, but there is no evidence put forward for why 20 years would be too long. Ofcom's proposal for a middle ground of 15 years is essentially a subjective decision. In contrast, our counter proposal, for a revocation potential if Ofcom saw a strong case for reassignment after 15 years, is more objectively based and we consider this preferable.

[13] An example of leasing by AT&T is set out in the GSMA document at Page 25 https://www.gsma.com/spectrum/wp-content/uploads/2022/01/Spectrum-Leasing-5G-Era.pdf

[14] Wireless Telegraphy Act 2006 (legislation.gov.uk)

Ofcom's proposed fixed term licence of 15 years does not support investment

Ofcom proposes to award fixed term licences of 15 years for mmWave mobile bands, with early revocation only under very limited circumstances, such as breach of licence conditions. All licences are proposed to be tradeable under the Mobile Trading Regulations but Ofcom does not propose to make the award licences leasable.

Ofcom's proposal gives certainty that licensees will benefit from the use of the spectrum for a period of 15 years, no more, no less. This is too short for efficient investment to be undertaken as we set out below. Bidders can mitigate the risk of a shorter licence duration by reducing the amount they bid in the auction.

Ofcom however, by virtue of setting a short licence duration, appears to favour investments with shorter investment horizons. We question whether Ofcom has sufficiently made the case for its proposal. For example, has Ofcom considered whether the investments it believes would make use of the spectrum can be fully recouped in a 10-15 year timeframe; and that there are no material investments on the horizon that may require longer timeframes for recoupment?

Ofcom appears to be placing greater weight on the possible option value of an uncertain future inefficiency requiring the rebalancing of spectrum in 15 years versus the risks to investment incentives in the meantime, and there is no evidence brought to bear on why this trade-off is correct.

The Ofcom commissioned study by CRA on optimal spectrum licence duration argues "*if secondary markets worked well duration is irrelevant from an efficiency point of view*".[15] For this statement to be true, it would also require that regulatory decisions are consistent, predicable and reliable over time e.g. investors would need to be able to expect that:

- unless specific - and known at the time of the auction - conditions are met, renewal is highly likely; and
- if the spectrum is re-auctioned at the end of the period, the regulator does not change the conditions of use (geography, degree or form of sharing or change of use) in any way so as to de-value pre-existing investments using spectrum efficiently; and
- more generally, the risk of regulatory failure (i.e. the way in which the regulator applies judgement in taking decisions on revocation/renewal/re-assignment as the case may be) must be low.[16]

Some econometric studies such as JLL (2019) find a large and statistically significantly positive effect of licence duration on investment levels.[17] Ofcom recently commissioned a discussion paper[18] to validate these results. Although no statistically significant relationship between licence duration and network investment was found, the study acknowledges that data limitations may have driven its results. Ofcom should, in addition to this econometric evidence, consider its fixed term licence proposal against the likelihood that *"fixed duration licences can run a risk of deterring investment, especially as the end of the licence term approaches."*[19]

We argue in the following that:

- Ofcom has not demonstrated that shorter duration investments are more likely, more material and/or more beneficial than longer term investments that may be required to make use of the spectrum to be auctioned: instead we consider that **short term licences are more likely than not to exacerbate the investment gap**.
- Ofcom has not made the case that market mechanisms like trading or leasing cannot work (or be made to work) effectively in the UK: **Ofcom should focus on making market mechanisms work rather than relying on regulation as a first port of call;** and
- Ofcom has not provided sufficient certainty and predictability for prospective bidders of how it will treat investments in assets complementary to the spectrum acquired at auction at the time the fixed licence term ends: **if Ofcom persists in its proposal for a fixed licence duration it should at a minimum provide certainty that it would expect to renew the licence unless there is evidence of materially inefficient use.**

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[15] https://www.ofcom.org.uk/__data/assets/pdf_file/0017/254015/CRA-Report-on-Mobile-Spectrum-License-Duration-and-MNOs-Investment-Decisions.pdf

[16] "Good regulation underpins well-functioning markets. But there are inevitably risks of regulatory failure, chiefly ineffectiveness and unintended consequences. A high-level framework that is appropriate for analysing many public policy issues is one that balances the twin risks of market failure and regulatory failure." Geoffrey Myers, https://press.lse.ac.uk/site/books/m/10.31389/lsepress.spa/ , 2023, page 53.

[17] Francois Jeanjean, Marc Lebourges and Julienne Liang, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3139711 , 2019.

[18] https://www.ofcom.org.uk/__data/assets/pdf_file/0017/254015/CRA-Report-on-Mobile-Spectrum-License-Duration-and-MNOs-Investment-Decisions.pdf

[19] Geoffrey Myers, https://press.lse.ac.uk/site/books/m/10.31389/lsepress.spa/ 2023, page 107.

Short term licences are likely to exacerbate an existing investment gap

While the optimal level of investments must be finite, we know that current investment levels are insufficient to meet future mobile data demand in the UK.[20, 21] Short fixed term licences will further exacerbate this emerging investment gap:

- For all mmWave use cases it will take time to create eco-systems of use cases (i.e., complementary investments to the original investment in the spectrum licence itself). The early licensing of spectrum, and the longer licensing period would enable investment in and experimentation with use cases, which are likely to take time to generate returns to shareholders. Limiting the timeframe of the licence to 15 years is likely to reduce incentives for those purchasing the spectrum to invest in new use cases simply because of the risk that they may run out of time in monetising the investment.
- The fact that the spectrum is only going to be fully available after 5 years means that, at best, only *c.*10 years is available for some deployments. In addition to that, the frequencies authorised at 26 GHz may change after the first five years, which could drive extra costs.
- As the point at which the fixed term licence would expire gets nearer, confidence and willingness to invest in further deployments will diminish, since there is no guarantee or clear basis to presume the same spectrum will remain available beyond the fixed term of the licence.
- While there may be hypothetical scenarios where shorter planning horizons do not necessarily imply lower investments, Ofcom[22] does not provide any evidence this is relevant to mmWave. There is a clear risk of regulatory error here should our technical experts be correct in considering it likely that creation of an eco-system and trialling of new use cases (to begin to scale the investment) is likely to require at least a 20-year investment horizon.

The CRA study commissioned by Ofcom explains that shorter licences could, in theory, lead to a lower likelihood of existing users hoarding spectrum, i.e. refrain from investing in complementary assets early on and waiting instead for no other reason than to deny a competitor to enter or expand in the market. [23]

However, CRA also recognise that waiting may well be more efficient for firms; even when from the regulator's point of view, a shorter licence duration may be preferable. The licensee may prefer to wait for a myriad of reasons not due to any strategic or hoarding behaviour but simply reflecting e.g., that the licensee may be waiting for certain equipment to become available, for a market proposition to be successfully tested, and developed for mass deployment etc.

We understand Ofcom may not place much faith in incentives to trade spectrum in the UK to facilitate efficient allocation of spectrum. We set out below why we consider its concerns to be misplaced and why Ofcom should do more to make market mechanisms work rather than relying on regulation as a first point of call: obstacles to effective market mechanisms like trading may not only reside with licensees but are also connected to Annual Licence Fees (ALFs) that may be set too high. Additional ways to enable commercial solutions to achieve greater market efficiency such as leasing, as is common in other jurisdictions (see section 7.2 and further below), could also help.

The challenge of ALFs as a potential obstacle to trading is likely to become increasingly prevalent as innovative spectrum management solutions (including sharing, local licences etc) may change "opportunity cost" over time and across locations. This will further diminish the ability of existing licensees to find sellers willing to buy it at the opportunity cost set by Ofcom for extended periods after the initial licence expires. For example, swaps in 3.4-3.8 GHz could ensure contiguity for all

[20] Ofcom's forecast of tens of thousands of small cells required to meet its medium traffic forecast of 40% yoy growth is already highly unlikely to be achieved. As BT has stated previously: "*even assuming [Ofcom's] traffic estimate is reasonable, it is not practical to deliver the number of small cells that Ofcom estimates will be required in this case if only new mmWave spectrum and a small increment of 1400 MHz downlink spectrum is made available*." Given the extensive small cell deployments required for mmWave a shorter 15-year fixed term licence will likely make this investment even less likely. See also https://www.ofcom.org.uk/__data/assets/pdf_file/0024/237462/bt.pdf of 8 April 2022 to Ofcom's consultation https://www.ofcom.org.uk/__data/assets/pdf_file/0017/232082/mobile-spectrum-demand-discussion-paper.pdf February 2022.

[21] Independent analysis shows an emerging investment gap between investment required to meet 5G and OTT peak traffic growth forecasts and what can be funded through existing and forecast revenue. According to Frontier Economics under existing trends (capex/revenue) in the UK there is an investment gap of around £12-£14bn for 4 stylised operators over 8 years (or around £400-550m per operator per year) to bring what Frontier refer to as "enhanced quality and coverage" to semi-rural areas – unless incremental revenue was forthcoming. Frontier Economics, The Investment Gap To Full 5G Rollout: Report for the UK Digital Connectivity Forum 7 September 2022 https://www.connectivityuk.org/wp-content/uploads/2022/09/The-Investment-Gap-to-Full-5G-Rollout.pdf

[22] Ofcom, Statement and consultation: Enabling mmWave spectrum for new uses, 13 March 2023 https://www.ofcom.org.uk/__data/assets/pdf_file/0015/255030/03-23-statement-and-consultation-mmwave.pdf and CRA commissioned by Ofcom, Mobile spectrum licence duration and mobile network operators' investment decisions, 17 February 2023.

[23] CRA commissioned by Ofcom Mobile spectrum licence duration and mobile network operators' investment decisions, 17 February 2023, 17 February 2023.

operators but ALFs set above opportunity cost have created a barrier to trading (see also case study in the next section).[24] .

Ofcom's recent approach to the 40 GHz MBNL licence exacerbates the above dynamics because it illustrates that, even when using spectrum efficiently, licensees cannot rely on being able to continue to use it. Ofcom's decision to revoke the indefinite 40 GHz licence of MBNL, in a situation where the spectrum is being very efficiently used, instead of liberalising its use, points to a new, less predictable, UK spectrum management regime creating uncertainty for potential bidders for new licences and a reluctance to rely on the ability to extend use at the end of the licence period even where the spectrum is efficiently used. For this reason we advocate indefinite licenses with a longer (e.g. 20 years) rather than a shorter (e.g. 15 year) initial term.

Ofcom should focus on making market mechanisms work rather than relying on regulation as a first port of call

Ofcom argues that there is a risk that the initial allocation of mmWave spectrum may become inefficient over time, as use cases change and opportunities for new entrants arise. Ofcom argues trading will not be sufficient to address this concern and is unlikely to work because *" we have seen very little evidence of trading spectrum between mobile operators to date and none between mobile operators and new entrants".* Ofcom further says *" We note that neither spectrum trading nor a potential variation of future licences are likely to be effective in resolving c)",* where c) is Ofcom's point that *"the optimum balance between spectrum available for citywide and Shared Access licences could change.*"

Firstly, trades in auctioned mobile spectrum during the initial term (as operators gear up to make the investments necessary to make use of and monetise the spectrum), can be expected to be few and far between – in particular as spectrum can be expected to have already been assigned efficiently in the auction.[25]

Secondly, the trades that did occur (see Figure 1) support our view that if market conditions were to change in the future leading to differences in user valuations, then trading could reasonably be expected to facilitate that spectrum assignments remain allocated efficiently over time.

Figure 1: UK mobile spectrum trades

Year	Description	Buyer	Seller	Status	Spectrum subject to ALFs at the time?
2012	As a condition of the Orange/T-Mobile merger to form EE, EE was required to divest 2x15 MHz of 1800 MHz spectrum	Three	BTEE	Completed	Yes*
2015	Vodafone and Three acquired a total of 40 MHz of L-Band spectrum from Qualcomm	Vodafone Three	Qualcomm Qualcomm	Completed Completed	No No
2018	Defragmentation of the 900MHz band	VMO2/ Vodafone	VMO2/ Vodafone	Completed	Yes*
2020	EE sold 25 MHz of 2.6 GHz spectrum to VMO2	VMO2	BTEE	Completed	No
2021	Defragmentation of the 3.4-3.8GHz band following the principal stage of the 3.6 GHz auction. VMO2 and Vodafone agreed to trade 40 GHz blocks Both MNOs will have shared access to both blocks until the end of 2025	VMO2/ Vodafone	VMO2/ Vodafone	Completed/ in progress	No

*AIP has been applied to the 900 MHz and 1800 MHz bands since the late 1990s but was not set to reflect 'full market value' until 2015 (and due to legal challenge final values were not set until 2018).

Source: Table reproduced from SPF Expert Report, 2022, Figure 5.1. Ofcom's transfer notification register, 2022.

Thirdly, other factors unrelated to the trading regime or strategic motives by licensees, e.g. ALFs, may act as a barrier to mobile spectrum trading after the initial term. For example, the SPF Expert Report states "*ALFs act as a trading inhibitor:*

[24] Enders Analysis, https://mcusercontent.com/e582e02c78012221c8698a563/files/d2c5bd80-9da7-66b5-bd00-98ade8519c6d/Shifting_sands_UK_mobile_market_in_Q3_2022_2022_122_.pdf , 7 December 2022, page 28.

[25] The SPF Expert Report states: "*In our view the limited amount of trading may be a result of factors that are not directly related to the trading framework… Auctions held in the UK are generally leading to economically efficient outcomes.*" In particular we note that the voluntary trade between EE and O2 relates to the 2.6 GHz band that was acquired by EE in the 2013 4G auction and where ALFs do not apply until 2033.

uncertainty on future levels of ALFs makes it difficult for different parties to agree on commercial terms for a trade". [26] We think it makes more sense to remove (or lower) ALFs than propose shorter duration licences - see case study below.

Case study: UKB/ Three spectrum in the 3.4/3.6 GHz bands

Following consultation in 2022, Ofcom decided to vary UKB's 3.4 GHz and 3.6 GHz licences so that they align with the terms of the licences in the 3.4 GHz and 3.6 GHz bands that were auctioned in 2018 and 2021, respectively.

There is currently some degree of fragmentation across the 3.4-3.8 GHz band which could in principle be removed through spectrum trading. However, Ofcom's Statement: Aligning licence terms in the 3.4-3.8 GHz band, October 2022, states that "*H3G and at least one other MNO have told us that they have had difficulties in agreeing trades in the band due to the disparity between the terms of auctioned licences and the terms of UKB licences.*"

UKB's licences were subject to ALFs, whereas the recently auctioned 3.4 GHz and 3.6 GHz licences will not be subject to ALFs until 2038 and 2041 respectively. Ofcom states that these differences "*could potentially lead to a complex and protracted negotiation and unnecessary transaction costs. This could act as a potential barrier to trading*". As such to remove the barriers to trading Ofcom has decided to require UKB to 'pay-off' the future ALFs due on its licences (to 2018 or 2041) through a single lump sum equivalent for each band. That is, the lump sum value for the 3.4 GHz ALFs is based on the 3.4 GHz (2018) action price and the lump sum value for the 3.6 GHz ALFs is based on the 3.6GHz (2021) auction price. ALFs paid by UKB since those auctions are offset in full (ie payments for 3.4 GHz in July 2019, July 2020 and July 2021 and for 3.6 GHz in December 2021).

Source: Case study excerpt reproduced from SPF Expert report, 2022, page 85

We note that the US, like the UK, has indefinite licences and a fully functional trading regime with at least 5 trades since 2011 (see Figure 2 for a list of recent mobile spectrum trades). Unlike the UK, the US does not apply ALFs based on estimated full market value.

Figure 2: Examples of recent mobile spectrum trades in the US

Year	Description
2011	Verizon $3.6bn purchase of 122 AWS licences from Comcast/Time Warner [27]
2013	Verizon sale of some 700 MHz B Block to AT&T for $1.9bn[28]
2017	Verizon pays $3.1bn from Straight Path for 39GHz spectrum [29]
2017	Verizon, Sprint, AT&T exchanges, $1.1bn plus in value[30]
2022	T-Mobile purchase of some 2.5 GHz licences from educational institutions[31]

No evidence of a material risk of strategic incentives resulting in un- or under-utilised spectrum

Successive Ofcom market reviews and competition assessments have not referenced any strategic behaviour by the MNOs

[26] SPF Expert Report, page 86. The Expert Report also considers that the limited trades between mobile operators and new entrants may also be causally related to ALFs and not the trading regime itself.

[27] https://www.teleinfotoday.com/operator-services/internet/verizon-wireless-buys-spectrum-for-36-billion

[28] https://www.fiercewireless.com/wireless/verizon-to-sell-700-mhz-b-block-spectrum-to-at-t-for-1-9b

[29] https://www.telecomtv.com/content/5g/verizon-buys-straight-path-spectrum-for-a-staggering-3-1-billion-15619/

[30] https://www.fiercewireless.com/wireless/verizon-sprint-at-t-detail-spectrum-exchanges-covering-pcs-aws-licenses. *"These kinds of spectrum trades occur monthly between all of the big players; AT&T, Verizon, T-Mobile, Sprint and U.S. Cellular,"* noted Brian Goemmer, president of spectrum analysis firm Allnet Insights & Analytics.

[31] https://www.lightreading.com/5g/t-mobile-buys-some---but-not-all---of-its-25ghz-spectrum-licenses/d/d-id/776087

regarding secondary spectrum trading which might give rise to competition concerns.[32] If mobile markets are assessed to be competitive, and there is no evidence of strategic behaviour, then it follows that mobile spectrum assets will be assigned efficiently between operators in the market.

Even if there was a risk of licensees exercising an option value this is not necessarily inefficient, as the option value of maintaining flexibility over the use of the spectrum for current spectrum holders may be significant. In any case we note that holding spectrum will only work as a strategy if the option value to the current user is higher than the option value to other users, otherwise trading will still be more valuable.

Leasing as a complement to trading could mitigate any risk of longer duration licences

If Ofcom saw a risk in relying on trading alone and/or outright trading of national licences might not be appropriate in all cases, then leasing could mitigate the risk of longer duration licences as it would provide licensees with additional commercial flexibility to entirely giving up a future option to use the spectrum. Instead, they could lease it to enable experimentation by third parties with new use cases. Furthermore, the owner of the spectrum will have the option of selling the spectrum outright if the option value does not materialise (including to the lessee).

If Ofcom persists with its proposal for a fixed licence duration it should at a minimum provide certainty that it would expect to renew the licence unless there is evidence of materially inefficient use

Regulatory uncertainty makes longer licence duration more desirable (noting Ofcom's approach to revocation of the 40 GHz licence has increased regulatory uncertainty). We believe this is particularly important where there is high uncertainty over technologies and relevant eco-systems being deployed. Adding regulation to the list of uncertainties is unlikely to facilitate efficient investment.

If Ofcom maintains its position of awarding licences of 15 years, it should at a minimum:

(i) Provide a clear statement in the terms of the licence that it would expect to renew the licence unless (and in the specific circumstances and locations where)[33] there is evidence of inefficient use; and

(ii) not include revocation powers in the licence prior to the 15 year mark.

This would be the minimum necessary to give investors confidence that the licensing framework is based on the transparent application of clear principles, is predictable, and that the investment horizon has no arbitrary cut-off at year 15.

9 Licence technical conditions

Question 15 (section 13): Do you agree with the proposed technical licence conditions for award licences and local access licences in the 26 GHz and 40 GHz bands? If not, please give reasons.

9.1 In-band power limits

9.1.1 Base stations

Ofcom proposes an in-band power limit for base stations of:

- 30dBm/200 MHz TRP for auction licences and medium power Shared Access Licences.

[32] Ofcom recognises that the UK mobile markets are highly competitive. First, in the competition assessment for the 2.3/3.4 GHz auction Ofcom concluded in 2014 that "the market appears to be operating well at present, with strong competition between suppliers, relatively low prices for UK consumers, and continued investment in new services." Second, in Ofcom's 2015 Strategic Review of Digital Communications Consultation, it acknowledged that: "UK consumers have benefited greatly from end-to-end competition in mobile services." Third, Ofcom's comprehensive competition assessment for the 700MHz / 3.6 GHz auction did not suggest any fundamental change from Ofcom's earlier assessments. Finally, Ofcom rejects competition measures for the mmWave auction because they consider "such strategic bidding in the auction would be very costly, as it would require the strategic bidder or bidders to acquire a large amount of spectrum which would be surplus to their needs over the term of the licence" (1.15) and "acquiring spectrum in an auction entails a substantial upfront capital investment which must be justified to investors" (7.70).

[33] For example it may well be possible that some licensees make efficient use of their licence, and some in some or all locations or have plans to do so. Ofcom should not expropriate or curtail investments that are on-going or planned in particular where they complement existing investments at that point in time.

- 25dBm/200 MHz TRP for low power shared access licences.

If Ofcom maintains its proposal of 100MHz lot size (which we disagree with) then we suggest that the power should be specified per 100MHz.

We question why Ofcom proposes to constrain the auction licence power limits in this way and are concerned that it will limit the coverage that can be provided and will make deployments more costly and the spectrum less useful, with negative consequences for the business case to acquire spectrum and commit investments to networks. Since Ofcom anyway proposes a field strength limit at the boundary of the auction areas, it's unclear why an in-band power limit is needed.

The power limits set in some other countries are much higher than Ofcom proposes. For example:

- USA FCC: 75 dBm / 100 MHz EIRP in the 28GH, 37 GHz and 39 GHz bands[34]
- Finland: No limit

{✂ redacted } We conclude that the present power limits that are proposed could constrain certain use cases and prevent the full benefits of future available equipment deployments to be fully realised.

We propose that Ofcom increases the base station in-band power limits in the medium power auction licences by 6 dB.

9.1.2 Fixed Wireless Access CPE

Concerning the proposed maximum power limit for devices of 23 dBm TRP, we are concerned that this is too constraining for FWA applications. It is much less than the 35dBm/5MHz EIRP limit for fixed terminal installations in 3.6 GHz licences. The relevant standard for Class 1 (FWA) equipment[35] contains a value of 35dBm TRP / 55dBm EIRP for the mmWave bands (we understand this derives from regulatory rules of the US FCC). We ask that Ofcom considers allowing an increased power for fixed CPE that is closer to the value in the relevant standards

9.2 In-band access and backhaul (IAB)

BT welcomes Ofcom's willingness to allow IAB if licensees require this but understand this will require further work to be done on Ofcom's part. We advocated for the IAB option in our previous consultation response and still see this as a useful future capability. {✂ redacted }. If Ofcom is not in a position to immediately allow deployment of IAB under the auction licences it would be helpful if Ofcom could indicate in its statement that it would be favourably disposed to developing suitable technical conditions on request with a view to including these in future licence variations if requested.

9.3 Synchronisation

BT prefers that Ofcom does not initially mandate synchronisation and we therefore agree that Ofcom's Option 2 is the best approach.

9.4 Antenna height

Question 16 (section 13): Do you have any comments on our proposed licence conditions relating to antenna elevation?

We note that Ofcom proposes a 10m height limit for low power licences and no height limit for medium power licences (as they will be coordinated). We assume that if a licensee chooses to use a power somewhere between low and medium power the base station would be coordinated and no height limit would apply?

[34] https://www.ecfr.gov/current/title-47/chapter-I/subchapter-B/part-30/subpart-C/section-30.202

[35] 3GPP specification TS 38.101-2 Table 6.2.1.1-2

10 Shared access licences

Question 17 (section 14): Do you agree with our proposal to make available channel sizes of 50 MHz, 100 MHz, 200 MHz, 400 MHz and 800 MHz? If not, please give reasons.

No comments.

Question 18 (section 14): Do you have any further comments on the proposal to limit low power outdoor deployments in 24.45-25.05 GHz to three base stations in any 300km² area in order to comply with the EESS protection requirements?

We have no comments.

Question 19 (section 14): Do you have any further comments on the proposed level of fees for the Shared Access licences in the 26 GHz and 40 GHz bands?

We have no further comments.

Question 20 (section 14): Do you have any further comments on the proposed extension of the Shared Access licensing framework (including its standard non-technical licence conditions) to the 26 GHz and 40 GHz bands?

We agree that where the spectrum is not auctioned the shared access licensing framework could be adapted to authorise use of 26 GHz and 40 GHz outside of those areas.

22 May 2023

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Offices worldwide

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