Three's response to Ofcom's consultation on enabling mmWave spectrum for new uses.

Non-confidential

Date 08/08/2022

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Executive Summary.

Three welcomes the opportunity to respond to Ofcom's consultation on enabling mmWave spectrum for new uses. Ofcom sets out four policy objectives for mmWave frequencies: i) achieve an efficient allocation of spectrum; ii) sustain strong competition in mobile; iii) encourage investment and innovation; and iv) ensure timely availability of spectrum.

In our response, we explain why we believe that a different set of proposals are needed to achieve Ofcom's objectives.

Ofcom should liberalise 40GHz in the hands of the existing licensees and use market tools to ensure an optimal allocation

Ofcom's proposal to revoke 40GHz licences for reallocation is a very intrusive intervention. It is extremely important for the confidence of the industry and investors that Ofcom does not undermine property rights, commercial security, and investment without good cause.

Three purchased its 40GHz spectrum (together with other spectrum through its £300m acquisition of UK Broadband in 2017) on the expectation that our rights would be respected. We expected to be able to use our spectrum, not to be forced to vacate the band without compensation.

Firstly, revocation of 40GHz licences is not objectively justifiable, proportionate, or targeted only at cases where action is needed. There are less intrusive ways of reallocating 40GHz spectrum that would be better at achieving Ofcom's objectives.

The UK led the way in Europe in introducing market mechanisms to manage spectrum efficiently. Since 2005, Ofcom's policy has been "*to move away from central management of spectrum and allow market forces to prevail where this is in the best interests of citizens and consumers".* Ofcom has adopted flexible tools such as liberalisation, trading, leasing, and auctions in pursuit of that objective.

This market-based policy enables licensees (rather than the regulator) to decide how best to use the spectrum, including whether to use it, trade it, or lease rights to others in response to changes in consumer demand and technology. Consistent with its market-based policy, Ofcom should:

- Liberalise 40GHz in the hands of the three existing licensees; and
- Rely on trading and leasing, or an incentive auction, to ensure that 26GHz and 40GHz are both optimally allocated, with users holding large contiguous blocks and avoiding split holdings (if that is the

efficient outcome).

Unlike 26GHz, the 40GHz band is block assigned to three licensees only (Three, MBNL and MLL). The number of potential trades needed to allow new uses in the band and deliver an optimal allocation of both 26GHz and 40GHz would be manageable.

If Ofcom nevertheless believes that central reallocation of 40GHz is needed, an incentive auction is a better way of achieving its objectives while respecting licensees' rights. Incentive auctions are now best practice in spectrum management as they enable regulators to integrate the clearing of incumbent uses into an auction.

An incentive auction is a two-sided auction in which 40GHz licensees would voluntarily agree to sell their licences back to Ofcom without the need for five years' notice. New users would then purchase newly issued licences to the spectrum released. Auction revenues would be used to fund payments to existing licensees and any relocation costs.

Unlike Ofcom's proposal, an incentive auction would determine not only who the best users for the band are but also the optimal amount of spectrum to be repurposed from fixed links to mobile and other uses. This is important as Ofcom does not know which of these competing uses generates more value for the spectrum.

Ofcom proposes instead several options, none of which would deliver optimal use (particularly as Ofcom does not trust trading):

- In its preferred Option 2, Ofcom would clear fixed links through 'command and control' and release the entire band to new uses – revoking MBNL's licence and not allowing it to re-bid for its duplex holding, even if fixed links may be the highest value use for some or all of that spectrum; and

- In Option 3, MBNL would be allowed to retain its entire holding – even if, as Ofcom recognises, there may be higher value users for some or all of MBNL's spectrum and some users may not receive contiguous blocks (as the duplex split would be maintained).

This is exactly the reason Ofcom adopted market mechanisms in the first place. The market, not Ofcom, should decide whether MBNL should retain all, some, or none of its spectrum. The market is better placed than Ofcom to ensure that spectrum is put to its most productive use.

We understand that Ofcom does not currently have legal powers to run an incentive auction. With the auction still some time away, there is ample time for Ofcom to request those powers and for legislation to grant them (as government proposed to do a few years ago). Adopting better, new market-based tools would represent a step forward in Ofcom's approach to spectrum management.

Secondly, revocation would discriminate against Three. Ofcom should liberalise 40GHz in the hands of existing licensees to enable mobile use (including 5G), as it has always done when enabling new technologies (3G and 4G) in bands held by MNOs (such as 900MHz, 1800MHz, and 2100MHz).

Ofcom is also proposing to liberalise Vodafone's 900MHz, 1800MHz and 2100MHz spectrum to enable 5G and make similar changes to other MNOs' licences upon request. To our knowledge, Ofcom is not proposing to revoke these licences. Ofcom has not assessed the risk that the current allocation of Vodafone's licences may be inefficient, [✂] nor analysed whether Vodafone may be "the highest value user" for this spectrum.

We have ambitious plans to use our 40GHz spectrum that would be undermined by Ofcom's proposals to revoke our licence

Our long-term plans for 40GHz spectrum are ambitious. We are investing time and resources today towards progressing to trials and, ultimately, deployments for a variety of use cases. An intervention by Ofcom to revoke our 40GHz licence would undermine these investments.

- [✂]

The next step in many of these plans is to undertake proof of concept trials. We are proactively engaging with vendors to drive the equipment and device ecosystem necessary to progress these trials and, ultimately deployments.

Revoking 40GHz licences would delay rollout in the band

One of Ofcom's objectives is to ensure the timely availability of mmWave spectrum. Ofcom expects that 40GHz spectrum would be equally available for new uses by 2024 in any of the four options it has considered. Our view is that the revocation of 40GHz licences would risk significant delays to the availability of the spectrum for two reasons:

- Firstly, 40GHz rollout requires intensive engagement between operators and device/equipment vendors over years – no UK operator will be having these discussions with vendors for several years if Ofcom chooses to revoke 40GHz licences. We would expect this to delay the rollout of 40GHz spectrum; and

- Secondly, Ofcom proposes that new 40GHz licensees would be able to use the spectrum wherever existing users are not using it during the 5-year notice period – but our intention to deploy the spectrum during the notice period could prevent new licensees from accessing the spectrum in a timely manner.

Uncertainty about the extent to which a winner of 40GHz spectrum in Ofcom's auction would be able to use the spectrum during the notice period would make it difficult for them to value the spectrum. This could lead to an inefficient allocation which would be avoided under other methods of achieving an efficient spectrum allocation, such as trading/leasing or an incentive auction.

Ofcom has underestimated the costs of revoking MBNL's spectrum

Ofcom has significantly under-estimated the costs of MBNL moving its fixed links out of the 40GHz band if Ofcom revokes its licence because it has:

- Under-estimated the unit cost of replacing microwave equipment;

- Under-estimated the useful life of microwave equipment; and

- Not included the costs of deploying additional microwave sites in the baseline scenario it relies on.

Amending Ofcom's analysis to reflect these factors increases the total cost by approximately five times. For example, Ofcom under-estimates the cost of moving MBNL's fixed links out of its top 80 high-density areas by over £20m.

There are additional implications from revoking MBNL's 40GHz spectrum that Ofcom does not include, but we are unable to quantify. We would expect these to further increase the costs to MBNL and society more broadly.

Three's view on Ofcom's other auction proposals

In relation to some of the other auction proposals by Ofcom:

- Ofcom has not appropriately justified setting aside 850MHz of 26GHz in high-density areas for local uses – Ofcom should assess other options such as directing potential users to the largely unused Shared Access Bands (e.g. 3.8-4.2GHz) or re-allocating spectrum in other mmWave bands (e.g. 39-40GHz).

- Ofcom should expand its high-density areas and auction the 26GHz band in sub-national lots – Ofcom should increase the number of high-density areas to at least its 80 highest ranked areas, and probably more, and take the simpler approach of auctioning sub-national licences in the 26GHz band. The complexity of valuing spectrum based on future demand in 40+ individual towns and cities is unlikely to lead to an efficient auction outcome with geographic lots.

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1. Ofcom should liberalise 40GHz spectrum in the hands of licensees and rely on its market-based tools to achieve its objectives for mmWave.

Executive Summary

Ofcom's proposal to revoke existing 40GHz licences for reallocation is a very intrusive intervention. It is extremely important for the confidence of the industry and investors that Ofcom does not undermine property rights, commercial security and investment without good cause.

Three purchased 40GHz spectrum (together with other spectrum through its £300m acquisition of UK Broadband) in 2017 on the expectation that our rights would be respected. We expected to be able to use our spectrum, not to be forced to vacate the band without compensation.

Firstly, revocation is not objectively justifiable, proportionate, or targeted only at cases where action is needed. There are less interventionist ways of reallocating 40GHz spectrum to new uses (including mobile) that would better achieve Ofcom's objectives without the need for revocation.

The UK led the way in Europe in introducing market mechanisms to manage spectrum efficiently. Ofcom's long-standing spectrum management policy is "*to move away from central management of spectrum and allow market forces to prevail where this is in the best interests of citizens and consumers".* Ofcom has gradually introduced spectrum liberalisation, trading, leasing, and pricing as key elements of this strategy.

Consistent with this policy, Ofcom should:

- Liberalise 40GHz in the hands of the three existing licensees; and
- Rely on trading/leasing or an incentive auction to ensure that 26GHz and 40GHz are both optimally allocated, with users holding large contiguous blocks and avoiding split holdings across bands (if that is the efficient outcome).

We agree with Ofcom's proposal to revoke fixed link 26GHz licences in high-density areas, as these would materially constrain 26GHz availability for new uses. With 1,300 individual links licensed – and each licence authorising a single wireless link between two points – too many trades

may be needed for overlay licences to deliver the optimal clearance of the 26GHz band.

The situation in 40GHz is different. The band is block assigned for fixed links to three licensees only (Three, MBNL and MLL) and Ofcom can rely on its market-based policies to optimally repurpose the band. In particular:

- **Ofcom has inappropriately dismissed trading** – users can achieve large contiguous blocks and avoid split holdings by trading 40GHz before the 26GHz auction, securing large contiguous blocks at 40GHz and then participating in the 26GHz auction without the need for complex cross-band trades;

- Even if trading occurred after the 26GHz auction (with users uncertain about how much 40GHz would be available through trading and associated terms), the number and complexity of trades would be manageable – there are only three 40GHz licensees on the supply side (Three, MBNL and MLL) and on the demand side, there have only been between three and five winners in all 26GHz auctions in Europe to date;

- **An incentive auction would be a more effective way of repurposing 40GHz spectrum** – i.e. a two-sided auction where 40GHz licensees voluntarily agree to sell their licences back to Ofcom (without the need for five years' notice), and new users purchase newly-issued licences to the spectrum released. Auction revenues could be used to fund payments to existing licensees and any relocation costs. Unlike Ofcom's proposals, an incentive auction would determine the optimal amount of spectrum to be repurposed from fixed links to mobile. This is important as Ofcom does not know which of these competing uses generates greater value for at least some of the spectrum; and

- **Ofcom has not assessed the potential role of spectrum pricing (i.e. ALFs) in achieving its objectives** – if Ofcom no longer trusts that ALFs can deliver optimal use it should relieve the mobile industry of its £320m annual bill. Otherwise, Ofcom should spell out clearly why ALFs would not ensure an efficient allocation of 40GHz spectrum over time, but do when applied to 900MHz, 1800MHz, 2100MHz and 3.4-3.8GHz spectrum.

More broadly, mandatory revocation is not best practice. Over the past decade regulators have integrated the clearing of incumbent uses into the auction process. The US FCC has already conducted two incentive

auctions to repurpose 600MHz and mmWave spectrum. Ofcom should move with the times and add incentive auctions to its market-based tools, cementing Ofcom's reputation as a progressive, forward-thinking regulator.

Secondly, revocation would discriminate against Three and would not be consistent with other interventions by Ofcom. Ofcom should liberalise 40GHz in the hands of existing licensees to enable mobile use (including 5G), as it has always done when enabling new technologies (3G and 4G) in bands held by MNOs (such as 900MHz, 1800MHz, and 2100MHz).

Ofcom is also proposing to liberalise Vodafone's 900MHz, 1800MHz, 2100MHz spectrum to enable 5G and make similar changes to other MNOs' licences upon request. To our knowledge, Ofcom is not proposing to revoke these licences. Ofcom has not assessed the risk that the current allocation of Vodafone's licences may be inefficient, [✂] nor analysed whether Vodafone may be "the highest value user" for this spectrum.

Ofcom should liberalise 40GHz spectrum in the hands of existing licensees and rely on its market-based tools to achieve its objectives for mmWave

Ofcom's provisional conclusion is that Three's preferred option – liberalisation of 40GHz licences in the hands of licensees (Option 1) – is unlikely to meet its objectives as it risks an ongoing inefficient allocation of spectrum, which could in turn pose barriers to investment and innovation.[1]

Ofcom acknowledges that this risk could potentially be mitigated by trading but believes that this may require a complex series of trades across the 26GHz and 40GHz bands which are likely to be difficult and/or costly. Ofcom prefers the option of revoking and reallocating all 40GHz licences (Option 2).

Table 1 compares Ofcom's assessment of the two options.[2]

[1] Ofcom mmWave consultation, paragraph 7.83
[2] Ofcom mmWave consultation, Table 7.2 and paragraphs 7.38-7.66

Table 1: Ofcom's assessment of liberalisation and revocation of existing 40GHz licences

Objective	Option 1: liberalise 40GHz in hands of licensees	Option 2: revoke all 40GHz licences
Efficient allocation	Significant risk of inefficient allocation: only 3.25GHz at 26GHz available to all other operators Barriers to trading may prevent efficient allocation and contiguity of mmWave spectrum	Maximise likelihood of efficient allocation: 6.25GHz available to users across 26GHz and 40GHz Greatest opportunity for operators to secure large contiguous holdings (avoiding split holdings)
Investment & innovation	Potential barriers on investment & innovation: only 3.25GHz available to other prospective users	Maximises opportunities for investment and innovation: 6.25GHz available across 26GHz and 40GHz
Competition	Least likely to promote competition: only 3.25GHz available to other operators (although unlikely to have detrimental impact)	More likely to promote competition: more mmWave (6.25GHz) available to operators

Source: Ofcom mmWave consultation document

It is clear from Table 1 that the reason Ofcom prefers revocation to liberalisation is the same in all cases – i.e. that absent revocation only 3.25GHz at 26GHz would be available to other operators (of which Ofcom proposes to auction citywide licences for 2.4GHz),[3] and that trading barriers may then prevent an efficient allocation (and contiguity) across both mmWave bands.

This concern is unfounded. Ofcom can liberalise 40GHz in the hands of existing licensees and trust its own market-based tools (trading/leasing) or an incentive auction to ensure that the optimal amount of 40GHz spectrum is made available to other prospective users. mmWave spectrum (26GHz and 40GHz) would then be optimally allocated, with users holding large contiguous blocks (and avoiding split holdings if that is the efficient outcome).

[3] Ofcom mmWave consultation, paragraphs 7.34 and 7.36.

This sub-section sets out Three's view that:

- Ofcom's proposal to revoke 40GHz licences is not objectively justifiable, proportionate or targeted only at cases in which action is needed;
- Spectrum trading and leasing can be equally effective at achieving Ofcom's objectives without encroaching on licensees' rights;
- Ofcom can rely on a market-based incentive auction that would be better than revocation at achieving its objectives; and
- Ofcom has not explained why it cannot rely on spectrum pricing to achieve its objectives for mmWave spectrum.

Ofcom's proposal to revoke 40GHz licences is not objectively justifiable, proportionate or targeted only at cases in which action is needed

Ofcom's power to revoke spectrum licences is subject to limitations. This power is provided by paragraph 6 of Schedule 1 to the WT Act 2006, which allows Ofcom to revoke a licence by giving notice in writing to the licensee. Paragraph 6A, however, prohibits Ofcom from doing so unless the proposed revocation is "objectively justifiable".

In addition, licences authorising use of 40GHz spectrum provide that the licence may not be revoked except in certain limited circumstances, including by consent, or for spectrum management reasons, provided that the power is exercised after at least five years' notice is given in writing to the licensee.

Ofcom has a general duty to ensure that its interventions are proportionate and targeted only at cases in which action is needed.[4] When assessing the proportionality of different measures to achieve the desired objectives in other cases, Ofcom has considered the following principles:[5]

- The measure must be effective in achieving Ofcom's aims;
- The measure must be no more onerous than is required to achieve those aims;
- The measure must be the least onerous if there is a choice of equally effective measures; and

[4] Section 3(3) CA 2003.
[5] Statement: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands (ofcom.org.uk)

- The measure must not produce adverse effects which are disproportionate to the aims pursued.

Ofcom must act in accordance with its statutory duties and general legal principles, including the duties to act reasonably and rationally when making decisions and to take account of any legitimate expectations.

Ofcom has also made several policy statements that it is expected to observe unless it provides adequate reasons to depart from them. Ofcom and its predecessor organisations have applied market mechanisms to the management of the radio spectrum.

The UK led the way in Europe in introducing market mechanisms for managing spectrum efficiently through the Wireless Telegraphy Act 1998, including auctions, spectrum pricing (administered incentive pricing), and spectrum trading and leasing.

The aim was to move away from the regulator deciding who could use what airwaves for which purpose, and to replace this with market mechanisms to manage spectrum. This was new in 1998 but it is now fully embedded in Ofcom's policy.

Ofcom originally set out its spectrum management policy in its 2005 Spectrum Framework Review (SFR):[6]

"As a light-touch regulator our preference is to move away from central management, allowing market forces to prevail... We believe that market forces should be allowed to prevail where this is in the best interests of citizens and consumers".

"This is based on the belief that firms have the best knowledge of their own costs and preferences and a strong incentive to respond to market signals and put resources to their best possible use".

Ofcom proposed "*to allow the market to modify historical allocations towards those more likely to maximise economic efficiency*" through the use of auctions, trading, liberalisation, and spectrum pricing "*to inject some market disciplines into the allocation and assignment process*".[7]

Compared to a 'command and control' policy, market mechanisms grant firms greater freedoms relating to spectrum allocation and usage. Firms generally hold the most market information and are better suited to

[6] Spectrum Framework Review Statement (ofcom.org.uk)
[7] Ibid, page 20

evaluate market demand and supply than the regulator.

By applying market forces, licences can be reallocated and reassigned in the secondary spectrum market. Spectrum trading and leasing allow for the release of spectrum to those who value it the most, resulting in more efficient allocation of spectrum.

Licensees can flexibly choose how to use their spectrum (including whether to use it or to transfer or lease rights to others), taking into account market factors such as consumer demand, technology, competition, and the opportunity cost of retaining their spectrum.

Ofcom's latest policy statement in 2020 does not depart from the principles originally set out the SFR. This reiterates the "*general principle of relying on the use of market mechanisms… where possible and effective, whilst undertaking regulatory action where necessary*".[8]

In view of the above, Ofcom's intervention should be the minimum necessary to achieve its desired objectives effectively. We do not consider that revocation would be objectively justifiable or targeted only at cases in which action is needed, nor that it is appropriate or proportionate for Ofcom to intervene in the manner proposed.

More effective ways exist of achieving Ofcom's objectives which are less interventionist than revoking 40GHz licences. Ofcom can liberalise 40GHz spectrum in the hands of existing licensees and use trading/leasing or adopt an incentive auction to achieve its objectives more effectively, with no detrimental impact on property rights, commercial security and investment, and without imposing undue costs on existing licensees.

In this context, Ofcom should consider that revoking 40GHz licences is a very intrusive regulatory intervention that would undermine property rights and commercial security, reducing licensees' (both current and future users) certainty over their future spectrum rights, which could impact future investment and roll-out plans.

Spectrum trading and leasing can be equally effective at achieving Ofcom's objectives

Spectrum trading allows holders of WT Act licences to buy and sell all or part of their rights to use spectrum. Ofcom originally introduced trading in

[8] Supporting the UK's wireless future: Our spectrum management strategy for the 2020s (Ofcom Statement, 19 July 2021) available at https://www.ofcom.org.uk/__data/assets/pdf_file/0017/222173/spectrum-strategy-statement.pdf.

2004 "*as a key element of its move towards market-based mechanisms*".[9] 40GHz licences have been tradable since they were auctioned in 2008.

As Ofcom has recognised, the spectrum trading regime "*is an important part of the regulatory regime for spectrum, as it enables licensees, rather than only the regulator, to play a part in deciding what the efficient allocation of spectrum is"*.[10]

Similarly, Ofcom introduced leasing of certain licences in 2011.[11] We understand that all tradable licences (including 40GHz) can be leased, except those covered by the Mobile Trading Regulations. Leasing enables licensees to allow other users to use some or all of the licence rights for a specific period. This is achieved through a contractual arrangement between the parties, without the need for a new licence from Ofcom.

Both trading and leasing aim to ensure that spectrum is transferred through the market to those that can generate the greatest benefits for society, helping secure optimal use and making it easier and faster for higher-value users to access spectrum for innovation and growth.[12]

These market-based tools can be equally effective at achieving Ofcom's objectives without encroaching on existing licensees' rights. If, as Ofcom believes, the current 40GHz allocation may be inefficient for new uses and existing licensees may not be the highest-value users for all of their 40GHz spectrum, they would have a strong incentive to:

- **Lease access to 40GHz spectrum to higher-value users** (nationally or in specific geographies) – as 40GHz rights can be leased to other users; and/or

- **Trade 40GHz spectrum to higher-value users** in full or in part – 40GHz licensees can trade all rights and obligations in the licence ('total transfer'), or partition them by frequency, geography or time into distinct licences and transfer some frequencies or geographies ('partial transfer') to higher-value users for those.

However, Ofcom's provisional conclusion is that the option of liberalising 40GHz licences and relying on trading is unlikely to meet its objectives, as it risks an ongoing inefficient allocation of spectrum (which could in

[9] simplify.pdf (ofcom.org.uk)
[10] Statement: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands (ofcom.org.uk)
[11] Consultation (ofcom.org.uk)
[12] pdf_version.pdf (ofcom.org.uk)

turn pose barriers to investment and innovation). We understand that Ofcom's concern is as follows:[13]

(a) **Operators** who do not currently hold 40GHz spectrum **may require more mmWave spectrum than would be available in the 26GHz band alone**;

(b) **Risk of an initial inefficient allocation of 26GHz** at the 26GHz auction – "*prospective users would be constrained to the 26GHz band to begin with*" and *"uncertainty in the future availability of the 40GHz band may incentivise more operators to acquire smaller blocks of 26GHz spectrum than would be ideal;"*

(c) **Trading barriers may prevent an efficient allocation of mmWave spectrum** – *"while operators could acquire supplementary spectrum in the 40GHz band later on",* a complex series of multilateral trades may be needed across both bands to achieve large contiguous blocks, which could be difficult / costly and result in split holdings across the bands; and

(d) There may be a **strategic benefit** to Three (and MBNL) in retaining its full allocation of spectrum (even if it were unlikely to use all of it) in order to reduce the amount of spectrum available to other MNOs.

We do not agree that liberalisation and trading of 40GHz licences risk an ongoing inefficient allocation of spectrum. Like Ofcom, we focus our analysis on high density areas, as this is where most mmWave deployments are expected.[14]

Firstly, prospective users would not be necessarily constrained to the 26GHz band "*to begin with*". 40GHz can be traded (and leased) before the 26GHz auction. Users can negotiate with the three existing 40GHz licensees, get certainty about their 40GHz holding and then decide whether to participate in the subsequent 26GHz auction.

This means that there would be no need for complex multilateral trades across bands to remedy an initial inefficient allocation in the 26GHz auction (due to uncertainty about the future availability of the 40GHz band), as 40GHz would have already been traded.

[13] Ofcom mmWave consultation, paragraphs 7.83, also 7.40-7.41 and 2.52
[14] Ofcom mmWave consultation, paragraph 7.24

Users that had secured large contiguous blocks at 40GHz from the existing licensees (nationally or in their desired geographies) could decide to sit out the 26GHz auction, while others would be able to buy large contiguous blocks of 26GHz spectrum at the auction.

Through this process, mmWave spectrum would then be optimally allocated across both bands (with spectrum won the highest-value users and no operator with split holdings across bands, if indeed that is the efficient outcome),[15] maximising opportunities for innovation, investment and competition.

Secondly, Ofcom should not overstate the complexity of trading, even if trades took place after the 26GHz auction. On the supply side there are only three licensees (Three, MBNL and MLL) in the 40GHz band. On the demand side, the number of potential would-be traders after the 26GHz auction is likely to be limited. Where the 26GHz band has been auctioned in Europe, it has been won by between three and five operators. We see no evidence to suggest that there would be more winners in the UK.

[15] Unless the operator believes that the extra value from having a larger holding exceeds the additional cost of having split holdings – i.e. procuring and deploying multiple sets of equipment.

Table 2: European auctions of the 26GHz band

Country	Year	MHz	Licences	Winners	26GHz won
Italy	2018	1,000	National (plus club model)	5	• TIM: 200MHz • Iliad: 200MHz • Fastweb: 200MHz • Vodafone: 200MHz • Wind: 200MHz
Croatia	2021	1,000	National	4	• Hrvatski: 400MHz • Eolo: 200MHz • Telemach: 200MHz • A1: 200MHz
Denmark	2021	2,850	National	3	• TDC: 1,250MHz • Hi3G: 1,000MHz • TT: 600MHz
Finland	2020	2,400	National	3	• Elisa: 800MHz • Telia: 800MHz • DNA: 800MHz
Greece	2020	1,000	National	3	• Cosmote: 400MHz • Vodafone: 400MHz • Wind: 200MHz
Slovenia	2021	1,000	National	3	• Telekom: 400MHz • A1: 400MHz • Telemach: 200MHz

Source: Three research

If, as we recommend in Section 6, Ofcom also auctioned 26GHz spectrum in sub-national lots covering all high-density areas (rather than multiple geographic city/town-specific lots), the number of trades would be even smaller. With only a few potential traders and a manageable number of lots, transaction costs would be low. Trading (and leasing) would ensure optimal allocation without the need for intrusive regulation.

However, if Ofcom remains concerned that winners of “less than optimal” amounts 26GHz may need to trade 26GHz with other auction winners, Ofcom could consider introducing a Negotiation Phase (like in the 3.6-

3.8GHz auction) to allow 26GHz winners to ensure their spectrum was adjacent to facilitate post-auction trades. Ofcom could set out proposals of such a Negotiation Phase as part of its Consultation on the auction design.

Finally, the suggestion that Three may have a strategic incentive to retain its full 2GHz to deny it to other MNOs is indefensible. Any 40GHz licensee which retains more spectrum than it needs for strategic reasons would incur:

- **High costs** – including opportunity costs of foregone revenues by not trading (or 40GHz ALFs which may take effect from 2023); and

- **An uncertain pay-off** – as Ofcom suggests, the benefits of denying mmWave spectrum to others are uncertain (as use cases and spectrum requirements are still emerging). With 2.4GHz available at the 26GHz auction and other MNOs also able to access the 850MHz set aside for Shared Access licences, there is unlikely to be any payoff from denying 40GHz to other MNOs.

The suggestion of strategic behaviour by Three is plainly inconsistent with Ofcom's assessment elsewhere in the Consultation and in other recent Ofcom documents. Ofcom cannot suggest on the one hand that Three may have an incentive to retain all of its 40GHz for strategic reasons while on the other hand concluding the following:[16]

- That the risk of strategic bidding in the mmWave auction is low due to the uncertain payoff and high cost of acquiring large quantities of spectrum to deny it to rivals – this applies equally to Three, who would forego revenues on all 2,000MHz by retaining its entire holding for strategic reasons (or face an ALF reflecting the market value of that amount of spectrum by not trading);

- That for a competition concern to arise Three would have to add "*a significant amount of 26GHz spectrum in the auction*" to its 40GHz holding and hold "*such a large amount of mmWave spectrum that, in the longer term, it was able to offer superior services that other MNOs were not able to replicate"* – there can then be no strategic benefit to Three in retaining its full 2GHz of spectrum to deny it to others;

- As above, that if Ofcom liberalises 40GHz in the hands of licensees, a 'precautionary cap' could still enable Three to buy

[16] Ofcom mmWave consultation, paragraphs 11.17,11.24-11.27, 11.31.

some 26GHz spectrum at the auction while preventing "*a very large spectrum asymmetry between MNOs from occurring, which could potentially be damaging to competition in the future*"; and

- That Three has an incentive to trade (in the context of defragmentation of the 3.4-3.8GHz band) because there are benefits from defragmenting the band and Three "*will only be able to profit from this*" by trading.[17]

An incentive auction would be more effective in achieving Ofcom's objectives than revocation and reauction of 40GHz

If Ofcom nevertheless believes that central reallocation by the regulator is required (due to the potential complexity of trading), there are better ways of repurposing the 40GHz band and achieving Ofcom's objectives than through revocation.

An incentive auction is a two-sided auction where existing licensees agree to voluntarily sell their spectrum back to the regulator on the supply side, and users purchase newly-issued licences to the spectrum released on the demand side. Auction revenues from selling the new licences are used to fund compensation to the existing licensees and any relocation costs.

Incentive auctions are now best practice in spectrum management, as they enable regulators to integrate the clearing of incumbent uses into the auction process. Traditional auctions take the spectrum use as given and seek to allocate licenses to the highest-value users within that use. Incentive auctions allow the market to determine not only who the best users are but also how the spectrum is used (i.e. the optimal split of the band between different uses).

In the US, the 2010 National Broadband Plan introduced incentive auctions as a tool to help ensure efficient spectrum allocation through the market. In 2012 the US Congress authorised the FCC to conduct incentive auctions. Since then, the FCC has conducted two incentive auctions:

- In 2017 to repurpose 84MHz of 600MHz spectrum used by free-to-air TV broadcasters to mobile (and unlicenced used) – giving TV stations the opportunity to relinquish their spectrum voluntarily to new uses and users in exchange for incentive payments;[18] and

[17] Statement: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands (ofcom.org.uk)
[18] How It Works: The Incentive Auction Explained | Federal Communications Commission (fcc.gov)

- In 2020 to release 3,400MHz of mmWave spectrum available in the 37GHz, 39GHz, and 47GHz bands – with existing 39GHz licensees voluntarily committing to relinquish all spectrum rights before the auction in exchange for incentive payments.[19]

The 2017 US incentive auction was the world's first. Like Ofcom, the FCC believed that voluntary trading would not be an effective means of repurposing 600MHz for mobile, as the band was encumbered my more than 2,000 TV stations (each holding unique rights to specific frequencies and locations).

Unlike Ofcom, however, the FCC did not propose to revoke existing licences. Instead, it decided to give TV broadcasters a financial stake in the reallocation of the band. Broadcasters were given a share of the proceeds from the auction of new 600MHz licences in exchange for relinquishing their spectrum and compensation for moving any spectrum they wished to retain to a band location that ensured contiguity to all users.

An incentive auction in the UK would be a voluntary, market-based means of recycling 40GHz spectrum in high-density areas for new uses, by encouraging licensees to voluntarily sell their spectrum without the need for five years' notice. The auction would bring together the three existing 40GHz licensees (Three, MBNL and MLL) on the supply side and prospective buyers of 40GHz spectrum on the demand side.

The auction could be run before the 26GHz award or in conjunction with it. For simplicity we assume that only 40GHz would be available at the auction. Two key objectives of the auction would be to:

- **Determine the optimal amount of 40GHz spectrum to be repurposed from fixed links to mobile** – market forces would determine not only who gets to use the spectrum (e.g. which mobile users), but also how each portion of the spectrum should be used (e.g. for mobile or fixed links). This is important as Ofcom does not know which of these competing uses for the band generates greater value for at least some of the spectrum;

- **Ensure that all users hold contiguous spectrum post-auction (avoiding split holdings)** – the auction would rationalise 40GHz by freeing up the band (or a portion of it) for new uses while simultaneously reallocating any spectrum 40GHz licensees wish to

[19] FCC Concludes Largest Ever Spectrum Auction | Federal Communications Commission

retain for legacy uses to a new location that ensures contiguity to all (determined by the band plan).

As regards the first point, unlike Ofcom's proposal an incentive auction would determine not only who the best users for the 40GHz band are but also the optimal amount of spectrum to be repurposed from fixed links to mobile and other uses.

Ofcom instead proposes four options, none of which would deliver optimal use (particularly as Ofcom does not seem to trust trading):

- In its preferred Option 2 Ofcom would clear fixed links through 'command and control' and release the entire band to new uses – revoking MBNL's licence and not allowing it to re-bid for its duplex holding, even if fixed links may be the highest value use for some of that spectrum. Ofcom acknowledges that this could result in a less efficient allocation in the 40GHz band.[20]

- In Option 3 MBNL would be allowed to retain its entire holding – even if, as Ofcom recognises, there may be higher-value users and uses for some of MBNL's spectrum and some users may not receive contiguous blocks (as the duplex split would be maintained).[21]

This is exactly the reason Ofcom adopted market mechanisms in the first place. The market, not Ofcom, should decide whether MBNL should retain all, some, or none of its spectrum. The market is better placed than Ofcom to ensure that spectrum is put to its most productive use.

As shown in Figure 1, an incentive auction would use three separate but interdependent components:

- **A reverse auction –** a descending clock auction in which existing 40GHz licensees bid to sell their spectrum, which sets the price at which they will do so and the amount of spectrum cleared for new users and uses;

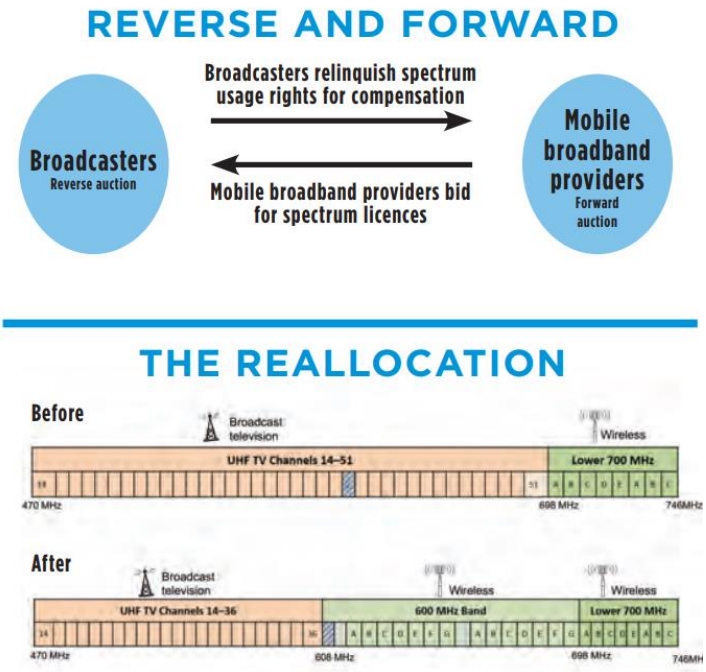
- **A forward auction –** this could have two phases: i) an ascending clock auction of generic 40GHz lots, in which users bid to acquire the cleared lots for new uses, which determines the price users pay and the amount of spectrum allocated to them; ii) a second-

[20] Ofcom mmWave consultation, paragraph 7.47 and footnote 137
[21] Ofcom mmWave consultation, paragraph 7.51 and footnote 139

price, sealed-bid assignment stage that would guarantee contiguity to all users;

- **A reallocation or "repacking" of the 40GHz band –** this involves reorganizing the band in a new band plan, freeing up the band (or a portion of it) for new uses while simultaneously reallocating unsold legacy allocations to a new location that ensures contiguity to all (determined by the band plan).[22]

Figure 1: The FCC's 2017 600MHz broadcast incentive auction



Source: Lesson from the US incentive auction (Milgrom and Symons)

These components would work together: i) reverse auction bids and repacking determine how much spectrum is cleared for reallocation in the forward auction; ii) winning reverse auction bidders are paid from forward auction proceeds; and iii) repacking determines the location of the unsold legacy allocations and which spectrum will be offered for sale in the forward auction.

[22] The 40GHz band is arranged with a duplex split used to provide backhauling for mobile masts. The links operate according to ITU-R F.2005-1 specification, which requires a separation of 1500MHz between the upper and lower blocks. MBNL can adopt the 3GPP Integrated access and backhaul technology (IAB or self-backhauling) to use a different configuration. 40GHz is a 5G TDD band in 3GPP and IAB can be used to join MBNL's blocks into a single contiguous 500MHz block located anywhere in the band. MBNL would need to engage with RAN vendors to purchase the necessary equipment.

The auction would conclude once revenues from the forward auction were sufficient to meet: i) the compensation required by the successful reverse auction bidders to clear their spectrum; and ii) any reasonably incurred costs incurred by existing 40GHz licensees in relocating any spectrum they wish to retain.

This format makes full use of market mechanisms to secure spectrum efficiency. On the demand side, the forward auction allocates the 40GHz spectrum released to the highest-value users and uses. On the supply side market-based incentives in the reverse auction (i.e. a share of auction proceeds) determines the optimal allocation of the band as between uses (fixed links and mobile), and also encourages 40GHz licensees to relinquish the optimal amount of spectrum (retaining only that spectrum for which they themselves are the highest-value users).

Like the FCC's 2017 incentive auction, Ofcom could adopt the following steps prior to the auction.[23] For simplicity, we assume Ofcom would issue sub-national 40GHz lots covering all high-density areas but the format can easily accommodate separate geographic lots for each high-density area.

- **New 40GHz band plans –** Ofcom would not know how much spectrum would be available for reallocation until the end of the auction, so the band plan must accommodate varying amounts of spectrum potentially released. Ofcom would draw up a range of band plans, each associated with a clearing target – i.e. the number of new generic 100MHz lots available in the forward auction for a range of 100MHz blocks potentially cleared in the reverse auction;[24]

- **Reserve price and commitments –** next, Ofcom's Statement could announce the maximum price (i.e a high reserve price) it would offer for 40GHz licensees to clear spectrum in the reverse auction. Existing 40GHz licensees would be asked to declare how much spectrum they would commit to sell at that price;

- **Initial clearing target** – Ofcom could then compute the maximum amount of 40GHz spectrum that would be cleared based on 40GHz licensee's commitments at the reserve price, and the associated maximum number of new generic 40GHz lots that could be sold in the forward auction based on the band plan;

[23] Lesson from the US incentive auction (Milgrom and Symons), available at im-jan2018-lessons-1.pdf (iicom.org)
[24] For instance, if Three, MBNL and MLL cleared all of their spectrum in the reverse auction, that would make available 3,000MHz in the forward auction (e.g. fifteen 200MHz lots). If Three released its top block (42.5-43.50GHz), that would clear 1,000MHz (five 200MHz lots) in a position to be determined in the band plan, etc.

- **Provisional clearing targets –** these would link the forward and reverse auctions. To align bidding in both, the auctions would be conducted in stages, with each stage associated with a clearing target in the band plan. This represents the target amount of spectrum to be cleared in the reverse auction (and the associated number of generic 40GHz lots to be offered in the forward auction), at that stage;

- Ofcom would progressively reduce the clearing target in each successive stage if existing 40GHz licensees in the reverse auction demanded more (by way of compensation payments) than prospective users are willing to pay in the forward auction for that amount of spectrum;

- In essence, Ofcom would fix supply at each stage (equal to the clearing target) and progressively reduce the amount of spectrum available until it finds the clearing price at which supply equals demand for the amount of spectrum specified in that stage's clearing target.

In terms of the auction mechanics, the auction would begin with stage 1 as follows:

- **Reserve auction** – 40GHz licensees would have committed to sell the amount of spectrum set out in the initial clearing target at the reserve price;

- **Forward auction** – Ofcom would offer for sale the number of 40GHz lots associated with the initial clearing target. Bidders would specify how many lots they wished to buy at each round price. The price would increase until bidders were willing to buy the number of generic blocks associated with the initial clearing target (i.e. no excess demand);

- If the price in the forward auction was equal to or greater than the reserve price in the reverse auction, the auction would close – as bidders would then be willing to pay the required compensation (or more) to the 40GHz licensees for them to clear the amount of spectrum in the initial clearing target.

Otherwise, the auction would proceed to stage 2. Ofcom would reduce the clearing target, with less spectrum needing to be cleared in the reverse auction and fewer generic 40GHz lots available in the forward auction:

- **Reverse auction** – 40GHz licensees would specify how much spectrum they would each sell at the new round price. The price would decrease until the total supply dropped to the new clearing target (i.e. no excess supply);

- **Forward auction** – this would resume with those bidders still in the auction at the end of stage 1. The round price would increase until total demand dropped to the number of lots associated with the new clearing target (i.e. no excess demand).

As before, if the closing price in the forward auction in stage 2 was equal to or greater than that in the reverse auction, the auction would close. Otherwise, the auction would proceed to stage 3, and so on.

The final stage rule would be triggered when, after a round, revenues from the forward auction exceeded the compensation required by 40GHz licensees in the reverse auction (plus any relocation costs payable to incumbent 40GHz licensees for non-relinquished spectrum).

Winners in the reverse auction would release the spectrum offered for sale and receive the last accepted price in the reverse auction. The amount of 40GHz spectrum in the final clearing target would be assigned in large contiguous blocks following the assignment stage (as per the band plan).

Incumbent 40GHz licensees may need to be relocated to other parts of the band in respect of any spectrum they wish to retain to guarantee contiguity to all users, with relocation costs funded by auction proceeds.

40GHz spectrum would then be optimally allocated. The closing price in the reverse auction would reflect the marginal cost of clearing one extra block, while the price in the forward auction would reflect the marginal value of one extra block to bidders. The auction would proceed until the marginal value of an extra block equalled the cost of clearing that block.

We understand that Ofcom does not currently have the legal powers to conduct an incentive auction. Ofcom can include spectrum licensed to the existing 40GHz licensee holders in an award but there is no statutory means to transfer auction proceeds to them (rather than paying those into the Consolidated Fund in accordance with section 400 of the Communications Act 2003).

We consider however that the required legal powers can be readily granted, as most of the necessary steps were taken back in 2012-2015.

DCMS issued a consultation paper in 2012 seeking views on whether to introduce legal powers for Ofcom to run incentive auctions, to which Ofcom replied as follows:[25]

"*New explicit powers to conduct specific types of award could be helpful in enabling awards that might be more efficient and effective ways to secure optimal use, for the benefit of citizens and consumers"*.

"*We agree that it could be very useful to have this additional way of enabling spectrum to change hands, and to change uses, in future. If this were changed, it could reduce the transaction costs, and risk, for a licensee wishing to test the market for his spectrum who would otherwise have to go to market on his own behalf. Reducing the transaction costs of trading spectrum in this way could increase the likelihood of spectrum finding the most efficient use and user.*

Incentive auctions could also facilitate greater efficiency by providing a mechanism for co-ordination between potential suppliers of spectrum rights (existing licensees) and/or potential purchasers, when this might be otherwise be difficult to achieve."

In 2013, DCMS then published its 'Connectivity, Content and Consumers' White Paper, which committed to legislate to allow Ofcom to run incentive auctions.[26] The aim was to:

"*give spectrum licensees the right incentives to surrender all or part of their rights to spectrum for other uses where it is no longer needed or is being under-used, by giving Ofcom the power to run auctions where some of the proceeds are shared with the licensees that have surrendered their spectrum rights*".

DCMS conducted an Impact Assessment (IA), which noted that negotiations with HM Treasury to allow auction proceeds to flow to the existing licensees were ongoing. The IA highlighted the need to keep spectrum management tools up to date and discussed the benefits of introducing incentive auctions.[27]

This was followed by publication of DCMS' UK spectrum strategy document in March 2014, which reiterated the need to have the widest range of tools available to help get the best value from spectrum and proposed to introduce incentive auctions.[28]

[25] TEMPLATE for Ofcom Statements and other documents
[26] 1185-C Comms Review 2013:1185-C Comms Review 2013 (publishing.service.gov.uk)
[27] Impact Assessment (publishing.service.gov.uk)
[28] UK_Spectrum_Strategy_FINAL.pdf (publishing.service.gov.uk)

We understand that the coalition government intended to introduce legislation enabling Ofcom to conduct incentive auctions in the 2015 Communications Bill. This was never done, however, because the opportunity to use an incentive auction did not arise.

As part of its 2013 Call for Inputs on the future use of the 700MHz band, Ofcom had consulted on the possibility of using an incentive auction to determine the timing of the release of 700MHz (then used by Digital Terrestrial TV) for mobile, as opposed to the release of that spectrum.[29] Consultation responses did not see the point of having an auction to determine the timing of that release, so in its May 2014 consultation Ofcom abandoned the idea.[30]

With the planned auction still some time away, there is ample time for Ofcom to request the require legal powers and for legislation to grant those. Mandatory revocation is not best practice. Over the past decade, regulators have integrated the clearing of incumbent uses into the auction process. Adopting new, better spectrum management tools would represent a step forward in Ofcom's commitment to market-based tools, cementing its reputation as a progressive, forward-thinking regulator.

A simple alternative to an incentive auction would be to use a voucher system like the one used by the FCC for its mmWave auction. Existing 40GHz licensees would receive a voucher equal to the value of their spectrum (e.g. Three would receive 2GHz, MBNL and MLL 500MHz each). At the auction:

- If a 40GHz licensee wants to retain its 40GHz holding, it would bid for an amount of spectrum equal to its voucher – the licensee would then retain the same amount of spectrum it had and pay nothing;

- If the licensee wanted to win more 40GHz spectrum, it would bid for more spectrum than its voucher – and pay for any additional spectrum (over and above the voucher) at the price determined by the auction; and

- If the licensee wanted to sell 40GHz spectrum, it would bid for less spectrum than its voucher – and then receive an incentive payment for the difference between its voucher and the amount of spectrum won (at the price determined by the auction).

[29] uhf_si_call_for_inputs.pdf (ofcom.org.uk)
[30] First draft of CBA-UP.docx (ofcom.org.uk)

In this auction, the supply would be the entire 3GHz in the 40GHz band, but Ofcom would require legal powers to be able to pay existing 40GHz licensee holders in the event that they released spectrum in the auction.

Ofcom has not explained why it cannot rely on spectrum pricing to achieve its objectives

In the consultation, Ofcom has not assessed the potential role of ALFs in achieving its stated objectives for mmWave spectrum. Although Three does not agree that ALFs serve any purpose for tradeable spectrum, Ofcom's long-standing policy has been to secure optimal use of spectrum over time by setting ALFs based on market value (for spectrum expected to be in excess demand).

The Wireless Telegraphy Act 1998 made it lawful to charge spectrum users a fee that was designed to ensure efficient use of spectrum, rather than simply recovering the cost to Ofcom of licensing spectrum use. Since then, Ofcom has extended the application of Administered Incentive Pricing (AIP, now also known as Annual Licence Fees, or ALFs) to almost all sectors for which it is appropriate.

Ofcom's rationale is that, in a well-functioning market, ALFs based on market value would reflect opportunity cost – i.e. the value to the best alternative user or use denied access to the spectrum. Ofcom believes that this promotes optimal use by incentivising users to only retain that spectrum for which they have the highest value and relinquish spectrum to Ofcom (or sell it to other users) if higher-value users appear over time.

If, as Ofcom believes, the current 40GHz allocation may be inefficient for new uses and existing 40GHz licensees may not be the highest-value users, Ofcom can introduce ALFs from Feb 2023 (as specified in those licences).

In response, if existing 40GHz licensees were not the highest-value users for their holdings, Ofcom would expect them to relinquish some or all of their 40GHz spectrum (either nationally or in specific geographies such as low-density areas) for Ofcom to reallocate.

It is therefore surprising that Ofcom has obviated its own market-based spectrum pricing policy as an alternative way of securing its objectives. ALFs aim to secure the same objectives that Ofcom seeks through

revocation – i.e. an efficient allocation, which Ofcom believes would also maximise investment and innovation in services.[31]

Ofcom applies ALFs on all mobile bands outside their initial licence period – 900MHz, 1800MHz, 2100MHz and UKB's 3.4-3.8GHz spectrum to date. Ofcom should spell out why ALFs are effective in ensuring optimal use, competition and innovation when applied to these other bands, but would not be if applied to 40GHz spectrum.

If, on the other hand, Ofcom no longer trusts that ALFs can secure optimal use of spectrum, it should abolish mobile fees and relieve the industry of an annual £320m ALF bill.

Revocation of 40GHz spectrum would discriminate against Three and would not be consistent with other interventions by Ofcom

Ofcom should liberalise 40GHz in the hands of existing licensees to enable mobile use (including 5G), as it has always done when enabling new technologies in bands held by MNOs:

- In January 2011, Ofcom liberalised 2G 900MHz and 1800MHz licences in the hands of the incumbents to enable 3G services – as it was required to do so following a direction by the Secretary of State. This decision meant that access to low band spectrum (900MHz) remained concentrated in the hands of just 2 MNOs: Telefonica and Vodafone;[32]

- In August 2012, Ofcom decided to liberalise EE's 1800MHz licences to allow the use of 4G – effectively granting EE a one-year head start in the provision of 4G services in the UK.[33]

- Likewise, Ofcom is currently proposing to liberalise Vodafone's 900MHz, 1800MHz, 2100MHz spectrum to enable 5G –and to make similar changes to other MNO licences upon request.[34]

To our knowledge, Ofcom has never revoked spectrum held by MNOs to enable new uses and technologies. In the most recent consultation proposing to liberalise Vodafone's licences for 5G, Ofcom has not assessed either the risk that the current allocation of Vodafone's licences may be inefficient, nor analysed whether Vodafone may be "the highest

[31] Ofcom mmWave consultation, paragraph 7.28
[32] Statement (ofcom.org.uk)
[33] Statement (ofcom.org.uk)
[34] Consultation: Ofcom's response to Vodafone's and Telefónica's requests to update the technical conditions of their mobile licences to enable the deployment of newer technologies including 5G

value user" for this spectrum. [✂].

We are unclear as to why Ofcom proposes to adopt a different approach in respect of Three's 40GHz spectrum, and we consider that the proposal to revoke our 40GHz licence is discriminatory.

2. We have ambitious plans to use our 40GHz spectrum.

Executive Summary

As Ofcom recognises, our current commercial use of 40GHz spectrum is limited to a few tens of fixed links. Our longer-term plans for the spectrum are far more ambitious though. We are investing time and resource today towards progressing to trials and, ultimately, deployments for a variety of use cases.

Ofcom's proposals to revoke our 40GHz licence risk undermining the investments we are making in using the spectrum in the coming years. [✂]

The next step in many of these plans will be to progress to proof of concept trials. However, we are currently unable to run trials as the equipment and device ecosystem does not yet support 40GHz spectrum. We are proactively engaging with vendors to drive the ecosystem – certainty over the future of our 40GHz licence will enable us to make commitments required for vendors to invest in developing and manufacturing equipment and devices which support the band.

We have identified four main 40GHz use cases and are engaging with industry to progress them

In this section, we discuss the four main use cases [✂]

- 5G services on small cells, including self-backhauling,
- High speed 5G FWA,
- Neutral host models; and
- Private networks.

There are many other use cases which are suited to the large mmWave holdings we have in the 40GHz band.[35] [✂]

Small cells

As Ofcom recognises, mmWave spectrum, such as 40GHz, is well suited to small cell deployments to offload 5G mobile traffic.[36] The 40GHz band was standardised for 5G in 3GPP in 2018/19 at our request and we have since been in discussions with the industry to develop ecosystem support. mmWave spectrum has large bandwidths but limited

[35] [✂]
[36] Ofcom mmWave consultation, paragraph 2.42.

propagation characteristics. This makes the spectrum particularly well suited to small cell rollouts which will be targeted in very localised areas (where the spectrum doesn't have to travel far) and where there are large volumes of traffic to offload from other spectrum bands.

Our intention will be to use our 40GHz spectrum exactly for this purpose. [✂].[37] We will deploy 40GHz spectrum on small cells where it is economic and practical to do so. Our view is that this is most likely to be where we can deploy clusters of small cells to offload high levels of traffic in areas with a particularly high footfall.

Figure 2: [✂]

[✂]

Source: Three UK modelling

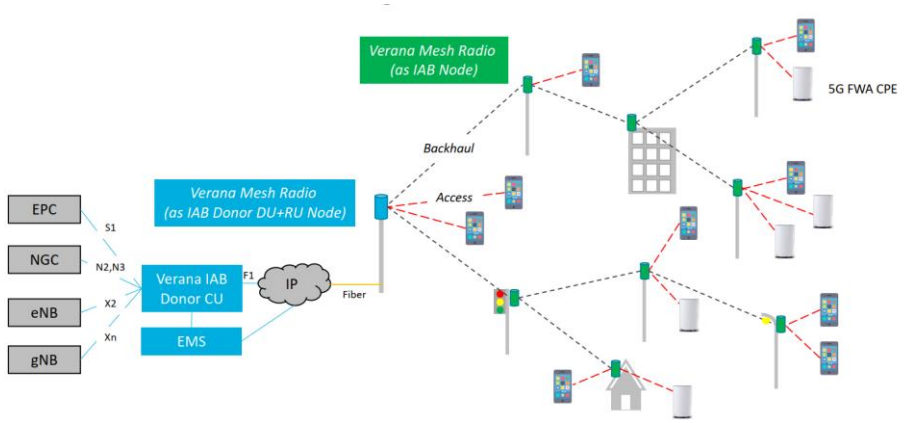
One of the key issues with targeting small cells to offload traffic in specific areas is the ability to locate them where they will be most effective. As we have previously shared with Ofcom[38], there are various factors which can complicate small cell deployments, including availability of fibre backhaul.

The size of our 40GHz spectrum holdings means that we will have the option to overcome fibre availability issues using self-backhauling technology. [39] Self-backhauling will allow us to split our 40GHz holding to allocate 1GHz to 5G access and 1GHz to microwave backhaul. Using this technology, we would be able to wirelessly transmit data back from

[37] Ofcom recognises in its Mobile Spectrum Demand paper that network planning considerations and access to new locations for macro sites can be challenging. See Ofcom Mobile Spectrum Demand Paper paragraph 5.28. We agree that there is a limit to the number of macro sites that can be feasibly and economically deployed and that we may be getting close to it.
[38] See Three UK's response to Ofcom's 2022 Mobile Spectrum Demand consultation document.
[39] Also known as Integrated Access and Backhaul (IAB) under 3GPP standards.

multiple small cells through a series of hops to a hub site (e.g. a macro site) with fibre backhaul, as illustrated in Figure 3.

Figure 3: Self-backhauling illustration



Source: Verana Networks

Self-backhauling technology was standardised by 3GPP and our understanding from discussions with vendors is that equipment, once developed, should support it. It is only with large spectrum holdings that self-backhauling becomes feasible since splitting smaller holdings will result in insufficient spectrum being available for radio access for consumers to see the benefits of mmWave spectrum.

[✂]

Fixed Wireless Access (FWA)

40GHz is also a great candidate band for FWA deployments. [✂]

[✂][40] Our view is that consumers will increasingly value the speeds that 5G FWA connections can deliver, alongside the ease of being able to quickly set up a connection without inconvenient and time-consuming engineer appointments.

FWA is also attractive from a provider's perspective. [✂]

[✂][41] [✂]

[40] [✂]
[41] [✂]

Figure 4: [✂]

[✂]

Source: Three UK

[✂]
[✂][42][43]

Neutral Host models

mmWave spectrum is also well-suited to providing connectivity for neutral host solutions in certain environments. Neutral host models involve a third party constructing the radio infrastructure in an area which is then shared by MNOs. Each MNO either deploys their own spectrum on the neutral host's infrastructure or has shared access to a partner MNO's spectrum.

Neutral host models can be deployed both indoor and outdoor, typically where it is impractical or uneconomic for each MNO to deploy their own infrastructure. The wide bandwidths we hold in the 40GHz band are attractive for neutral host providers because:

- Users of their neutral host system will receive faster speeds than on spectrum with narrower bandwidths; and
- More MNOs will be able to be supported in models where the spectrum is shared across multiple MNOs.

[42] [✂]
[43] [✂]

[✂][44]

[✂]

Private networks

mmWave spectrum will also be important for 5G private networks. Our understanding is that there is a wide range of different applications for which 5G private networks are relevant (for example, in airports, cities and ports).

[✂]

We are engaging with vendors to develop equipment to support the 40GHz band

[✂]

There is currently no support for 40GHz spectrum worldwide, as far as we are aware. This is due to a limited amount of 40GHz being allocated to mobile operators - our understanding is that no 40GHz spectrum has been allocated for new uses in Europe. Manufacturers do not invest in producing new equipment unless there is robust demand for it.

However, we have ambitious plans to use the spectrum, as we discuss above. We are already engaging in discussions with manufacturers to drive the 40GHz ecosystem.

Our discussions with equipment vendors

We are having discussions with equipment manufacturers to drive the 40GHz ecosystem. [✂]

[✂]

[✂]

Our discussions with device vendors

The importance of device availability varies by use case. FWA deployments only require 40GHz support in one CPE model, whereas small cell mobile deployments will only be successful in relieving congestion if a large proportion of mobile devices support the band.

[44] [✂]

[✂]

Currently no device manufacturers have announced plans to support 40GHz in their handsets or CPEs. [✂]

3. Revoking 40GHz licences will delay rollout in the band.

Executive summary

Ofcom's view is that revocation of 40GHz licences will not delay the availability of the band for new uses. It expects that in any of its four options, 40GHz spectrum will be available for new uses by 2024.

Our view is that the revocation of 40GHz licences will, instead, risk significant delays to the availability of the spectrum for two reasons.

Firstly, 40GHz rollout requires intensive engagement between operators and device/equipment vendors. It typically takes a number of years for these conversations to result in sufficient support for operators to effectively rollout their networks.

We are currently having initial discussions with these vendors to drive future support in the 40GHz band, but our incentive to do so will disappear if Ofcom were to revoke our spectrum. There would then be a period of lost time between Ofcom's notification to revoke the spectrum and the conclusion of the mmWave award a number of years later when no UK operator will be having these discussions. We would expect this to delay the rollout of 40GHz spectrum significantly beyond 2024.

Secondly, Ofcom considers that new 40GHz licensees will be able to use the spectrum wherever existing users are not using it during the 5-year revocation notice period. This may not be the case.

If Ofcom chooses to revoke our spectrum, we may still plan to deploy it during that 5-year period for targeted congestion relief [✂], potentially alongside other 40GHz spectrum we win back in the auction. Our plans to use the spectrum could prevent new licensees from accessing it during the notice period.

Uncertainty about the extent to which an operator will be able to use 40GHz spectrum in the first few years post-auction will make it incredibly difficult for them to value the spectrum. This could lead to an inefficient allocation if an operator takes an overly-optimistic or negative view of the extent to which they can use the spectrum in the 5-year notice period.

Ofcom intends to make 40GHz available for new uses by 2024

One of the objectives against which Ofcom assesses its four options for the 40GHz band is whether it will ensure the timely availability of spectrum. This objective is derived from its statutory duty to secure the optimal use of spectrum.[45]

[45] Communication Act 2003, section 3, paragraphs 21-22.

Its view is that all four of its options perform similarly in relation to the timely availability of spectrum and that the 40GHz band should be available for new use on similar timescales to the 26GHz band – by 2024.[46] It also expects that equipment for 40GHz may become available for deployments of new uses to begin around 2024.[47]

One risk to the timelines of spectrum availability under Ofcom's revocation options is potential delays during the 5-year revocation notice period where existing licensees continue to hold the spectrum. Ofcom considers this not to be a problem since it proposes that new deployments by users could be coordinated with existing licensees during the 5 years.[48]

In the rest of this section, we discuss why we believe that any revocation of 40GHz licences will likely delay rollout of the band for two reasons:

- The device and equipment ecosystem relies on demand from mobile operators. This demand will not arise while operators do not hold 40GHz licences; and

- New licensees may be unable to deploy spectrum where they want during the 5-year revocation notice period.

MNOs cannot drive the 40GHz ecosystem without long-term certainty on spectrum holdings

The 40GHz ecosystem has not yet been developed

As Ofcom recognises, the device and equipment ecosystem for the 40GHz band lags that of more advanced mmWave spectrum bands, such as 26GHz, 28GHz and 39GHz. These bands have been allocated to mobile and deployed much more widely than 40GHz.[49] This drives demand and, therefore, support from the mobile ecosystem.

Our understanding from discussions with the industry is that:

a) No radio equipment has been developed for the 40GHz band, [✂]. By contrast, RAN equipment is already available and deployed for the 26GHz, 28GHz and 39GHz bands; and

[46] Ofcom mmWave consultation, paragraph 7.28.
[47] Ofcom mmWave consultation, paragraph 7.77.
[48] Ofcom mmWave consultation, paragraph 7.61.
[49] Our understanding is that the 40GHz band has not been awarded to mobile operators anywhere else in Europe.

b) No device vendors have announced plans to support the 40GHz band in their phones. The 26GHz, 28GHz and 39GHz bands are widely supported in regions where the spectrum has been deployed, for example the iPhone 13 in the US.

The 40GHz ecosystem will only develop with demand from mobile operators

It is expensive for equipment and device vendors to develop and produce products which support new spectrum bands. The European 40GHz ecosystem will be no different - vendors will not develop products supporting the band absent robust demand from mobile operators.

Our discussions with equipment vendors have confirmed this. [✂]

It is a similar story for 40GHz support in mobile handsets. [✂]

There will still be a considerable development timeline once we are able to make a volume commitment to equipment and device manufacturers. [✂]

For 40GHz deployments to be effective at alleviating 5G mobile congestion, it is necessary for there to be widespread support from device vendors. This will take even more time. If the market share of the devices which do not support the band remains small, very few consumers will connect to the 40GHz band in high footfall areas. The majority of traffic will remain on the already congested spectrum bands, and the congestion will remain.

These timelines and demand requirements highlight how important it is for operators to have long-term discussions with vendors about supporting new spectrum bands. Ecosystem support is not something that can simply be quickly switched on once an MNO gains access to a spectrum band.

Demand for 40GHz equipment and devices will be delayed if Ofcom revokes the spectrum

We consider it highly likely that any decision by Ofcom to fully revoke 40GHz licences will delay equipment and device support for the band, potentially resulting in a delay to rollout.

As we set out in Section 2, we are currently holding discussions with various third parties to drive the ecosystem and plan 40GHz trials. It is necessary to hold these discussions now given the long lead times

associated with chipset, device and equipment support for new spectrum bands.

If Ofcom were to announce a decision to revoke our 40GHz licence, these conversations would inevitably stop. We would have no incentive to continue pushing for 40GHz support if we knew that we will need to relinquish the spectrum within 5 years.

No other UK MNO would have an incentive to push 40GHz ecosystem support until the conclusion of the mmWave auction, since they would have no idea whether they might win spectrum in the band. This could lead to a significant period of time during which no UK MNO progresses discussions with the mobile ecosystem.

Our understanding is that Ofcom intends to publish its mmWave decision by the end of 2022 and complete the allocation of mmWave spectrum by 2024. This implies a minimum of one year (i.e. 2023) in which no operator will be progressing the 40GHz mobile ecosystem. However, we consider it optimistic that Ofcom will conclude the mmWave auction by 2024.

Taking the example of the most recently concluded auction, Ofcom first consulted on the design of the 700MHz and 3.6-3.8GHz bands in December 2018 with the intention of concluding the award in spring 2020.[50] It then published two further consultations on the auction design in October 2019[51] and May 2020[52] before finally concluding the award in March 2021, more than two years after the initial consultation.

Each consultation process is different, but the point is that these further issues in the recent auction process were not envisaged by Ofcom at the outset. If the mmWave auction takes a similar period of time from consultation to completion, we might expect the award to be complete in late 2024 or early 2025. Any delay to the mmWave auction will result in further time lost to the development of the 40GHz ecosystem. This will inevitably delay mmWave rollouts in the UK.

We can sometimes rely on demand from other European countries to drive the ecosystem available in the UK, as the equipment and devices are often produced at a regional level. However, we know that the demand to drive 40GHz ecosystem support is unlikely to come from another European operator, given the lack of 40GHz allocations in Europe. [✂]

[50] https://www.ofcom.org.uk/__data/assets/pdf_file/0019/130726/Award-of-the-700-MHz-and-3.6-3.8-GHz-spectrum-bands.pdf
[51] https://www.ofcom.org.uk/__data/assets/pdf_file/0028/172648/revised-proposal-auction-design.pdf
[52] https://www.ofcom.org.uk/__data/assets/pdf_file/0023/195521/consultation-sut-modelling-700mhz-3.6-3.8ghz-spectrum.pdf

New licence holders may not be able to deploy spectrum during the 5-year revocation notice period

Deployments by existing licensees may delay rollout by new users of the 40GHz band during the 5-year revocation period

Ofcom's view that new 40GHz licensees will be able to deploy the spectrum in areas where it is not otherwise in use relies on an assumption that the existing users will not have plans to deploy it during the revocation notice period.

Ofcom appears to be proposing to use the Local Access Licensing regime to enable access to existing users' spectrum during the notice period. The process requires the prospective user to contact the existing licence holder via Ofcom to ask for access to spectrum in a certain area for a period of time (usually three years). The existing licensee then notifies Ofcom of whether it has deployed spectrum in the area or has plans to do so during the relevant time period. If so, it can raise a reasonable objection to the request which will prevent the new prospective user from accessing the spectrum in that area.

In its assessment of the timely availability of spectrum, Ofcom appears to have overlooked the prospect of existing licensees having plans to use the spectrum during the notice period which would prevent access from new licensees.

If Ofcom revoked our entire 40GHz licence and we did not win any back in the mmWave auction, we would not continue to drive equipment and device support, as we discussed in the previous section. However, we would expect new licensees to re-start those discussions and, once they did, we may plan to deploy the spectrum in some areas to flexibly offload traffic during the notice period.

For example, [✂]

Once we made these plans, we would expect to raise reasonable objections to requests from other users to access the band in areas where we consider traffic relief might be necessary over the 5-year notice period. This would likely delay the timely use of the spectrum over that time period.

The issue would likely be exacerbated if we won back some 40GHz spectrum in the mmWave auction. In this case, we would deploy the spectrum won at auction more widely. In many areas, we may plan to also deploy the holdings subject to revocation during the notice period

alongside the newly won spectrum. This would delay use of the spectrum by new users.

Uncertainty about usage in the notification period will affect spectrum valuations

We would expect new licensees to be uncertain about the extent to which they will be able to use the 40GHz spectrum they won in the auction during the 5-year notice period. This could either be for the reasons described above or because of the risk that another operator submits a request to share the spectrum via Ofcom's Local Access licensing regime before they do.

A corollary of this uncertainty is that operators will find it difficult to value the spectrum pre-auction. As we discuss below in Section 6, we believe Ofcom's proposed approach to awarding individual geographic lots already brings considerable uncertainty to the valuation process. Uncertainty about the extent to which new licensees may be able to access the spectrum during the 5-year notice period will only exacerbate this.

Mobile operators value spectrum by estimating the discounted flow of expected net benefits that they will receive from its use. This calculation will typically compare the operator's network costs in each year with and without the spectrum. For example, an operator may not need to bear the costs of deploying a certain number of new mobile sites in each year if traffic is offloaded onto their new spectrum instead.

Where an operator is unsure of the extent to which it will be able to deploy the spectrum for the first three to four years, it will be unable to robustly estimate its network costs with the spectrum in those years.[53] This will impact its ability to accurately value the spectrum.

As we discuss below, bidders being unable to robustly value spectrum in an auction risks an inefficient allocation of that spectrum, inconsistent with Ofcom's statutory duty. Overly-optimistic operators will potentially win too much spectrum and overly-negative operators, too little.

The potential impact of this uncertainty on spectrum allocations would be avoided under the alternative options we present in Section 1. Both an incentive auction and trading would result in licences being immediately transferred to the highest value user of the spectrum (if that is not the

[53] This is particularly problematic because the act of discounting puts more weight on the earlier years (where there is more uncertainty) and less on the later years.

existing user). There would be no revocation notice period and, therefore, no complications arising from the uncertainty of access to spectrum during that period.

4. Ofcom has underestimated the costs of moving MBNL's fixed links out of the 40GHz band.

Executive summary

Ofcom has correctly identified that there will be costs to moving MBNL's fixed links in the 40GHz band. However, we believe that it has significantly under-estimated them because it has:

a) Under-estimated the unit cost of replacing microwave equipment;

b) Under-estimated the useful life of microwave equipment; and

c) Not included the costs of deploying additional microwave sites in the baseline scenario it relies on.

As a result, Ofcom's estimate of the costs of moving MBNL's fixed links out of the 40GHz band in the top 80 high-density areas is over £20m lower than our conservative estimate.

Ofcom also does not recognise that there would be additional implications from revoking MBNL's spectrum that we are unable to quantify. For example, the impact on customers from degraded service, the impact on MNOs' other programmes and the necessity to use fibre backhaul in some areas.

We suggest that Ofcom amends its analysis to include these additional factors. Our view is that an updated analysis would yield costs so significant that Ofcom discounts its option 2 because it would impose such a large cost on two of the industry players (us and EE).

Ofcom's estimate of the costs of moving MBNL's fixed links out of the 40GHz band is around five times lower than ours

Ofcom's options 3 and 4 propose the full or partial revocation of Three and MLL's licences while allowing MBNL to retain its licence.

Ofcom's rationale for treating MBNL differently from other licensees is that it could place a higher value on its holdings than any new users because of its large number of fixed links in the band (around 4,500).[54] Ofcom also considers that options 3 and 4 would reduce the costs of intervention by avoiding the costs of clearing MBNL's fixed links, which Ofcom estimate to be £2.9-4m in its baseline scenario.

[54] Ofcom mmWave consultation, paragraph 7.22.

Our view is that Ofcom has materially under-estimated the costs of moving MBNL's fixed links out of the 40GHz band. In this subsection, we amend Ofcom's modelling to:

- More accurately reflect the unit costs of moving fixed links;
- Use a more appropriate asset life; and
- Include the costs of deploying additional sites.

In the subsequent subsection we describe other factors that we have not been able to quantify but we expect to materially increase the cost to MBNL of moving its fixed links out of the 40GHz band beyond our and Ofcom's estimate.

Ofcom has underestimated the unit capex of moving fixed links

Ofcom assumes that the unit cost of moving MBNL's fixed links is restricted to two costs: equipment capex and installation. Our assessment is that:

a) Ofcom has underestimated capex costs; and

b) There are further costs that Ofcom appears not to have considered.

Table 3, sets out a comparison of our cost estimates against Ofcom's. These are the costs of simply replacing equipment on an existing site. We separately discuss the additional costs associated with deploying fixed links on new sites (e.g. additional hops) below.

Table 3: Comparison of fixed links unit costs

Cost	Ofcom estimate	Our estimate
Equipment	£7,000	[✂]
Installation	£3,500	[✂]
Managed Serve Provider[55]		[✂]
Survey		[✂]
Access and Other		[✂]
Administrative		[✂]
Total	**£10,500**	**£14,432**

Source: Ofcom and Three UK cost estimates.

MBNL have provided us with an estimate of equipment costs of [✂] based on its recent experience of procuring microwave hardware.

Ofcom's £7,000 estimate for equipment costs is based on a 2015 Plum Report for Ofcom[56]. It considers this estimate remains appropriate given its view that equipment costs have remained broadly flat in real terms. Our view is that Ofcom should adopt an equipment cost of [✂] given that it is based on the actual equipment costs MBNL experiences today, rather than an estimate made in 2015.

Ofcom's installation costs estimate is calculated as 50% of the equipment cost, again based on information from the 2015 Plum Report. This is a very rough estimate, based on old information, which only appears to reflect a one-off labour cost. Our additional cost estimates are again provided by MBNL who are more familiar with the costs of replacing fixed link equipment.

The impact of using the more accurate replacement costs provided by MBNL would be to increase the unit capex cost of replacing fixed links by around £4,000 per link.

Ofcom has underestimated the useful life of microwave equipment

Ofcom's baseline scenario assumes that MBNL's fixed link equipment has a useful life of seven years,[57] after which MBNL will replace the

[55] These are outsourced IT and Cloud services.
[56] https://www.ofcom.org.uk/__data/assets/pdf_file/0030/79464/plum_report.pdf
[57] Again, using information from the 2015 Plum Report.

equipment. It also assumes that the rolling seven-year equipment replacement cycle will already be costed into MBNL's deployment plans.

Ofcom, therefore, assumes a decision to revoke MBNL's 40GHz licence will only impact MBNL's replacement costs for equipment which has a remaining asset life beyond the five-year revocation notice period. Any equipment that would have been replaced during those five years anyway will not accrue an additional cost resulting from Ofcom's decision.

The useful lives of MBNL's microwave links are significantly longer than seven years. MBNL replaces fixed link equipment when either the link runs out of capacity (and needs upgrading) or reaches the end of its design life (25-40 years). It conservatively estimates that the average fixed link is replaced every 15 years.

Ofcom should include the costs of deploying additional fixed links in its analysis

Ofcom's baseline scenario assumes that MBNL will simply replace equipment on existing microwave sites if its 40GHz licence were revoked. It is only in its sensitivity analysis that it considers the possibility of additional sites being required.[58]

Our view is that there will inevitably be additional sites required for two reasons:

a) In some cases, MBNL will be required to use spectrum at a higher frequency than alternative fixed link bands to maintain the same backhaul service.[59] Additional hops may then be required to provide the backhaul due to the worse propagation characteristics of higher frequency spectrum.

b) Some existing sites may not be able to support replacement equipment. For example, if it is larger than 40GHz equipment and cannot be supported by the mast. In these cases, there will inevitably be greater costs driven by i) mast strengthening, or ii) MBNL having to relocate the site in circumstances where it cannot get permission to upgrade the existing site.

It is impossible to robustly estimate the number of replacement sites MBNL will require without undertaking a detailed survey of its 40GHz

[58] Ofcom mmWave consultation, paragraph A8.38.
[59] We have undertaken a rough assessment of MBNL's fixed links and estimate, based on link distances, that approximately [✂] may require higher frequency (E Band) spectrum.

estate. We, therefore, take the 2% figure Ofcom uses in its sensitivity analysis as a central estimate (i.e. the actual figure could plausibly be much higher or lower).

Placing additional fixed link sites will require acquisition and line of sight (LOS) costs which will increase the replacement unit cost we discuss above. MBNL's view is that the LOS and acquisition costs will amount to [✂] and [✂] per site respectively.

We estimate the costs of moving MBNL's fixed links out of the 40GHz band to be approximately five times higher than Ofcom's estimate

We have re-estimated the costs of moving MBNL's fixed links out of the band using the same methodology as Ofcom, but amending it to correct for the three issues we discuss above. Based on this, we calculate an average unit write-off cost of £6,271 and a total cost of approximately £25m to replace MBNL's fixed links in Ofcom's top 80 high-density areas.[60] Table 4, below, compares our analysis against Ofcom's baseline scenario.

Table 4: Comparison of the costs of moving MBNL's fixed links

		Ofcom's baseline scenario		Three's estimate		
No. of high-density areas	**No. of links replaced**	**Avg. cost per link**	**Total cost to MBNL**	**Avg. cost per link**	**Total cost to MBNL**	**Difference**
20	2,936	£1,000	£2.9m	£6,271	£18.4m	£15.5m
40	3,426	£1,000	£3.4m	£6,271	£21.5m	£18.1m
80	3,956	£1,000	£4.0m	£6,271	£24.8m	£20.9m
UK-wide	4,417	£1,000	£4.4m	£6,271	£27.7m	£23.3m

Source: Ofcom and Three UK estimates

There are additional migration costs that Ofcom has not considered in its analysis

Although significant, we consider that the cost estimates we presented in the previous section materially underestimate the impact of any Ofcom

[60] As we discuss above, our view is that operators are likely to widely deploy mmWave spectrum in at least Ofcom's top 80 high-density areas.

decision to revoke MBNL's licence. We have not been able to quantify these additional costs, but expect them to be similarly important.

The four main additional costs we have identified are:

a) The impact on mobile customers;

b) Resource implications and their impact on other programmes; and

c) The requirement for fibre backhaul in some areas

We discuss each in turn.

The impact on mobile customers

MBNL has estimated that it takes around 6 hours to replace the equipment required to support one fixed link. In some cases, a temporary link may be set up to mitigate the loss of service, but in many cases this will not be possible (for example, if there is no space available nearby for a replacement link). In these instances, mobile customers will experience a loss of service for a significant period of the day with implications for our reputation.

This loss of service is likely to be particularly harmful to customers since:

a) The replacement activity has to happen during the day[61] when most customers use mobile services.

b) By definition, the high-density areas where MBNL will be required to replace its 40GHz links will be where there is the greatest demand for mobile services.

There is also a risk of a longer-term degradation of customer service if MBNL is not able to replace a 40GHz link with something with similar characteristics. For example, the only option for some of the longer links may be the 10GHz band. This band has narrower bandwidths than 40GHz and will not be able to support the same capacity, with an adverse impact on quality of service.

Resource implications

A programme to replace MBNL's fixed links in high density areas within five years would be hugely challenging for two main reasons.

[61] Engineers cannot work on replacing fixed links during the night.

Firstly, we are already experiencing a shortage of skilled workers. Specifically, it is increasingly difficult to source microwave instrumentation and control engineers, field teams and designers for our existing rollout programmes. It is highly unlikely that MBNL would be able to source additional workers with the appropriate skillsets to undertake this work.

In practice, it is most likely that we and MBNL will need to repurpose many of these workers from their current roles delivering 5G rollout, 4G upgrades, the SRN and complying with Government's High Risk Vendor requirements. This would have a significant impact on these programmes.

Secondly, we are currently experiencing significant equipment shortages. We are seeing lead times of 12+ months to procure equipment, which are showing no signs of improving. This means that, in practice, a material proportion of the 5-year notice period is likely to be spent sourcing replacement microwave equipment rather than actually swapping out existing equipment.

We, therefore, expect that it would be incredibly challenging to migrate MBNL's fixed links onto other bands. Staff and equipment shortages will be exacerbated by the fact that microwave replacements tend to be difficult to undertake in the winter, increasing the run rate required to meet a 5-year deadline.

Fibre backhaul

Ofcom recognises that there could be some instances where MBNL may need to replace a fixed link with a fibre connection.[62] Its view is that this will be the case where it is more cost effective to use fibre backhaul than microwave.

Our view is that there could be instances where fibre will be the only option to replace a 40GHz link. As we discussed above, there could be cases where there are no suitable locations for replacement sites or additional hops. Like Ofcom, we would expect fibre costs to be considerable in these areas – in most cases, the reason we use fixed links in the first place is because of the difficulty/cost of fibre backhaul.

[62] Ofcom mmWave consultation, paragraph A8.10-A8.13.

5. Ofcom has not appropriately justified setting aside 850MHz of 26GHz in high density areas for local area users.

Executive Summary

Ofcom plans to set aside 850MHz (over a quarter) in the 26GHz band in high density areas for low power local users on a first-come-first-served basis. This is a very interventionist measure which has not been appropriately justified in the consultation.

Ofcom has already made large amounts of spectrum available for Shared Access Licences in the 1800MHz, 2.3GHz, 3.8-4.2GHz and 26GHz (low power indoor) bands, with limited take-up to date. Adding a large amount of 26GHz to the long list of lightly used Shared Access bands and denying that spectrum to wide-areas users requires further consideration.

In its 2005 Spectrum Framework Review (SFR), Ofcom decided to move away from a 'command and control' spectrum management model (where the regulator decides the optimal uses and users for a band) and to allow market mechanisms (auctions, liberalisation, and trading) to determine the optimal use of spectrum.

This was based on Ofcom's belief that firms, not the regulator, have the best knowledge of their values and costs and a strong incentive to respond to market signals and put resources to their best possible use.

Like Ofcom's proposal to disregard trading and revoke indefinite 40GHz licences for spectrum management reasons, the proposal to set aside a large amount of 26GHz spectrum (i.e. 850MHz) for local area users is reminiscent of the command and control model of the past.

We are concerned that Ofcom may be rolling back its market-based philosophy without adequate consideration of the risks of "regulatory failure" which led it to adopt the philosophy in the first place. Before deciding to set aside a large amount of 26GHz spectrum for these users, Ofcom should:

- Identify a market failure that can justify the set-aside – such as a "coordination problem" preventing local users from participating effectively in the 26GHz auction, and which cannot be resolved by the market;

- Carry out a cost-benefit analysis of the proposal to set aside 850MHz of 26GHz – giving due weight to the risk of reserving

spectrum to lower value users and creating artificial spectrum scarcity (and higher prices) in the 26GHz auction; and

- Assess alternative options of making shared spectrum available to local users – such as directing potential users to the Shared Access Bands (e.g. 3.8-4.2GHz) which remain largely unused, or re-allocating spectrum in other mmWave bands (e.g. 39-40GHz), which do not seem to have been considered by Ofcom.

Ofcom should not set aside 26GHz for local uses unless it has identified a market failure, has carried out a cost-benefit analysis and discarded other alternatives

Ofcom proposes to make both local and citywide 26GHz licences available in high density areas. The reason is that Ofcom believes that the new users with the highest value for this spectrum are likely to be a combination of wide area operators and local operators.[63]

Local licences suitable for local deployments would be available through Ofcom's Shared Access licensing framework. Wide area, citywide licences would then cover a wider geographical area for more widespread deployments by MNOs, FWA providers, etc.

As regards the specific amounts to be allocated to each type of user, Ofcom wants to ensure that "*a reasonable amount of spectrum*" for new uses is available for local users, and that wide area users have the opportunity to acquire *"large blocks"* of spectrum. Ofcom considers that "*the majority of the 26GHz band*" should be allocated to wide area users, and a smaller part primarily to local users.

Ofcom's rationale for reserving 850MHz of the 26GHz band (rather than any other number) to local users for low power use on a first-come-first-served basis in high density areas is that:

- 800MHz is **"*within the range*" of early indications for spectrum demand per operator (200MHz to over 1GHz);**

- Making the **'spare' 50MHz available to local users on a first come, first served basis would be more straightforward than incorporating it into the auction;** and

[63] Ofcom mmWave consultation, paragraph 3.12.

- The set-aside **would allow multiple local users to access the spectrum in high density areas, while still making "*the majority of the band*" available for citywide licences.**

This is an intrusive regulatory intervention that could materially limit the amount of 26GHz spectrum available to wide-area users in high density areas.[64]

Ofcom should spell out why it proposes to reserve 850MHz specifically (e.g. rather than 200MHz which is also "*within the range*" of early indications for demand and would allow multiple local users to access the spectrum in high density areas). The proposal requires much more evidence and analysis than has been presented in the consultation.

One of Ofcom's key objectives is to achieve an efficient allocation of spectrum – that is, that spectrum is allocated to the uses and users that can generate the greatest value to society from its use. This is particularly important for 26GHz spectrum, which has been earmarked as the pioneer mmWave band for 5G mobile in Europe.

A large spectrum set-aside of 26GHz for local users represents a break from the use of market mechanisms to allocate scarce spectrum. Since publication of its SFR in 2005,[65] Ofcom has relied on market mechanisms (auctions, trading and liberalisation) to allocate spectrum, complemented with regulatory action where needed.

Broadly, market mechanisms have proven a reliable means of ensuring that scarce spectrum is used efficiently and generates maximum value for society. As part of the SFR framework, Ofcom's approach has been to auction spectrum in excess demand (rather than resorting to command and control approaches, such as beauty contests or spectrum set-asides for specific users) as a way of enabling the market to determine the efficient allocation.[66]

This reflects the widely held view that the market does a better job than the regulator of deciding the highest value uses and users for the spectrum. In an auction, the spectrum is awarded to the highest bidder, which is likely to be the user who expects to derive the greatest value from the spectrum and provide the most value to society.

[64] We recognise that Ofcom proposes to allow citywide licence holders to hold Shared Access licences in high density areas, but this provides little comfort if those licences have already been taken up by local users when needed.
[65] Spectrum Framework Review Statement (ofcom.org.uk)
[66] Ofcom mmWave consultation, paragraph 3.22.

Set-asides should only be used when i) there is evidence of market failure (such as when major changes of use are needed and the market is unlikely to deliver them); ii) the benefits of the set-aside exceed the costs; and iii) other regulatory remedies are not viable. The risk of a large spectrum set-aside is that the spectrum may end up in the hands of lower value local uses or go largely unused.

Before deciding to set aside a large amount of mmWave spectrum for local users, Ofcom should first:

- Identify a market failure that can justify the set-aside – such as a "coordination problem" preventing local users from participating effectively in the 26GHz auction – and which cannot be resolved by the market;

- Carry out a cost-benefit analysis of the proposal to set aside 850MHz 26GHz – giving due weight to the risk of assigning spectrum to lower value users and creating artificial spectrum scarcity (and higher prices) in the auction; and

- Assess alternative options of making mmWave spectrum available to local users – such as directing users to other, lightly used, Shared Access bands (e.g. 3.8-4.2GHz) or re-allocating spectrum in other mmWave bands (e.g. 39-40GHz).

We assess each of these in turn.

Ofcom should first identify a market failure that could lead to an inefficient spectrum allocation to local users and which cannot be resolved by the market

The first question to be assessed is why local users should not gain access to 26GHz spectrum like everyone else – i.e. by bidding at the auction. This would be the standard way of ensuring that these users can access 26GHz only if they are likely to generate a higher value than alternative (i.e. wide-area) users of that spectrum.

Ofcom proposes a first-come, first-served mechanism to allocate local licences in high density areas due to the existence of a "coordination problem". Ofcom does not believe that an auction would be appropriate for local licences given their small coverage area and the number of licences that would be available. The number of potential lots, Ofcom

says, would make an auction process complex and would likely deter participation from prospective local users.[67]

We recognise that local users need access to shared spectrum on an ongoing basis, and that the main use will be for low-powered cells covering small areas in high density locations. We can understand why Ofcom may not like the idea of having large numbers of individual local users needing to buy spectrum in a one-off 26GHz auction, and why it may prefer the flexibility of granting access to shared spectrum to these users when needed (and on a first-come first-served basis).

More specifically, we can see that there could be a market failure (a "coordination problem") if many potential local users had to bid for shared spectrum in competition with wide-area users. This could prevent local users with a high combined willingness to pay from successfully expressing their joint values at the auction. Local users would need to negotiate a joint bid between sharers at the auction, and transaction costs would increase with the number of potential sharers.

For these reasons, we recognise that the approach Ofcom has adopted in previous auctions (e.g. in the 2013 combined 800MHz and 2.6GHz award and the 2006 auction of the DECT guard band) to address coordination problems may not be suitable – i.e. due to the higher number of licences that may be needed this time around.

In the 2013 award, Ofcom allowed up to ten concurrent low power shared users to compete for a given amount of spectrum with wide-area users (i.e. 2x10MHz or 2x20MHz of 2.6GHz paired), to determine what type of operator was the highest value user for that spectrum. Ofcom introduced a mechanism to aggregate individual bids from shared users at the auction.[68] Similarly, the 2006 auction of the DECT guard band gave 12 licensees concurrent access to 2 x 3.3 MHz of spectrum.

Notwithstanding the above, Ofcom has not investigated whether these coordination problems could be addressed by the market, for instance through band managers or market aggregators that gauge demand from local users, participate in the auction and aggregate the disparate individual demands of these users.

If, as Ofcom believes, local users could generate significant value for society, we would expect them to have a correspondingly high valuation for 26GHz spectrum in combination. If there is sufficient demand from

[67] Ofcom mmWave consultation, paragraph 3.33.
[68] i.e. summing the value of all bids and assigning that lot to the local use bidders at the auction if their combined bids exceed the highest bid from other users.

local users and their combined willingness to pay can match demand from wide-area users, the market can be expected to deliver intermediaries that coordinate demand from local users and bid for 26GHz spectrum on their behalf.

For instance, band managers can buy wide-area 26GHz licences at the auction and then trade, lease (if allowed) or partition the spectrum in specific areas to make it available to local area users. Neutral-host operators (like Cellnex, WIG, Freshwave or BAI) or financial investors may be well-placed to play this role, acting as agents on behalf of large numbers of individual local users.

These market intermediaries can be very effective at addressing coordination problems when individual local users have short term, unpredictable requirements for spectrum, or when spectrum is sold in large blocks but individual local users only require small blocks – as could be the case here.

For these reasons, Ofcom should investigate the prospect of market intermediaries resolving coordination problems before deciding to set aside a large quantity of spectrum for local area users.

Ofcom should carry out a robust cost-benefit analysis of the proposal to set aside large amounts of 26GHz spectrum

Once Ofcom identifies a market failure that would not be resolved by the market, it should carry out a cost-benefit analysis of the proposal to set aside a large amount of 26GHz spectrum in high density areas for local users.

We recognise that a detailed quantified cost-benefit analysis may not be possible, as this requires weighing uncertain benefits from local access services which have not yet been introduced with the likely opportunity cost of the spectrum set-aside.

However, Ofcom should at least carry out a qualitative assessment of the associated benefits and costs, if only to show that it has taken the potential risks into account. Since the 1950s, economists have warned of the perils of having the regulator decide, when competing uses exist, which spectrum user creates more value for society.

Setting aside a large amount of 26GHz spectrum for local users would displace alternative, wide-area users that could generate much higher value for consumers:

- Firstly, Ofcom's approach is likely to lead to an inefficient allocation of the spectrum. As Ofcom acknowledges, allocating spectrum on a first-come-first-served basis cannot ensure that highest value users are prioritised over lower value users.[69] This would be inconsistent with its duty to secure the optimal use of spectrum,[70] particularly for spectrum as potentially valuable as the 26GHz band.

- Secondly, under Ofcom's proposals the use of the spectrum will be determined by how many local users come forward to ask for spectrum on a first-come-first-served basis. Given the large amount of spectrum Ofcom plans to reserve and the fact that these requests will be localised, it appears unlikely that Ofcom's approach will lead to widespread use of the band across high density areas.

We acknowledge that Ofcom proposes to allow citywide licence holders to also hold Shared Access licences in high density areas, but this provides little comfort if those licences have already been taken up by lower value local users when needed. 26GHz spectrum may end up being used in a small number of locations and remain underused in many high-density areas.

This is a clear risk as the potential demand for Shared Access Licences in the 26GHz band is highly uncertain. The needs of local industrial users can be met by other means, such as licence exempt technology (i.e. Wi-Fi), MNOs' public networks (e.g. through 5G network slicing) or Local Access licences to unused MNO licenced spectrum.

There are indications that this risk may be materialising in some Shared Access Licence bands.[71] For instance, in December 2019 Ofcom made available 390MHz of 5G spectrum for Shared Access Licences in the 3.8-4.2GHz band. These licences are available for private networks and Fixed Wireless Access users.

Take-up of the 3.8-4.2GHz licences has been relatively low. There are only 423 Shared Access licences granted to 51 licensees in the band. A substantial amount of spectrum has been reserved but is being used in a tiny part of the country by very few users. This arrangement prevents other types of 5G users (beyond private networks and FWA) from using

[69] Ofcom mmWave consultation, paragraph 3.29.
[70] Particularly in relation to achieving an efficient allocation of spectrum.
[71] Since December 2019, these licences have been available in four spectrum bands: 1800 MHz, 2.3GHz, 3.8-4.2 GHz, and 24.25-26.5GHz (indoor low power licences only) bands.

the spectrum and fragments the rights of use into small geographical areas. National mobile use has been precluded.

There is a further risk of inefficiency if the set aside of 850MHz limits the number of wide-area users that could win a large contiguous block of 26GHz spectrum. A large set-aside could also create artificial scarcity in the auction, inflating the prices paid for 26GHz spectrum in high density areas.

Ofcom should assess other alternatives to a 26GHz set-aside

Finally, Ofcom should assess whether there are alternatives to a 26GHz set-aside that may deliver comparable benefits at lower cost to society. Alternatives include making arrangements for local users to bid for 26GHz spectrum (e.g. through spectrum aggregators as discussed above), facilitating access to wide-area licences where spectrum is not being used, and making available alternative bands for shared use.

As discussed above, Ofcom has already made large amounts of spectrum available for Shared Access Licences in the 1800MHz, 2.3GHz and 3.8-4.2GHz bands, with limited take up to date. One alternative to a 26GHz set-aside is to direct potential users to these other access bands, which remain largely unused at present. Adding a large amount of 26GHz to the long list of lightly used Shared Access bands and denying that spectrum to wide-areas users requires further consideration.

If Ofcom insists in a spectrum set-aside for local users, a good alternative would be the 39-40GHz band. The band has relatively few users (fixed links in the lower 500MHz and light use by the MOD in the upper 500MHz). The wider 37.5-43.5 GHz band has been identified globally for mobile use and has widespread equipment and device[72] support off the back of deployments in large markets like the US.[73] Like the 26GHz band, its device and equipment ecosystem is far more advanced than the 40GHz band.

Ofcom does not appear to have considered allocating the 39-40GHz band for new uses, despite its international use for mobile services and advanced mobile ecosystem. Instead, Ofcom only gives reasons for the 28GHz and 66-71GHz bands to not be in the scope of this consultation. We ask Ofcom to consider other mmWave bands (including 39-40GHz) if, despite the above, it still believes that a set-aside for local users would be appropriate.

[72] For example, it is supported in the iPhone 13 in North America.
[73] As Ofcom recognises. See: Ofcom mmWave consultation, paragraph 2.15.

6. Ofcom should expand its definition of citywide areas and auction spectrum in sub-national lots.

Executive summary

Ofcom is planning to split the country into two areas, based on its view of the future prospect for widespread mmWave deployments. Its assessment is that 40 towns and cities are likely to fall under the 'high-density' category requiring widespread mmWave deployments.

Our view is that Ofcom has significantly under-estimated the number of areas in the high-density category because it has:

a) Not taken a future-looking approach to assessing potential candidates;

b) Inferred too much from the density of existing macro sites; and

c) Not considered many areas which are likely to require small cell deployments in the future – as shown by our congestion analysis.

We therefore believe that Ofcom should increase the number of high-density areas to at least its 80 highest ranked areas, and probably more.

We also disagree with Ofcom's proposal to auction the 26GHz band in separate geographic lots. The complexity of valuing spectrum based on future demand (5-10 years in advance) in 40+ individual towns and cities is unlikely to lead to an efficient auction outcome.

We therefore suggest that Ofcom should take the simpler approach of auctioning sub-national licences in the 26GHz band.

Ofcom's underestimates the number of 'high density' areas

This section discusses how Ofcom proposes to split the country into high and low-density areas. We go on to explain that:

- Ofcom's approach to identifying high-density areas does not consider future developments;

- The density of base stations today may not be representative of future mmWave deployments; and

- [✂]

Ofcom uses a two-stage approach to split the country into high and low density areas

Ofcom's proposals for the 26GHz band vary depending on whether a location falls into one of two categories: 'high-density areas' and 'low-density areas'. Ofcom determines which area a location falls within using a two-step process.

a) Firstly, it identifies towns and cities which have either (i) a population of at least 75,000, or (ii) notably high peak hour mobile traffic. This gives a list of 107 potential high-density areas.

b) It then ranks those areas based on the level of mobile traffic they experience at peak hours and the greatest density of mobile base stations with the area.

Ofcom proposes to categorise the top 40 ranked areas as 'high-density' based on a visual assessment of graphs which rank areas by peak hour traffic and base station density. These 40 areas account for 38.7% of the UK population.

Our view is that Ofcom's proposals risk significantly under-estimating the number of areas that will require licensed mmWave deployments in the future. We also consider that the impact of over-estimating the number of these areas is likely to be materially smaller than under-estimating, particularly since Ofcom intends to enable Local Access Licences in the spectrum band. We discuss why below.

Ofcom's approach to identifying high density areas does not consider future developments

A key drawback of Ofcom's assessment is that it is a static analysis taken at one point in time. For example, Ofcom uses the following metrics captured in the recent past:

- The population of towns and cities (from the 2011 Census).
- Data traffic by town and city (from the 2021 Connected Nations report).
- Base station density (from the 2021 Connected Nations report).

- Data traffic by base station (from the 2021 Connected Nations report).

However, mmWave spectrum may not be widely deployed until the mid-late 2020s. Over that time, some of these metrics may change, significantly in some cases. Ofcom's approach is not future proofed to account for these future changes.

For example, the recent shift from a typical expectation that workers will spend five days in the office to hybrid approaches with far more home working has had an impact both on traffic distribution across mobile operators' networks and the locations where people are looking to live in the future.[74,75]

These changes are likely to continue to evolve over time, directly affecting metrics a), b) and d) above. We would also expect MNOs to respond to any changes by adapting their networks, affecting the base station density across different areas (metric c)).

Neither us nor Ofcom know which events may further impact the locations where extensive mmWave deployments are required in the future. As a result, our view is that Ofcom should take a more cautious view and err on the side of categorising more and wider areas as 'high density'. This will reduce the risk of future widespread mmWave deployments being required in areas which operators will be unable to access spectrum on a licenced basis.

The density of base stations today may not be representative of future mmWave deployments

Ofcom's view is that areas with a greater density of mobile base stations are likely to be a good predictor of where mmWave spectrum is likely to be deployed more extensively. We believe that Ofcom has put too much weight on this inference.

We try to deploy our network based on forecast traffic demand. Where demand is highest, we will often try to densify our macro network to increase capacity. However, the number of macro sites we have deployed is not necessarily an indication of where we will deploy mmWave in the future.

[74] For example, the ITU has noted that the impact of COVI-19 was to shift traffic from central business districts to residential areas. See https://www.itu.int/dms_pub/itu-d/opb/pref/D-PREF-EF.COV_ECO_IMPACT-2020-PDF-E.pdf.
[75] For example, FJP investment has found that 17% of people surveyed reported a newfound desire to live in a different region of the UK post-COVID. See https://www.fjpinvestment.co.uk/wp-content/uploads/2021/11/FJP-Report-Q4-Market-Research.pdf.

Firstly, we aim to deploy all of our spectrum on our masts in higher traffic areas. This means that a macro site in a low traffic area might have a very different spectrum configuration and, therefore, less capacity than one in a high traffic area. Simply counting the number of mobile sites in an area is not always particularly informative of how MNOs have adapted their networks to meet capacity requirements and what additional deployments may be undertaken in the future.

Secondly, we only densify our network where we are able to do so. Issues with gaining access, planning permissions, transmission and power can mean that we are often unable to efficiently build new macro sites in some areas to meet capacity demands. It is in these areas that small cell deployments with mmWave spectrum may be particularly useful. This is because it can sometimes be easier to gain access to and planning approval for sites for small cell deployments than macro sites.

These two factors mean that it is not always the case, as Ofcom suggests, that a high density of macro sites today will correlate with a high density of future small cells. In some cases, small cell deployments with mmWave spectrum will be most efficiently deployed in areas with a relatively low density of macro sites.

[✂]

The primary reason for mmWave deployments on small cells will be to alleviate congestion on existing macro cells. We would, therefore, expect Ofcom's high-density category to focus on high footfall areas where existing mobile sites are most likely to become congested. Ofcom appears to reflect this where it classifies high density areas as '…where we expect the most widespread deployment of mmWave spectrum for new uses to occur.'

We would expect the opposite to apply to low-density areas. These should be where there is little chance of future congestion and, therefore, less need for future mmWave deployments.

We have undertaken analysis to understand the congestion we might experience in 'low density' areas in the future. [✂][76][77]

[✂]

[76] Ofcom, Meeting Future Demand for Spectrum
[77] [✂]

Figure 5: [✂]

[✂]

Source: Three UK

[✂]

[✂]

This under-estimate of the scope of high-density areas extends beyond Ofcom's top 80 ranked areas. [✂]

In the absence of licenced access to mmWave spectrum in these areas, MNOs would either have to i) let the areas congest; or ii) make a series of requests for Shared Access licences with little certainty about whether they would be able to access the bandwidth or frequencies compatible with their equipment to effectively offload the traffic. Neither outcome is likely to lead to good consumer outcomes.

In our view, Ofcom should extend the scope of its high-density areas to more comprehensively include areas which will also require mmWave deployments in the future. We believe the definition should certainly include Ofcom's top 41-80 ranked areas and would likely extend to other areas where future network congestion is plausible.

Ofcom should auction 26GHz spectrum in sub-national lots

Ofcom proposes to auction 26GHz spectrum in geographic lot categories (i.e. city/town-specific) rather than lots which cover all high-density areas (sub-national lots).

Geographic lots are unlikely to lead to a more efficient allocation

The main advantage Ofcom identifies for the proposal to allocate geographic lots is that it would enable entry from operators with use cases just for specific towns and cities. Ofcom's view is that this could lead to a more efficient allocation of the spectrum as the operators with the highest valuation in each area would be most likely to win the spectrum.[78]

We do not agree that this will lead to a more efficient allocation of the spectrum than alternatives for the following two reasons:

a) National operators will find it difficult to value spectrum at the level of granularity Ofcom is proposing. As we have discussed above, the value of mmWave spectrum will primarily be derived from its ability to alleviate congestion in high footfall areas. It will also take time post-auction for the spectrum to be deployed.

   The combination of these two factors means that, under Ofcom's proposals, operators will be required to accurately identify which specific towns and cities will require significant congestion relief in the future, years in advance. They will also require a detailed understanding of the extent to which they will be able to deploy mmWave spectrum in those cities to combat that congestion, for example, having a detailed knowledge of the assets, power and backhaul in each traffic hotspot.

   In practice, a national operator is likely to value 26GHz spectrum at a geographically aggregated level – i.e. as a substitute for a given number of sites that may otherwise be needed to address congestion. For these purposes, whether a specific site may be required in central London or Birmingham is not particularly relevant.

   All the operator needs to know to value 26GHz is roughly how many sites would otherwise be needed nationally by a given timeframe. The operator can then trust the law of large numbers – i.e. that underestimates in one particular city will likely be compensated by overestimates in another – to ensure it has not grossly overestimated or underestimated the value of the spectrum.

[78] Ofcom mmWave consultation, paragraph 9.9.

With Ofcom's proposed geographic lots, we expect that national operators will over-value spectrum in some cities where it will either not ultimately be required or not possible to deploy it. Similarly, the spectrum will be under-valued in cities where they under-estimate future congestion. This will not result in the efficient allocation of spectrum that Ofcom envisages.

b) Ofcom is already proposing to set aside 850MHz of 26GHz spectrum for use by local operators. This should be more than sufficient to enable entry from any new entrant sub national operator that wants to deploy a network in a specific town or city. We have seen no evidence that new entrants will have value for spectrum beyond that 850MHz.[79]

Ofcom downplays the disadvantages from auctioning the 26GHz band in geographic lots

Ofcom then considers two downsides from auctioning geographic lots. In summary these are that:[80]

- National operators could win different amounts of spectrum and different frequencies in different high-density areas; and
- It could increase the complexity of bidding in the auction for national bidders.

We agree that these are downsides of auctioning spectrum in geographic lots but believe that Ofcom has under-estimated their importance. We discuss each in turn.

Ofcom considers that the equipment and logistical costs of managing deployments in different frequencies in different high-density areas are unlikely to be large.

While we understand that one large manufacturer has very recently developed equipment which can cover the whole 26GHz band, this is not the case more widely. Other manufacturers will typically have the choice between developing equipment with wider bandwidths or cheaper equipment which covers a smaller section of the band. Although the latter may be more efficient for some vendors, it may not be possible if operators win different holdings in different cities. In this situation,

[79] As we discuss above, evidence from other European 26GHz auctions appears to indicate the demand for the band from non-MNOs is likely to be weak.
[80] Ofcom mmWave consultation, paragraph 9.10.

Ofcom's proposals will require operators to contribute to the development costs of more expensive RAN equipment with wider bandwidths.

Ofcom's view is that national operators should be able to cope with an increase in the complexity of an auction because national operators have previously participated in auctions. This is an unconvincing argument for auctioning geographic lots.

Firstly, Ofcom is downplaying the complexity of including a minimum of 40 geographic lot categories in the auction. As we discuss above, we will first have to forecast the extent to which we will require spectrum in each area and then understand whether we will be able to realistically deploy it. We will then have to determine a value for each lot and bid to that value in the auction. This would not be a simple undertaking.

As we discuss above, our view is that Ofcom's 40 proposed high-density areas risk materially under-estimating the scope of future mmWave deployments. An approach that more accurately estimated future mmWave deployments would include at least Ofcom's 80 top-ranked areas, and probably some additional areas with significant forecast congestion. This approach, although more likely to represent the scope of future widespread mmWave deployments, will add further complexity to an auction of geographic lots.

Secondly, Ofcom assumes that national operators will be able to cope with this complexity because we have participated in auctions before. There are two issues with this assumption:

a) New entrants that require the spectrum over wide areas may not have previously participated in auctions. There are wide area use cases for the spectrum that could be attractive to either non-MNOs or new entrants. For example, one mmWave use case is fixed wireless access (FWA). It is plausible that either an existing fixed player or a new entrant may want to win a sub-national mmWave licence to complement their network in towns/cities where they do not have a wired presence.[81]

b) Even for operators with experience, auctions are massive undertakings which require a huge amount of time and resource to prepare for. The more complex an auction is, the more preparation is required and the greater the chance of mistakes, even for the most sophisticated bidders. [✂]

[81] This appears to be why FastWeb won 26GHz spectrum in Italy.

Ofcom should, therefore, always err on the side of simplifying an auction process unless there is a very compelling reason not to.[82] We do not believe there is such a reason in this case.

We therefore believe that Ofcom should auction 26GHz spectrum in sub-national lots. We see no evidence to suggest that this would lead to a less efficient outcome than geographic lots, and we believe that the risks associated with auctioning geographic lots are too large to justify their use in any case.

[82] This is the approach it took when deciding on using a SMRA format in the 2021 700MHz and 3.6GHz auction. Ofcom considered the main advantage of the SMRA to be its simplicity and its downsides were considered to be manageable and did not warrant a more complicated auction format. See: Ofcom, Award of the 700MHz and 3.6-3.8GHz Spectrum Bands Statement, paragraphs 5.2 to 5.15.

Annex A [✂]

[✂]

Annex B [✂]

[✂]