Award of the 700 MHz and 3.6 - 3.8 GHz spectrum bands

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Executive Summary

1. BT/EE[1] welcomes Ofcom's proposals[2] for the award of the 700 MHz and 3.6 GHz bands on a national basis. This is an important milestone towards the wide roll out of 5G in the UK and we expect the award of this spectrum to bring benefits to UK consumers. We recognise Ofcom's various policy objectives and are generally supportive of its plans to auction this spectrum, but we have concerns with some aspects of the proposals and believe these require modifications to address the legitimate concerns of stakeholders. As we set out in this response, our concerns relate to (i) the specific design of the coverage obligations; (ii) the lack of competition measures to guard against very asymmetric distribution of sub-1 GHz spectrum; and (iii) the overly complex auction format, including the assignment round and its potential to support defragmentation of the 3.4 – 3.8 GHz band.

2. We support Ofcom and Government's ambition to further extend mobile coverage across the UK and agree, in principle, that spectrum auctions can be the right opportunity to introduce publicly-funded coverage obligations. Ofcom makes the case for two 90% geographic coverage obligations and although this would still fall short of the Government's 95% ambition, we agree it would represent good progress.

3. However, we strongly object to the proposed sub-obligations of 500 new sites and coverage of 140,000 new premises that have been added to the geographic percentage coverage targets. Ofcom states that these sub-obligations will ensure that the benefits of the obligations are broadly equal regardless of which MNOs win them; in essence, that more onerous or more directional obligations are needed in case the leading operator wins a coverage obligation, in order to extend an equivalent level of benefits to consumers. This assumption is misguided and has far-reaching consequences. Lagging operators already have a commercial incentive to catch up on coverage and therefore such coverage should neither be subsidised nor counted as a benefit of a subsidy. Ofcom should compare the benefits of what the public subsidy is actually needed to deliver, namely the extension of coverage beyond the commercially-viable footprint.

4. Furthermore, the nature of the sub-obligations discriminate against leading operators because it is more costly to deliver coverage to new premises the more extensive an operator's coverage already is. For these reasons, we believe Ofcom's approach may represent illegal state aid and, more generally, would undermine incentives for operators to differentiate their networks, where differentiation and competition have been the strongest drivers of coverage expansion.

5. Even if Ofcom pursued its obligations as proposed, our preliminary analysis suggests that the sub-obligations would significantly increase the costs of delivery, which risks the obligations going unsold. We believe that absolute geographic targets for UK and the nations without any sub-obligations, or alternatively an equivalent obligation to deliver coverage to premises in total not-spots, could deliver meaningful coverage benefits for society through the auction process without distorting the wider competitive incentives which in general serve customers well.

6. In our view the competition measure that Ofcom proposes in the form of an overall 37% cap on share of total spectrum is unnecessary and doesn't address the main risk to competition: namely, that the current very asymmetric distribution of sub-1 GHz spectrum could get worse,

[1] BT including its subsidiary mobile operator EE Limited.

[2] Consultation on "Award of the 700 MHz and 3.6-3.8 GHz spectrum bands", Ofcom, December 2018 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

leaving BT/EE and/or H3G with just 5% of sub-1GHz spectrum if we are unable to win any 700 MHz spectrum. Within the assessment of the likely harm to competition from very asymmetric sub-1 GHz spectrum shares, a key question for Ofcom must be how promoting static efficiency objectives, i.e. that it is efficient for the bidder(s) with the highest valuation(s) to be awarded spectrum, should be balanced with competition objectives to support broad availability of services and the best possible outcomes for consumers. We believe that Ofcom's analysis of what matters most for consumers, and therefore competition, is mistaken on a key point. Customers want mobile data services, with speeds of at least 2 Mbit/s, and they want it indoors and outdoors, i.e. seamless connectivity. Ofcom's technical analysis (as well as our own analysis) shows that sub-1 GHz is important for delivering seamless connectivity indoors and deep indoors. BT/EE and H3G operate 1800 MHz macrocell site grids and therefore have a structural cost disadvantage in deploying sub-1 GHz spectrum compared to Vodafone and O2. This will endure at least for the next 3-5 years while macrocell deployments remain key and it translates into lower valuations for 700 MHz spectrum. In turn, the lower intrinsic valuations present a material risk that BT/EE and/or H3G would win no 700 MHz in the absence of a safeguard cap, leading to the risk that competition in the market will be less fierce than it could have been. Ofcom should therefore intervene with a 75 MHz sub-1 GHz 'safeguard cap'.

7. Ofcom has proposed to award the spectrum in a combinatorial clock auction (CCA). We believe this is unnecessarily complex and has a number of undesirable features. We encourage Ofcom to opt for a simpler auction design, based on a simultaneous multiple round ascending auction (SMRA) format, similar to Ofcom's auction of 2.3 and 3.4 GHz spectrum in 2018. Ofcom's desire to award coverage obligations in separate lots to spectrum lots and the so-called positive price constraint, i.e. that Ofcom cannot pay out a net subsidy to winners of a coverage obligation and spectrum, can be achieved in an SMRA. We suggest that in the SMRA, bids for the coverage obligation lots would remain in play until that bidder submits a higher coverage obligation bid or the auction ends, and that such coverage obligation bids are 'live' whenever the sum of a bidder's standing high bids for spectrum and a bid for a coverage obligation meets the positive price constraint. We believe that this auction format would have as high likelihood of awarding the coverage obligation as Ofcom's proposed CCA, with far less complexity.

8. The award of the 3.4 – 3.8 GHz band across two auctions and the presence of existing licences in the band have unfortunately left the holdings of spectrum in this band fragmented, which is sub-optimal for 5G. Whichever way Ofcom looks to address this, there will be a timing problem but nonetheless, Ofcom must make every effort to facilitate the defragmentation of this band. We believe Ofcom should allow a period for multilateral negotiations prior to the completion of the assignment round and must consider measures to prevent H3G, as the existing licensee, from engaging in strategic bidding to impede this process.

9. We welcome continued discussion with Ofcom, and where appropriate with other stakeholders, as the auction proposals are finalised with a view to Ofcom arriving at a final auction design that meets its key objectives and addresses the concerns of stakeholders where possible.

1 Introduction

1.1 The award of 700 MHz and 3.6 GHz frequencies is an important step to enable the future evolution of 5G mobile services within the UK. BT supports Ofcom's aims to ensure that the benefits derived from use of this spectrum will be maximised and to award the spectrum by auction on a national basis.

1.2 It is, however, important to get the details of the award right and we welcome this opportunity to provide our views on some critical aspects of this process, including the scope of coverage obligations, competition measures, the auction format and potential defragmentation of the wider 3.4 - 3.8 GHz band.

1.3 Our response is structured largely in line with the consultation document and we have addressed the specific questions that Ofcom has posed within the relevant parts of our response.

1.4 In **section 2** we have provided our views on the coverage obligations that Ofcom proposes to include within the auction.

1.5 In **section 3** we set out our views on the competition measures that we believe are necessary to maximise the benefits to consumers.

1.6 **Section 4** addresses the important issue of how the auction process can support defragmentation of the wider 3.4 - 3.8 GHz band to achieve more optimal and efficient use of the spectrum and in **section 5** we set out our views on the most appropriate auction format that we believe Ofcom should use.

1.7 **Section 6** covers the issue of how potential DTT interference from 700 MHz mobile should be managed and considers interference coordination with existing services in 3.6 - 3.8 GHz.

1.8 In **section 7** we address the technical and non-technical licence conditions.

1.9 Finally, we have identified some particular areas where further discussion with Ofcom and stakeholders will be important to enable Ofcom to finalise its proposals and we summarise these in the **section 8**.

2 Coverage obligations

Question 1: *(Section 4) Do you agree with our proposals on the coverage obligations as set out in this section? Please give reasons supported by evidence for your views.*

Introduction

2.1 BT/EE supports the ambition to expand coverage to wherever people live, work and travel in the UK. We have consistently demonstrated our commitment to improving rural coverage, pursuing a strategy of building the biggest and fastest 4G network, now covering over 84% of the UK's landmass by Ofcom's measure of good coverage. Last year alone, we deployed over 350 new sites in rural locations and upgraded hundreds of existing sites, with further investment planned to deliver additional coverage growth to nearly ✂[redacted] by the end of 2019.

2.2 Our decision to invest in rural coverage has delivered a five-percentage-point lead over the next nearest operator and a ten-percentage-point lead over the lagging operator.[3] Our ability to market to consumers and businesses on the basis of this network leadership remains a key competitive differentiator and an important element of our customer proposition. Through our investment via the Emergency Services Network ("ESN") programme, we also expect to deliver near universal coverage of Great Britain's road network (albeit at signal thresholds that differ from Ofcom's specific measure of good coverage).

2.3 Infrastructure-level competition (supported by significant commercially-driven network sharing through, and between, two joint ventures) has been a hugely effective driver of industry investment and coverage across all four UK networks. However, the current model, relying exclusively on private investment, will not on its own provide an effective and timely solution to the challenge of extending networks into increasingly commercially unviable locations and addressing enduring rural not spots. Public funding, in some form, will be required to support investment in these areas so long as the broader societal benefits of such investment outweigh the costs.

2.4 We agree with Ofcom that, in principle, spectrum auctions can be an appropriate time to introduce publicly-funded coverage obligations. In setting the types and levels of such obligations, however, Ofcom must be confident that:

(1) the obligations do not unduly distort the auction outcome or network investment more broadly;

(2) the subsidy of the coverage is compliant with state aid rules; and

(3) the potential costs and benefits of the obligations are fully understood and are likely to provide good value for society.

2.5 For the reasons set out below, we do not consider that Ofcom's revised proposals (specifically the obligations to deliver 500 new macro sites and coverage to 140,000 new premises) secure any of these conditions. By pursuing these proposals Ofcom risks failing in its statutory duty to secure the optimal use of spectrum and in its key principle of ensuring that interventions are evidence-based and proportionate.

[3] According to Ofcom's 2018 Connected Nations Report (see Consultation document Annex 11 Fig. A11.1).

2.6 In the remainder of this section we:

- explain how BT is aligned to the ambition of improving coverage across the UK and moving towards the Government's 95% geographic coverage target;
- set out why we consider Ofcom's proposed coverage obligations on new sites and premises are not an appropriate way to improve coverage, and in particular how they would unduly distort the auction outcome and UK network investment more broadly;
- explain how these proposals may not be compliant with state aid rules;
- then explain why, even if Ofcom pursued its proposed methodology, its current approach significantly underestimates the costs of delivering the benefits it expects; and finally
- set out how Ofcom could adapt its proposals to meet the above conditions and guarantee to provide meaningful coverage benefits at more economic costs.

BT fully supports the need to deliver good mobile coverage wherever people live, work and travel

BT/EE's support for improving coverage

2.7 There have been significant advances in mobile coverage made over recent years, driven principally by private investment and infrastructure-level competition across all four UK networks.[4]

2.8 A significant minority of the UK's population and landmass, however, remain without good mobile coverage and, without a change in approach, these total not-spots will continue to endure. We note the Government's commitment to reach 95% geographic coverage[5] and agree that this establishes a useful proxy measure for good coverage wherever people live, work and travel. We want to be part of a solution to continuing to improve rural coverage and move towards this ambition.

Network competition and commercial solutions should be encouraged to deliver as far as possible, but public funding, in some form, is needed to fully realise coverage ambitions

2.9 Ofcom's proposed coverage obligations need to be considered in the broader sense of how the industry can improve coverage for consumers. In that context, we believe that commercially-funded coverage can be encouraged still further by governmental and regulatory action prioritised in the following areas:

- greater support for initiatives that make it easier to extend coverage whether as part of private or publically funded initiatives;
- encouraging operators to remain open for business to support further commercial sharing opportunities across their networks;

[4] See page 6 of Ofcom's 2018 Connected Nations Report recognises that in 2017, 21% of the UK landmass did not have good outdoor 4G coverage from any operator and this has reduced to 9% in 2018.

[5] Recently reiterated in the Government's consultation on its Statement of Strategic Priorities, Feb 2019 - see https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779226/SSP_Consultation_-_Publication_Version__2_.pdf.

- public funding that prioritises the delivery of coverage to total not spots; and
- a holistic approach across all public funded programmes to enhance digital connectivity across fixed and mobile.

2.10 We explain each of these in turn below.

Greater support for initiatives that make it easier to extend coverage

2.11 MNOs continue to face significant resistance in rolling out their networks, which increases costs unnecessarily, whether funded privately or publicly.

2.12 The influence that wider stakeholders play in enabling network deployment should not be underestimated: central government, Ofcom and devolved administrations in establishing the public policy framework and national-level regulations concerning access to land and planning permission; local government and other public bodies in considering planning applications, agreeing terms of access for the use of the public estate and developing local economic strategies; and private landowners and infrastructure providers in their willingness to host mobile sites and/or equipment on appropriate terms.

2.13 There has been some good progress across each of these areas, including that led by the DCMS Barrier Busting Taskforce, the creation of a Digital Infrastructure Toolkit for local authorities, and a number of progressive local authorities demonstrating best practice in supporting the deployment of mobile infrastructure. But there is further to go to create a deployment environment that better reflects the importance and necessity of delivering good digital connectivity to all parts of the country. The following outcomes would significantly enhance coverage deployment more broadly:

- further planning reform in all parts of the UK, focused on simplifying the framework and increasing investment certainty by making clear that all digital infrastructure is considered as permitted development, and by eradicating unnecessary differentiation between permissions for fixed and mobile-related deployments; and
- all public assets to have access terms that reflect the new Electronic Communications Code, which would have the dual positive effect of expediting roll out and setting helpful precedent for facilitating deployment more broadly.

Encouraging operators to remain open for business to support further commercial sharing opportunities across their networks

2.14 Infrastructure sharing on a commercial basis across the mobile sector is already extensive. The two joint ventures (MBNL and CTIL), for example, have enabled better coverage at reduced cost, through significant sharing and utilisation of wholesale infrastructure.

2.15 The opportunities that ESN and Extended Area Service ("EAS") deployments have created – in delivering new infrastructure to a large number of previously unserved areas – should also be recognised. EE won a competitive tender process for ESN and has made available all sites it is deploying under the ESN programme to other operators for sharing on commercial terms, and on an equal and non-discriminatory basis. A similar approach has been adopted by the Home Office for those EAS sites it is building directly.

2.16 Further sharing, which will support the erosion of partial not-spots (where only one or some operators are present), would be best encouraged by addressing planning policies that restrict the deployment of suitably tall structures that allow multi-operator deployments. Allowing

more operators to deploy on a single site avoids the duplication of physical infrastructure costs.

2.17 We also note that in its Statement of Strategic Priorities, the Government suggests that Ofcom should "maintain the option" of requiring roaming when granting licences for spectrum.[6] However roaming is just one method of implementing sharing agreements, with the market already producing several other commercial sharing arrangements (such as site and equipment sharing) to allow more cost effective deployments and, ultimately, more choice for customers. Including clauses in new spectrum licences that would allow Ofcom to subsequently mandate national roaming would create significant uncertainty at the time of the auction and beyond, and therefore we consider this to be bad regulatory practice.

2.18 BT/EE is happy to discuss potential commercial terms with any operator seeking to use roaming to improve its UK coverage. Indeed, BT/EE established a 2G roaming relationship with H3G, which has played a role in allowing H3G to meet its existing obligation to provide 90% geographic voice coverage. Given the market is successfully producing sharing agreements of various technical forms, it seems most efficient to allow the market to determine the right balance of these going forwards.

2.19 The further effect of mandating national roaming would be to remove the incentives for operators to differentiate their network. Differentiated networks provide more choice for consumers and enhance healthy competitive tension between operators. Mandating national roaming would distort this competition and lower incentives for operators to differentiate their services in the future.[7] There would appear to be little incentive, for example, for operators to expedite 5G coverage roll out if access to other operators was subsequently mandated on regulated terms. The distortive effects of mandated national roaming could therefore be significant, both in terms of restricting geographic coverage and hindering technological advancement. We agree with Ofcom's conclusion[8] that roaming arrangements should be entered into on a voluntary basis.

Public funding should prioritise the delivery of coverage to total not-spots and not subsidise lagging operators

2.20 We strongly believe that the priority for publicly-funded network roll-out should be to deliver coverage for people living, working and travelling in areas that currently have no coverage at all from any operator. We consider there to be significantly greater consumer benefit in going from zero to one operator in an area, than from one to two (and even more so than going from two to three). This is intuitive but also reflects the Government's objective of increasing *absolute* geographic coverage.

2.21 As we explain in more detail in the remainder of this section, we would be concerned if public funds were being used to subsidise lagging operators to enhance coverage in partial not-spots, if that money could be better spent providing coverage to consumers with no options today.

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[6] ibid para 31.

[7] We note that other authorities have reached the same conclusion. See, for example, the Australian Competition and Consumer Commission Domestic mobile roaming declaration inquiry (October 2017).

[8] Paragraph A17.28 of Ofcom's consultation.

A holistic approach across all public funded programmes to enhance digital connectivity across fixed and mobile

2.22 Whilst to date there has been little in the way of public programmes or subsidy for mobile operators to extend their coverage into non-commercial areas, this is not true for fixed broadband. Given i) increasing convergence, whereby similar services can be delivered to end-users with fixed, mobile or a combination, and ii) a significant proportion of the cost of delivering mobile coverage to rural locations is driven by backhaul, we believe that greater consideration must be given to taking a more holistic view of the approach to improving digital connectivity.

2.23 For example, without taking proper account of the forthcoming introduction of the broadband USO in the design of the mobile coverage obligations, there is a risk of inefficient public subsidy, in situations where the needs of customers could be met by one or other of the solutions. Ofcom should consider prioritising mobile coverage requirements to premises which do not also have access to broadband that meets the USO specifications. These premises could then receive broadband by FWA without needing a subsidised fixed broadband connection as well. In other words, in a converged world where similar services can be delivered to the end-user with fixed, mobile or a combination, it seems illogical to subsidise the delivery of fixed and mobile technologies to the same premises

Ofcom's current proposals risk distorting both the auction outcome and UK network investment more broadly

Ofcom has made some progress since its last consultation

2.24 We are pleased that Ofcom has taken on board the comments from BT/EE and others in refining aspects of its proposals on auction coverage obligations. Specifically, we welcome that Ofcom has:

- removed from its proposals a specific obligation to improve indoor coverage for up to 60% of rural premises with poor indoor coverage, which is an appropriate decision given the increasing importance of converged networks and reflects the alternative ways customers can get connected indoors, for example through voice over WiFi;
- undertaken economic analysis on the costs and benefits of its proposals, although, as described below, we think Ofcom underestimates the costs of delivery; and
- moved in the right direction regarding implementation by increasing the period to comply with the coverage obligation.

2.25 As demonstrated by the range of responses to its original consultation, Ofcom has a difficult task to find a solution that addresses the many points raised by operators and others. It appears that in attempting to do so, however, Ofcom has proposed additional sub-targets that destroy the simplicity, efficiency and fairness that is provided by solely an absolute coverage obligation.

An absolute geographic obligation on its own could be an efficient means of securing meaningful coverage improvements

2.26 An *absolute* geographic coverage obligation (i.e. a total level of coverage, such as 90% to be attained over a specified period of time), is a tried and tested method of achieving meaningful coverage improvements for consumers.

2.27 Naturally, the cost of achieving the incremental X% coverage to reach 90% is most easily identified by the operator already close to the limit of commercially viable coverage, but for all other operators the gap between current coverage and 90% will be a combination of commercially viable deployment and deployment requiring subsidy (in different proportions depending how far their existing commercial coverage reaches). Operators will bid only for the part of that extension which requires subsidy. In a sense, this 'levels' each operator's bidding position and determines the winner by reference to the minimum subsidy required (i.e. the operator with most efficient means of covering the non-commercial increment).

2.28 It therefore does not matter where operators start from: what matters is that Ofcom sets clear coverage objectives (in absolute terms) and allows sufficient time for operators to deliver commercial investment, as required, to catch up to the leading operator, and then to deliver the publicly funded final X%.

Ofcom's assumption that the social benefit would be broadly similar whichever operators delivered greater coverage is misguided and has far-reaching consequences

2.29 Fundamental to Ofcom's proposed approach is the assumption that the benefits of delivering the coverage obligations will be broadly similar whichever operators win them in the auction. Specifically, Ofcom anticipates that the following two benefits would balance across operators:

- Lagging operators would deliver greater societal benefits of meeting the 90% geographic target because they are starting at a lower point; which is broadly offset by
- BT/EE, as the leading operator in delivering the new premises requirement, being "more likely than the other operators to cover at least some premises in total not-spots in order to meet the premises *requirement, where the benefits of extending coverage are higher per direct beneficiary*".[9]

2.30 We agree with Ofcom that beneficiaries will value going from none to one operator more highly than going from, say, two to three. We fundamentally disagree, however, that Ofcom should seek to balance this against what it perceives to be a higher societal benefit of lagging operators catching up with BT/EE. Our disagreement is driven not by our position on the relative value of delivering coverage to total not-spots versus partial not-spots, but by the principle that lagging operators should not be rewarded for having invested less in their network.

2.31 The benefits of a public subsidy should be measured against what that subsidy will actually be used to deliver. A public subsidy is not required for – and should not be given to – lagging operators for them to catch up with BT/EE. By equating the two kinds of benefits, however, Ofcom is implying that it is a legitimate use of State resources to encourage lagging operators to catch up to coverage levels already deemed commercially viable by other operators. We question why, if the new sites and premises sub-obligations are required to equalise the benefits in this auction, Ofcom did not consider this was required with the standalone geographical obligation sold during the 2013 auction where, by Ofcom's current logic, the benefits must have been unequal?

[9] "Consultation: Award of the 700 MHz and 3.6 - 3.8 GHz spectrum bands", Ofcom, 18 December 2018, Annex 11 (page 171).

2.32 In fact, Ofcom was correct in its approach in 2013. In the 700 MHz proposals, on the other hand, the benefits of public funding are not equal because encouraging operators to catch up with BT/EE is not a legitimate use of public funds.

2.33 If societal benefits were indeed the same across operators, Ofcom would be able to evaluate alternative outcomes of the auction simply by looking at the amounts bid. By assuming this equality of benefits, Ofcom is essentially saying that a given measure of incremental 'catch up' from a lagging operator equals a given measure of heightened benefit from BT/EE delivering in total not-spots and, by extension, whichever operator can deliver either of those outcomes more efficiently will win the obligation. But the lagging operator has an inherent additional commercial incentive to catch up with the leading operator, which it will price in to its bid. By equating the benefits, therefore, Ofcom's approach favours lagging operators and risks providing public funds to subsidise a catch-up, primarily in partial not-spots.

2.34 It follows that Ofcom's proposals could also have wider distortive effects beyond the immediate confines of the auction: why would operators make *unfunded* coverage investment to gain competitive advantage by building new sites in marginal areas if they knew it could be subsidised via this mechanism? It surely should not be the case that an operator is placed at an advantage in the auction because they have chosen to invest less in their network up to that point. We accept that operators also compete on dimensions other than coverage, but this does not warrant intervention to support (with State resources) coverage expansion by these operators – other than on an equal footing with the operators who *have* focused on coverage.

2.35 Extending the potential consequences of this approach, Ofcom appears to be advocating policy that will ultimately undermine incentives for operators to compete to differentiate their networks. Differentiated networks – of which coverage is a single but important factor – provide more choice for consumers and enhance healthy competitive tension between operators, and we are extremely concerned that Ofcom's proposals would undermine this mechanism which has served customers so well.

Ofcom's additional proposals on new sites and premises are discriminatory because they place additional costs on leading operators

2.36 The issues described above resulting from Ofcom's attempt to equalise the benefits across operators are compounded by the asymmetric costs operators will face when delivering the sub-obligations of 500 new sites and 140,000 new premises.

2.37 Ofcom says ostensibly that the reason for including the additional premises and sites obligations is to ensure that the coverage is delivered in areas where it is most needed. Ofcom goes on to admit, however, that the inclusion of these obligations could have another effect – namely to increase the costs of achieving these obligations for the leading operators, which would offset the higher costs required for lagging operators to close a bigger gap in order to fulfil the 90% Geographic obligation. On the 140,000 new premises obligation Ofcom states:

> *"In practice, [the premises requirement] is likely to require the lead operator to deploy more sites to deliver the 90% level than it would have to without this constraint. We also consider it likely that this requirement will be proportionately harder to meet for operators who start with more extensive coverage, since they*

will be required to cover more premises per percentage point of landmass they add to their coverage."[10]

2.38 And on the 500 new sites obligation:

"the new sites requirement is also likely to contribute to ***equalising operators' costs*** *of meeting the obligation…..An operator with lower initial coverage levels would be able to deploy in more areas where another operator has already found it commercially viable to cover, even without the obligation."*[11] (Our emphasis).

2.39 Ofcom appears to see benefit in equalising the costs for different operators of meeting the obligations. We think this is unnecessary and, moreover, discriminatory. In doing so Ofcom is essentially saying to the leading operator: you have a cost advantage (i.e. a smaller gap to 90%) because you invested in good network coverage prior to the auction, and this needs to be redressed. Ofcom is redressing it by forcing the leading operator to deliver obligations that will be more expensive than those delivered by lagging operators. In the same way as results from seeking to equalise benefits, State resources are being used to help lagging operators remove BT/EE's competitive advantage which was gained at our own cost and risk and which helps deliver a vibrant, differentiated and competitive retail market.

2.40 Ofcom's approach is discriminatory and goes against one of its key auction principles:

"As a matter of policy, we do not want to take an approach which risks unduly rewarding operators who have to date chosen not to prioritise investment in geographic coverage, against those that have."[12,13]

2.41 If Ofcom accepts that it is inappropriate to favour lagging operators to catch up on geographic coverage, then it must recognise the asymmetry in knowingly imposing more costly sub-obligations on the leading operator. The leading operator may have a coverage advantage but quite clearly does not have a cost advantage, as the remaining areas to cover are more heavily skewed towards high cost (and un-commercial) deployment areas. Ofcom appears to be attempting to equalise costs that shouldn't be equalised and in so doing affecting the likelihood of who will win an obligation discount.

2.42 A further unintended consequence of Ofcom's approach is that operators might choose to delay planned coverage improvements in the period prior to the auction if they feel they would be rewarded for catching up via the auction obligation. This is a very serious possibility which Ofcom appears not to have considered sufficiently.

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[10] "Consultation: Award of the 700 MHz and 3.6 - 3.8 GHz spectrum bands", Ofcom, 18 December 2018, paragraph 4.123 (third bullet).

[11] ibid, paragraph 4.123 (fourth bullet).

[12] ibid, paragraph 4.122.

[13] We also support Ofcom's stated conclusion that to would not be appropriate to make specific interventions to address any "advantage" gained by BT/EE's provision of the ESN. Not only is it uncertain whether it will be viable to continue to provide commercial coverage on these sites following the end of the contract, but more importantly BT/EE in bidding for the contract priced in potential commercial benefits and significant risk, which we continue to carry. No further adjustment is therefore merited or required.

Ofcom's prescriptive approach to new sites could stifle innovation and encourage inefficient investment

2.43 As a matter of principle, we believe Ofcom should focus on consumer outcomes rather than on specific inputs. Ofcom's coverage obligation proposals for requiring 500 new macro sites, on the other hand, could lead to inefficient investment by not allowing operators the freedom to innovate in the most cost-effective delivery of the desired outcome. Specifically, new macro sites may not be the best way of delivering good coverage (for example multiple small cells in a mesh network might be more efficient in some locations).

2.44 More broadly, following an outcomes-led approach would mean that operators are incentivised to find the most efficient ways of delivering the services that society values. By specifying new macro sites as an obligation requirement, Ofcom is reducing incentives for industry to find better ways of delivering these services to consumers. This is particularly unwise in the mobile market where technology is advancing at such a rapid rate.

2.45 We note that regulators in several other industries have moved – or are in the process of moving – to an outcomes-based approach. In the water industry, for example, Ofwat has progressively moved – starting in PR14 and going further in PR19[14] – to setting prices based on broad outcomes that are demonstrated to be supported by customers. In practice, Ofwat has stopped prescribing specific inputs (i.e. the resources needed to deliver specific outputs) and now holds companies to account for delivering broader societal outcomes – how companies deliver these outcomes is, largely, up to them. This approach ensures that consumers see the benefits of these outcomes but also exploits the natural incentive of companies to find the best way of delivering them.

There could be illegal state aid implications for Ofcom's proposals

2.46 EU State aid rules operate to prevent aid being granted by EU Member States or through State resources in any form whatsoever which distorts or threatens to distort competition by favouring certain undertakings, in so far as it affects trade between Member States.

Granting of aid through State resources

2.47 The granting by Ofcom of the coverage obligation (encompassing the obligations to deliver 500 new macro sites and good quality outdoor coverage to 140,000 new premises) and the associated discount on the spectrum licences that the successful bidder(s) will be entitled to (up to a maximum of £300m - £400m), will result in the foregoing of revenues the State would otherwise achieve for the licencing the spectrum at full value through the competitive tender process.[15]

[14] See, for example Ofwat's "Delivering Water 2020: Our final methodology for the 2019 price review" (October 2017).

[15] See Commission Notice on the notion of State aid as referred to in Article 107(1) of the Treaty on the Functioning of the European Union (2016/C 262/01), paragraphs 51 to 53. See also the Judgment of the Court of Justice of 19 March 2013, Bouygues and Bouygues Télécom v Commission and Others, Joined Cases C-399/10 P and C-401/10 P, ECLI:EU:C:2013:175, paragraphs 137, 138 and 139.

2.48 Whilst Ofcom can legitimately decide to forego revenues from the auctioning of the spectrum licences without requiring prior State aid approval from the EU Commission, it can only do so where (i) all the operators concerned are treated in line with the principle of non-discrimination and (ii) there is an inherent link between achieving the regulatory purpose and the foregoing of revenue.[16]

2.49 As regards the non-discrimination criteria, and as explained in detail in paragraphs 2.29-2.45 above, Ofcom's additional proposals on new sites and premises are inherently discriminatory because they will have the effect of inappropriately subsidising lagging operators.

2.50 We further note that in relation to the criteria for an inherent link between achieving the regulatory purpose and the foregoing of revenue, Ofcom's objective of achieving "good quality mobile services in rural areas throughout the UK that currently have patchy coverage" will not be achieved by subsidising an operator with a smaller network to overbuild in areas where another MNO already provides good quality network coverage; indeed as explained in paragraphs 2.29-2.35 above, the societal benefits will differ according to which operator undertakes the coverage obligation. Ofcom can only achieve in a lawful way the societal benefits it desires if it ensures subsidy is granted solely to operators investing in so-called "white areas" where there is no existing or planned coverage by other operators and if the subsidy is otherwise compatible with the EU State aid rules

2.51 It is therefore likely that in its current form, Ofcom's proposed coverage obligation, which facilitates the duplication of existing or planned infrastructure and does not anticipate notification to the European Commission for State aid clearance, would constitute a granting of unlawful aid from State resources under EU rules.

The subsidy of the coverage obligation will confer a selective advantage

2.52 The operator(s) which undertakes the coverage obligation and which will benefit from the discounted spectrum licences will be able to commercially exploit the greater network coverage it will achieve from the State resources. This will provide a selective economic advantage to the operator(s) undertaking the coverage obligation as compared to competitors not in receipt of State support.[17]

[16] *Ibid* paragraph 54.

[17] Whilst the subsidy of the coverage obligation is intended to cover part of the costs of the operator in meeting the public service coverage obligation, it will not satisfy the *Altmark* criteria (as set out in Case C-280/00 *Altmark Trans* [2003] ECR I-7747 EU:C:2003:415) established by EU case law which requires, amongst other things that (i) the public service obligations must be clearly defined and (ii) the parameters on the basis of which the cost compensation is calculated must be established in advance in an objective and transparent manner. Ofcom's proposals on new sites and premises will entail different obligations to different operators (network development mostly in partial not spots versus network development predominantly in total not spots), with different outcomes for consumers, such that the public service obligation cannot be considered clearly defined. Furthermore, the fact that smaller operators can satisfy the obligation by focusing their network build in partial not-spots, whereas operators with larger networks will need to focus on network build-out in total not-spots means that the parameters on the basis of which the subsidy is calculated will not have been established in an objective and transparent manner.

The subsidy of the coverage obligation will distort competition

2.53 Network quality and coverage is a fundamental parameter of competition in the mobile market and a subsidy which allows a network operator to close the network investment gap with other network operators is liable to distort competition. In particular, an MNO which is able to part-fund its network roll-out through state resources will have a material cost advantage compared to other MNOs and this can be expected to have a distortive effect on competition.[18] It is also well established by the decisional practice of the EU Commission that State aid to telecommunications providers is capable of affecting trade between EU Member states.

The aid is unlikely to be compatible with EU rules and Ofcom has not carried out the necessary detailed assessment of those partial not spots where the State aid may be deployed

2.54 The EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks (the "EU Guidelines") explains that public funds should be carefully used in this sector and that "*the Commission ensures that State aid is complementary and does not substitute investments of market players*."[19] A detailed assessment of the compatibility of the subsidy associated with the coverage obligation is beyond the scope of this response, however, we note that specific features of Ofcom's sites and premises obligation will likely make it incompatible with EU State aid rules.

2.55 Aid is treated differently by the Commission depending on whether it is designed to improve coverage in complete not-spots ('white areas' as referred to in the EU Guidelines) or in partial not-spots ('grey areas' as referred to in the EU Guidelines), as the Commission recognises there is "*a priority to ensure timely investment in areas which are not yet sufficiently covered*" and that in partial not-spots "*subsidies for the construction of an alternative network could distort market dynamics*."[20] Therefore, State support for the deployment of broadband networks in partial not spots is only justified when "*it can be clearly demonstrated that a market failure persists."* In such partial not-spots, the Commission makes it clear that "[a] *more detailed analysis and a thorough compatibility assessment will be necessary*".[21]

2.56 As explained in paragraphs previously, Ofcom's proposed sites and premises sub-obligations to the main coverage obligation would permit an MNO with an underdeveloped network to focus its network build-out in partial not spots which may be more commercially viable as evidenced by the presence of other operators. The subsidy of the coverage obligation will be incompatible with State aid rules if it cannot be shown that the further network roll-out in

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[18] Case 730/79 *Philip Morris v Commission* [1980] ECR 2671

[19] See paragraph 4 of the EU Guidelines for the application of State aid rules in relation to the rapid deployment of broadband networks (2013/C 25/01). It is clear from paragraph 56 of the EU Guidelines and the Commission's decisional practice (see for example paragraph 26 of SA.38863 *Emergency Services Mobile Communications Programme*) that the EU Guidelines also apply to mobile networks.

[20] Paragraphs 66 and 68 of the EU Guidelines. The Commission also explains in paragraph 66 of the EU Guidelines that "*by providing financial support for the provision of broadband services in areas where broadband is currently not available, Member States pursue genuine cohesion and economic development objectives and thus, their intervention is likely to be in line with the common interest.*"

[21] Paragraph 68 of the EU Guidelines.

such not spots would not have been undertaken within the same time frame without the subsidy. Indeed the Commission specifically recognises that coverage obligations are unlikely to have an incentive effect.[22]

2.57 In addition to the sites and premises obligation not achieving the same societal benefits as an overall coverage obligation, any subsidy of network development in partial not spots would require a detailed analysis to show that in each partial not spot: [23]

- the overall market conditions are not adequate (involving, amongst other things, an assessment of pricing, the type of services offered, conditions attached to such offerings);
- in the absence of ex ante regulation imposed by Ofcom, effective network access is not offered to third parties or access conditions are not conducive to effective competition;
- overall entry barriers preclude the potential entry of other operators; and
- any measures taken or remedies imposed on the incumbent provider(s) in the partial not spots have not been able to address the coverage issues.

2.58 Ofcom has not carried out this detailed assessment.

2.59 The Commission's decisional practice highlights the need for aid to be complementary and to not substitute investments of market players. When the Commission approved the State aid for the mobile infrastructure project in 2012 the Commission did so on the basis that the project aimed to "*ensure the availability and use of mobile telephony in currently uncovered areas with no prospect for coverage on commercial terms in the near future*."[24]

2.60 Ofcom should therefore ensure that the obligations attaching to any discounts on spectrum licences which operators may obtain in the upcoming auction are the same irrespective of the identity of the operator and address the priority of extending coverage beyond the commercial foot print available at the time of the auction and mainly to complete not-spots where there are otherwise no incentives for operators to invest.

Ofcom underestimates the costs of delivering the obligations

Ofcom's sites and premises proposals would force BT/EE in meeting the obligations to deliver geographic coverage above 90%, where by Ofcom's own analysis the costs outweigh the benefits

2.61 Properly understanding the associated costs and benefits of Ofcom's proposals is crucial for determining if society will benefit overall, and therefore whether the coverage obligations are specified appropriately.

[22] Paragraph 45 of the EU Guidelines. In assessing whether there is an incentive effect, the Commission examines whether the network investment concerned would not have been undertaken within the same time frame without any State aid.

[23] Paragraph 70 of the EU Guidelines.

[24] SA.35060 *Mobile Infrastructure Project* paragraphs 26, 30 to 35.

2.62 We have estimated, based on our current expectation of BT/EE's coverage prior to the auction, what it would cost BT/EE to meet Ofcom's revised obligation proposals.[25] The diagram below summarises our current view of what it would take to deliver the obligations.[26] The Scenario assumes EAS sites are built as planned, but these do not count towards any of the obligations (per Ofcom's proposals).

Figure 2.1 Estimate of BT/EE requirements to meet Ofcom's coverage obligations (assuming EAS sites do not contribute)

✂[redacted]

Source: BT analysis.

2.63 As shown by our analysis, we estimate that to meet Ofcom's new premises obligation would require BT/EE to ✂[redacted],[27]

2.64 As Ofcom accepts, the new sites and premises obligations will be more difficult for the leading operator to meet, with fewer new premises covered for each new site built. Indeed, the key cost drivers for BT/EE are the sub obligations of new sites and premises, not the obligation for geographic coverage. As described above, this cost will be higher than for other operators solely due to BT/EE's relatively high starting position on coverage and the inevitable focus, therefore, on higher cost total not-spots in order to meet the obligation.

2.65 In BT/EE's case, meeting the new sites and premises requirements in a scenario where EAS sites are not allowed to contribute forces us to deliver well above 90% geographic coverage.

[25] This estimates are made using our current planning model and existing compliance methodology. Owing to the concurrent timings of the consultations we have not yet had an opportunity to assess the impact to our cost estimates of the methodology for verification of compliance with the coverage obligation that Ofcom is also currently consulting. More detail is provided in Annex 1.

[26] In our scenario new sites are built prioritised by how many new premises are added for each. We have removed potential sites that would have been located within 1km of an existing site (per Ofcom's proposed requirement).

[27] We have used ✂[redacted] estimate of capex and 20 year opex costs for new sites, ✂[redacted]. Though some cost efficiencies could be achieved in the future (for example from site sharing), our presented view on new sites required to meet the obligations assumes that those sites can be located in ideal locations, which will not be true in reality. We therefore think the cost presented is a low estimate on what it would take to deliver the obligations.

Ofcom's own analysis concludes that delivering over 90% geographic coverage as part of the spectrum coverage obligation would not be cost-beneficial.[28]

2.66 The discriminatory effect described previously, and the fact that the costs of delivery ✂[redacted] demonstrate, individually and together, that the sub-obligations of 500 new sites and 140,000 new premises as specified are not appropriate for publically funded coverage obligations (especially as part of a spectrum auction).

Ofcom's exclusion of EAS sites significantly increases delivery costs for BT and is not compatible with the proposed obligations on new sites and premises

2.67 We accept that the question of whether to allow EAS sites to contribute to the coverage obligations is a difficult problem to solve, but Ofcom's proposals do not solve it for any scenario (unless, of course, no EAS sites are deployed).

2.68 If Ofcom allows the EAS sites to contribute and the sites (the delivery of which are the responsibility of a third party, namely the Home Office) are not operational, it risks setting obligations that are unaffordable for operators.

2.69 If, on the other hand, Ofcom excludes EAS sites from contributing to the obligations but subsequently they do become operational, it compounds the discriminatory cost differences between operators (because it becomes even more difficult for the leading operator to cover new premises sensibly as the total number of available premises declines).

2.70 In addition, if premises served by EAS sites are not allowed to contribute to the premises obligation, it could produce perverse incentives to serve areas already covered by EAS sites – BT/EE could, for example, be encouraged economically to duplicate coverage on sites already covered by EAS sites but which don't count towards the coverage obligation. It would also reduce incentives for other operators to deploy on EAS sites where these are shareable, even if otherwise this would be the most efficient way of increasing coverage. This is clearly not an efficient outcome.

2.71 The increased costs are mitigated significantly if Ofcom removes its proposed sites and premises obligations: EAS sites cover a proportion of the premises that BT/EE would choose to cover to meet the sub-obligation, which leaves harder to reach premises which are more difficult to cover sensibly. This is demonstrated by the figure below.

[28] "Consultation: Award of the 700 MHz and 3.6 - 3.8 GHz spectrum bands", Ofcom, 18 December 2018, paragraph 4.59.

Figure 2.2 Estimate of BT/EE requirements to meet a 90% geographic target without sub-obligations (assuming EAS sites do not contribute)

✂[redacted]

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2.72 Given that EAS creates more partial not-spots, Ofcom could also solve the problem by designing the coverage obligation to focus on total not-spots (so exclude EAS) to make sure all operators are bidding to be the most efficient operator in total non-spots on an equal basis.

Ofcom's proposed number of new premises is excessive and will lead to inefficient investment

2.73 Though we disagree in principle with the inclusion of the new premises obligation, we have also undertaken sensitivity analysis around Ofcom's proposed target of 140,000. The table below summarises the approximate number of new sites that would be required for BT/EE to achieve Ofcom's new premises obligation at three different levels: 140,000, 120,000 and 100,000 new premises (note these are new premises for BT and will not all be in total not spots).

Table 2.1 Number of new sites required for BT/EE to meet different premises thresholds

Premises Target	No of Upgrades	No of New Sites
140,000	✂[redacted]	✂[redacted]
120,000	✂[redacted]	✂[redacted]
100,000	✂[redacted]	✂[redacted]

2.74 As shown in the table above, there is a high incremental cost associated with delivering coverage to a dwindling number of new premises: we estimate that an incremental 40,000 new premises (from a baseline of 100,000) would require around ✂[redacted]. Ofcom should, therefore, at the very least re-evaluate whether its proposed target delivers acceptable societal value.

Ofcom's definition of "good coverage" may overestimate the benefits associated with the proposed obligations

2.75 Ofcom considers that its view of what constitutes "good coverage" remains appropriate for the coverage obligations. This is:

"allowing nearly all voice calls which last for at least 90 seconds to be made and completed without interruption, and nearly all data connections to deliver a speed of at least 2 Mbps, with an average success rate of at least 95%."[29]

2.76 Ofcom equates this to a benchmark of at least -105dBm median RSRP signal for outdoor coverage. For the purposes of calculating the benefits of delivering good coverage, Ofcom assumes that customers who fall below this definition have no coverage at all. In reality, beyond the geographic area defined by Ofcom's 'good coverage' measure, operators will in many circumstances provide some level of coverage. BT/EE, for example, serves approximately a further 7% of the geography of the UK with a high probability of good coverage based on our own less stringent coverage thresholds.[30] It is possible, therefore, that Ofcom may have over-estimated the benefits of the additional coverage in situations where the "new" coverage is actually improving existing coverage.

BT has concerns over the derivation of 4G -105dBm RSRP as a coverage threshold and the extent of its applicability

2.77 The coverage obligation may be delivered over any spectrum holdings of an operator. BT notes that 4G -105dBm RSRP does not offer a consistent interpretation of probability across frequency bands. The Ofcom figure appears to be derived from low frequency 800 MHz and fails to consider frequency adjustment to higher frequencies such as 1800 MHz where antenna gains etc. will be higher. BT considers that -110 dBm RSRP, based on higher possible path loss of 4.7 dB from Table 2.1, would be an appropriate comparable, same conditions, threshold for 1800 MHz. Absent an adjustment for frequency, operators more reliant on higher frequency spectrum will effectively have to achieve a higher probability of service to deliver the obligation at consequent disadvantageous cost.

Table 2.2 – Effective Sensitivity Modifier differences between 4G Services.

	4G 800 MHz		4G 1800 MHz		Difference	
Mobile Antenna Gain	-3.75	dBi	-2.75	dBi	1	dB
TS24 TRP Device BHH delta[31]	3.7	dB	0	dB	3.7	dB
Effective Sensitivity Modifier	7.45	dB	2.75	dB	4.7	dB

2.78 BT also observes that the -105dBm threshold with an attribute of 95% probability appears to have been defined on the basis of measurement of a single frequency coverage layer and questions the extent to which this is representative of user experience of coverage in current multi frequency layer networks where users handover seamlessly between frequency layers.

2.79 As an additional point, if Ofcom is content with improving existing coverage rather than providing new coverage, it should recognise that its proposed 500 new sites obligation is not

[29] Consultation: Award of the 700 MHz and 3.6 - 3.8 GHz spectrum bands", Ofcom, 18 December 2018, paragraph 4.152.

[30] 4G signal RSRP prediction thresholds of -118dBm (1800 MHz) and -113dBm (800 MHz). These equate to 90% probability as determined by Jakes theory of single carrier outdoor cell coverage for mobile users who experience a range of radio conditions as they move around the network.

[31] TS24 – Operator Acceptance Values for Device Antenna Performance v3.0, Table 4 GSMA 1st October 2015

well suited to this aim. New macro sites are unlikely to be the right solution in all circumstances for improving coverage to customers who already have a given level of coverage today, smaller in-fill sites may be more appropriate. Hence, we consider there is an inconsistency between the new sites obligation and Ofcom's definition of good coverage, which could lead to inefficient investment. If Ofcom is convinced that its definition of good coverage is correct then this is another reason to remove the new sites obligation from its proposals.

Alternative options for coverage obligations

Requirements of coverage obligations

2.80 We consider that any alternative proposals for including coverage obligations in the spectrum auction must:

- be cost-beneficial (and cost less than the value of the relevant spectrum, thus minimising the risk of coverage obligations going unsold);
- not distort the auction outcome unduly or network investment more broadly;
- incentivise efficient delivery (or at least not encourage inefficiency); and
- make progress towards the Government's coverage ambitions.

2.81 It is also important that the coverage obligations are designed in a way that takes account of consumer connectivity more broadly. It may be that mobile coverage obligations could fulfil policy objectives of the broadband USO (or vice versa), for example, which may lead to more efficient investment overall.

Absolute rather than relative obligations could meet the requirements

2.82 We consider that there are, broadly, two legitimate options for Ofcom to consider that would better meet the conditions set out above:

- absolute UK (and nations) geographic coverage targets (without sub-obligations); and/or
- a requirement to serve a specified number of new premises in total not-spots.

2.83 We have already explained that an *absolute* geographic coverage obligation on its own would provide meaningful benefits to consumers and avoid the harmful distortive effects that Ofcom's new sites and premises coverage proposals produce. A geographic obligation is a simple, tried and tested method of achieving meaningful benefits and avoids providing subsidy to operators that have chosen to invest less in their networks.

2.84 An alternative would be to require operators to provide new coverage to a specified number of premises in total not-spots. There are three significant benefits of this kind of obligation over Ofcom's existing premises obligation:

- it delivers new coverage to consumers who need it the most – those who have no coverage today;
- it solves the problem of whether or not to allow coverage contributions from EAS sites (as any premises covered by these are by definition not in total not-spot areas); and
- by specifying that new premises need to be in total not-spots, it avoids subsidising operators to provide coverage in partial not-spots.

2.85 Specifying that new premises served must be in total not-spots would also be a more effective and efficient means of moving towards the Government's 95% coverage ambition (versus increasing coverage in partial not-spots, which is what Ofcom's proposed sites and premises obligations encourage). Because no operator serves these premises today, it also means that the societal benefits will be equal, irrespective of which operator(s) wins the obligation, thus avoiding the distortive effects described previously.

2.86 Ofcom would need to consider what would be the appropriate number of premises to be covered under such an obligation (no single operator knows where all these are today), and how these could be shared if more than one obligation is set. In particular, Ofcom would need to be confident that the number of premises it sets is not disproportionate to the cost, given that there is a diminishing return for new sites as we approach 100% premises coverage.

2.87 One potential drawback of this approach is that it could discourage operators from investing in coverage for premises in total not spots if they know another operator will, as part of meeting the coverage obligation, subsequently also provide coverage there. However, this will need to be considered against the likelihood that these premises would receive coverage without such an obligation.

Moving beyond 90% to the Government target of 95% geographic coverage

2.88 Having achieved a publicly funded 90% geographic coverage for two operators (or an equivalent from specified coverage to premises in total not-spots) via the spectrum auction, the question then arises: how to bridge the remaining gap to the Government's 95% ambition? We believe a different approach is called for. As Ofcom is aware, we are currently in conversation with Government and the other MNOs about how this could be achieved.

2.89 To extend coverage to the remaining areas, we believe that the creation of an industry-wide, demand-led and publicly-funded mobile universal service commitment ("USC") programme should be considered. Broadly, such a programme could work in the following way:

- A right to request coverage to address total not spots by communities (or appropriate stakeholders).
- An obligation on the USC provider(s) to deliver good outdoor 4G coverage, up to a maximum cost ceiling.
- A requirement on the requesting parties to provide a suitable site(s) and planning permission in order to significantly reduce delivery risk and bring stakeholders together to address perennial deployment barriers.

2.90 Though the details of such a programme would need to be worked through, it could in principle operate in a similar way to the planned broadband USO, whereby there is a cost ceiling on eligibility for consumers. This approach would, in theory:

- by being demand-led, ensure that coverage is provided to those that value it highly;
- move towards the Government's 95% ambition in a more targeted way; and
- if a cost ceiling is applied as in the broadband USO, provide helpful incentives for everyone – including Government – to work together to reduce mobile deployment costs.

3 Competition measures

Question 2: *(Section 5) Do you agree that we have identified the correct competition concerns?*

Question 3: *(Section 5) Do you agree with our assessment of these competition concerns, and our proposed measure for addressing them? Please give reasons supported by evidence for your views.*

700 MHz band competition concerns

The risk that very asymmetric shares in low frequency spectrum would weaken competition

3.1 An assessment of the likely harm to competition from very asymmetric sub-1 GHz spectrum shares in the 700 MHz and 3.6 GHz auction must be based on a forward-looking approach.

3.2 Within this assessment a key question for Ofcom is whether promoting static efficiency objectives i.e. that it is efficient for the bidder(s) with the highest valuation(s) to be awarded spectrum should be balanced with competition objectives to support innovation, choice and value for consumers.

3.3 BT/EE considers that Ofcom's analysis of what matters most for competition and consumers is mistaken on a key point. Customers want mobile data services, with speeds of at least 2 Mbps, and they want it indoors and outdoors. There is compelling evidence in support of this key attribute of mobile service demand:

- Consumer research (including Ofcom's) demonstrates that consumers want reliability and consistency in the mobile data service they pay for including using data indoors and outdoors. In other words, consumers want seamless connectivity.
- Ofcom's Smart Cities report found that data speeds of at least 2 Mbit/s are necessary for a good mobile data service including streaming.
- Internet browsing often requires data speeds of at least 2 Mbit/s on popular websites with video streaming, e.g. BBC online, and on popular social media sites using mobile apps where video streaming is part of the standard consumer experience e.g. Facebook, YouTube, Instagram and Snapchat.
- Consumers currently stream large amounts of video including on popular social media sites and this will only increase with new future 5G mobile services (currently streaming accounts for ✂[redacted] of traffic on EE's network).
- In the 2.3 and 3.4 GHz auction Ofcom proposed a safeguard cap because it was so concerned about the ability of operators to compete for data intensive customer segments if there were highly asymmetric shares in immediately usable spectrum including 2.3 GHz.
- In this consultation, Ofcom has raised similar concerns that asymmetric mid frequency holdings might affect some operators' ability to deliver high speeds reliably and consistently to consumers, arguing that an overall safeguard cap is needed to mitigate this risk.

3.4 However, in relation to the assessment of asymmetric shares in low frequency spectrum, including sub-1 GHz, Ofcom places the above evidence to one side and makes the separate and surprising claim that demand for data intensive services, such as streaming, is not as

important to consumers as basic coverage supporting less-data intensive services such as internet browsing without streaming and voice services. This finding is clearly at odds with the available evidence as well as Ofcom's own approach taken elsewhere demonstrating that consumers want seamless connectivity for mobile data services with speeds of at least 2mbps indoors and outdoors.

3.5 Ofcom's technical analysis (as well as our own analysis) shows that sub-1 GHz is important to delivering these mobile data services indoors and deep indoors and therefore asymmetric shares in sub-1 GHz spectrum risk undermining future competition for seamless connectivity and future 5G mobile services.

3.6 Macrocell deployment will remain key to extending mobile coverage for the foreseeable future, i.e. at least the next 3-5 years as early 5G services are introduced.

3.7 BT/EE and H3G operate 1800 MHz macrocell site grids and therefore have a structural cost disadvantage with deployments of sub-1 GHz spectrum compared to Vodafone and O2. This disadvantage will endure at least for the next 3-5 years while macrocell deployments remain key. BT/EE and H3G are therefore likely to have a lower intrinsic value for 700 MHz spectrum than Vodafone and O2.

3.8 Given this material risk that BT/EE and H3G win no 700 MHz, there is the very real possibility that competition in the market will be eroded leading to lower levels of innovation, and less consumer choice and value in retail and wholesale markets.

3.9 Ofcom should therefore intervene with a 75 MHz sub-1 GHz safeguard cap on the basis that it would be appropriate, necessary, least onerous and proportionate to promoting competition.

3.10 In the sections that follow, BT/EE sets out its reasoning and evidence in support of a 75 MHz sub-1 GHz safeguard cap as follows:

- Challenges in the current - and future - mobile market:
  1. <u>Seamless connectivity indoor/outdoor including for data intensives uses</u>
     - We provide evidence that consumers demand <u>seamless connectivity</u> including when using data-intensive services indoors and outdoors;
     - We highlight BT/EE's and H3G's challenge in serving these customers as we continue to have poorer indoor and deep indoor coverage than Vodafone or O2 due to a lack of sub-1 GHz spectrum;
     - Our technical network analysis (and Ofcom's) demonstrates sub-1 GHz spectrum is critical to offering seamless connectivity; and
     - We explain that macrocell deployments will remain the primary method of delivering coverage benefits for consumers in the foreseeable future.
  2. <u>Future 5G mobile</u>
     - There are important 5G use cases for which sub-1 GHz will be a critical input (Ofcom's market analysis is flawed because it does not address these future 5G mobile issues).
- The high risk of harm to competition from asymmetric low frequency spectrum shares:
  - We explain why there is a material risk that neither BT/EE nor H3G win any 700 MHz spectrum.
    - We consider both intrinsic and strategic value arguments for why the risk of not winning any 700 MHz is high.

- We show that competition will be weaker as a result with the risk that there is lower customer benefit now and in the future:
    - If neither BT/EE nor H3G win any 700 MHz, they would be less able to compete in offering seamless connectivity including for data intensive services indoors and deep indoors.
    - If neither BT/EE nor H3G win any 700 MHz, 5G services for mobile consumers may be delayed or reduced with less consumer value, choice and innovation.

- There is a strong case for intervention:
    - We provide reasoning and evidence for our criteria to determine when it is optimal to leave spectrum allocations to the market and when it makes sense to propose pro-competitive safeguard caps.
    - We establish why a 75 MHz sub-1 GHz safeguard cap would be appropriate, necessary, least onerous and proportionate.
    - We highlight that Ofcom proposed a sub-1 GHz safeguard cap in the 2013 800 MHz and 2.6 GHz auction for reasons that remains relevant today.
    - Finally, we share evidence of similar competition measures in relevant international jurisdictions.

Challenges in the current – and future - mobile market

3.11 This section will identify and explain some of the key challenges BT/EE faces when delivering minimum network quality of services to its mobile customers.

Seamless connectivity indoor/outdoor including for data intensive uses

Consumers demand seamless connectivity for data intensive uses indoors and outdoors

3.12 BT/EE continues to deliver improved 4G capacity and speeds, expanding 4G coverage to more new places and innovating in relation to mobile phone calls with customers now making more phone calls on 4G than on 3G for the first time – both on VoLTE and VoWiFi.

3.13 While BT/EE has continued to improve its mobile network quality of service and has delivered better outcomes for its customers over time, we have faced ongoing and significant challenges when competing with the service levels offered by other MNOs to provide good quality indoor and deep indoor coverage due to a lack of sub-1 GHz spectrum. This may appear to affect only one of many dimensions of competition and therefore not significantly undermine BT/EE's overall network service offering, however, most customers use data and make and receive calls and texts at home or at work or when commuting between home and work. Accordingly, the ability to offer coverage indoors, including in shallow and deep indoor environments, as well as on commuter corridors, is critical to ensuring a reliable and consistent mobile data and voice service.

3.14 BT/EE considers that very asymmetric shares of sub-1 GHz spectrum has the undesirable effect of undermining competition for the provision of reliable and consistent mobile services that are heavily used indoors and deep indoors. Indoor and deep indoor coverage issues are not transient like capacity in the busy hour. They result in ongoing and repetitive problems for customers (which can have a significant impact on churn and reputation (*i.e*. NPS scores for operators). For example, calls dropping when customers enter a lift or during the commute to work, or disruption of data sessions when deep indoors either at work or at home.

3.15 Indoor coverage is currently lower for BT/EE and H3G compared to Vodafone and O2 - roughly a 5-percentage point difference.[32] ✂[redacted].

3.16 Historically there have been fewer tools to compare the difference between the coverage provided by different operators. However, tools are increasingly available for customers to check their coverage including indoors ✂[redacted] (e.g. OOKLA speed test app). Customers are therefore becoming better able to choose the operator that provides the best indoor and deep indoor coverage to meet their needs, by making use of improved coverage checking tools. ✂[redacted].

3.17 In relation to the assessment of asymmetric shares in low frequency spectrum, including sub-1 GHz Ofcom makes the new and surprising claim that demand for high capacity services, such as video streaming, is less important to consumers than basic coverage, for less data intensive services such as internet browsing without streaming, citing both Enders Analysis and Ofcom survey work. Ofcom also claims that existing spectrum allocations can meet demand for basic coverage i.e. less data intensive services. BT/EE does not agree with either of Ofcom's findings for the following reasons.

3.18 First, we have reviewed the same survey evidence cited by Ofcom and found the results are similar to our own internal survey results. However, Ofcom misinterprets this key piece of evidence.

3.19 Enders research (in July 2017) showed that 'reliability' is the aspect of network quality considered most important by customers (48%), followed by coverage (33%) and then data speeds (which are increasing in importance but still behind the other factors - 14%, up from 9% in 2014).

3.20 Our internal analysis of NPS data is not dissimilar to the Enders survey results. ✂[redacted].

3.21 However, reliability in our view (and supported by our own customer insight) reflects the importance consumers place on consistently receiving the service that they pay for. For many customers, this includes being able to use high capacity services (e.g. video streaming) with seamless connectivity when using data intensive services including outdoors and in heavy-use environments such as indoors and deep indoors. Our research suggests that customers often include 'speed' within their understanding of reliability but 'speed' as an isolated concept is not clearly understood. As technology improves, including moving from 4G to 5G, customers will continue to expect faster and higher capacity services without interruption irrespective of their location.

[32] Ofcom, Table A9.7 (Indoor 4G coverage with download speed of 2mbps).

3.22 Ofcom argue that their consumer research shows web browsing is the most important mobile service for customers (ie less data-intensive), followed by calls and then by video streaming (ie more data intensive)[33]. However, internet browsing can cover a range of activities and not just text or picture-based websites. Many popular internet websites, e.g. BBC online, include news and stories and other forms of content using video streaming as part of the standard browsing service. In addition, consumers are increasingly browsing using mobile apps including when using social media on mobiles that includes video streaming as a standard feature of the consumer experience (e.g. Facebook, YouTube, Instagram and Snapchat). BT/EE considers that internet browsing includes video streaming on these popular websites and when using social media on mobile apps. These uses will therefore represent data intensive services.

3.23 To summarise customers clearly place a high importance on consistently receiving the mobile service they pay for. This includes experiencing seamless connectivity including when using data-intensive services indoors and outdoors. We think this is consistent with survey results which indicate that customers regard 'reliability' as highly important.

3.24 Throughout the remainder of this response, when assessing the harmful effects on competition arising from asymmetric shares in low frequency spectrum, we will refer to this key attribute, i.e. seamless connectivity, which can be expected to define a minimum good quality service. As explained below, we consider that acquiring 700 MHz ✂[redacted] because it is the only cost-effective solution that supports the delivery of this important attribute to customers.

3.25 Second, many content providers and social media platforms publish the minimum speeds necessary to browse their service which includes watching video as standard. As a rule, data speeds of at least 2Mbit/s are typically required for decent standard definition (SD) video streaming and at least 4Mbit/s for high definition video streaming.

3.26 Consumers currently stream large amounts of content on EE's network including on popular social media sites and this will only increase with new 5G mobile services. Currently steaming accounts for ✂[redacted] of traffic on EE's network. This evidence needs to be factored into Ofcom's assessment of the risk of harm to competition from asymmetric low frequency spectrum shares.

3.27 Third, in addition, Ofcom's own analysis published in its Smart Cities report has identified that 2mbps is the minimum threshold to ensure a consistent streaming service:

> "For download speed, we consider the proportion of tests that produced a speed greater than 2Mbit/s in addition to the overall averages, as such speeds are likely to be sufficient to support high-capacity video services."[34]

[33] Consultation document para 5.34

[34] https://www.ofcom.org.uk/__data/assets/pdf_file/0027/95904/Smartphone-Cities-Dec16.pdf, page 4

3.28 Fourth, BT/EE considers that that since Ofcom assesses compliance with coverage obligations in national spectrum licences using minimum data speeds of 2mbps we believe that speeds below this threshold are not adequate for mobile data services such as streaming.

3.29 Finally, Ofcom argues that all MNOs hold at least some low frequency spectrum such that even with asymmetric holdings all MNOs are providing good quality basic coverage[35]

3.30 For instance, Ofcom claims that all MNOs have good basic data coverage with little room for improvement in outdoor coverage

> "*All MNOs provide coverage of voice and data services of at least 200kbps via either 3G or 4G basic data coverage to 99% of outdoor premises, and good quality 4G coverage (of at least 2Mbps) to well over 98% of outdoors premises. As such, there is little room for improvement on these specific metrics*." [36]

3.31 This analysis assumes that data speeds of only 200kbps are required for good basic data coverage and that 3G and 4G can easily handle these requirements. We disagree with this finding. 200kbps might be suitable for browsing text and picture-based websites but few popular sites that are visited and used by most mobile customers are limited to this format. Internet browsing on many popular social media sites such as Facebook, YouTube, Instagram and Snapchat include video steaming as a standard part of the consumer experience and will therefore need will need at least 2mbps for a good streaming experience.

3.32 Although outdoor premises coverage may be comparable between the four MNOs for speeds of at least 2Mbps, seamless connectively when using data requires customers to use data indoors and deep indoor where usage is typically heaviest i.e. at home and places of work. As mentioned before, in these harder to reach locations, ✂[redacted] (there is a 5-percentage point difference in indoor coverage according to Ofcom's Figure A11.1).

Very asymmetric shares in sub-1 GHz spectrum in the current mobile market might be further entrenched in the upcoming 700 MHz auction

3.33 There is consequently a high risk that absent competition measures in the upcoming 700 MHz auction, Vodafone and O2 may entrench their existing very high shares in this band such that the provision of future 5G services may be less competitive and therefore less likely to deliver full benefits to customers particularly in the provision of seamless connectivity when using data intensive services in indoor and deep indoor environments.

3.34 The following chart (Figure 3.1) shows that there are very asymmetric shares in sub-1 GHz spectrum. BT/EE and H3G have very low shares of this spectrum both in absolute terms - 8% each - and relative to their respective shares of market demand i.e. BT/EE and H3G have a 33% and 12% market share of customers (respectively) and 36% and 26% share of data traffic (respectively).[37]

3.35 Vodafone and O2 have holdings that in any other context would be a cause for concern by Ofcom. For instance, Ofcom proposes an overall safeguard spectrum cap so that no MNO can

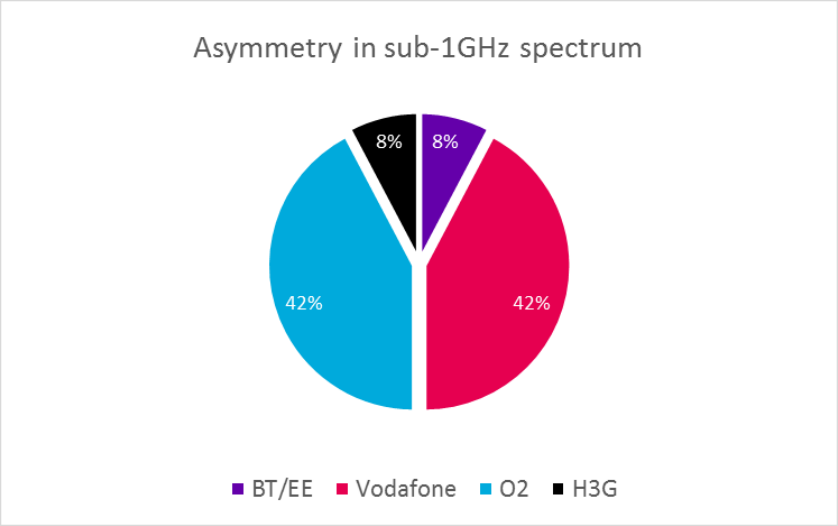
[35] Ibid 5.271

[36] Ofcom, para 5.272.

[37] Ofcom Figure A6.5 and A6.30

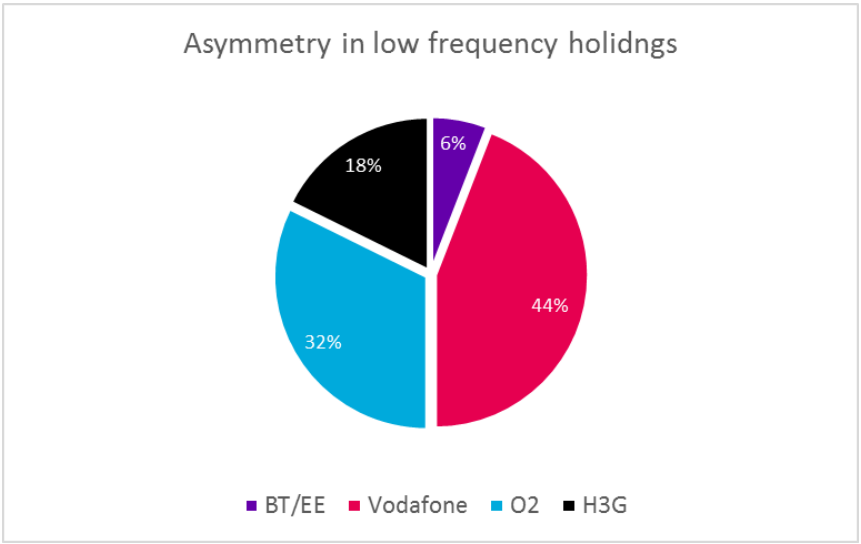
hold more than 416 MHz - or 37% - of overall spectrum. In contrast Ofcom has fewer competition concerns where two MNOs each hold more than this maximum acceptable share in the valuable and relatively scarce low frequency spectrum bands i.e. both Vodafone and O2 have a 42% share of this band as illustrated in Figure 3.1.

Figure 3.1 Current significant asymmetry in sub-1 GHz spectrum



3.36 BT/EE notes that Ofcom now relies on a newly defined low frequency spectrum band including holdings of 1.4 GHz, i.e. spectrum acquired by Vodafone and H3G from Qualcomm in 2015. Ofcom argues that its competition assessment in relation to this band is not sensitive to the inclusion of 1.4 GHz. However, including 1.4GHz spectrum in a low frequency band does have a significant impact on BT/EE's share of the low frequency spectrum from 8% to 6% as shown in Figure 3.2.

Figure 3.2 Current significant asymmetry in low frequency holdings (including 1.4GHz)



3.37 Furthermore, if we estimate spectrum shares on the downlink frequencies only this pushes BT/EE's share of low frequency spectrum down further to 5%.

3.38 If neither BT/EE nor H3G win any 700 MHz spectrum in the upcoming auction BT/EE's share of the low frequency spectrum would fall further to 4% and BT/EE's share of the sub-1 GHz spectrum would fall to 5%. BT/EE consider that this outcome would be detrimental to competition and consumers. This is illustrated in Figure 3.3 and Figure 3.4 for the case where the 700 MHz is split evenly between Vodafone and O2.

Figure 3.3 Significant asymmetry in low frequency holdings assuming BT/EE and H3G win no 700 MHz (including 1.4GHz)

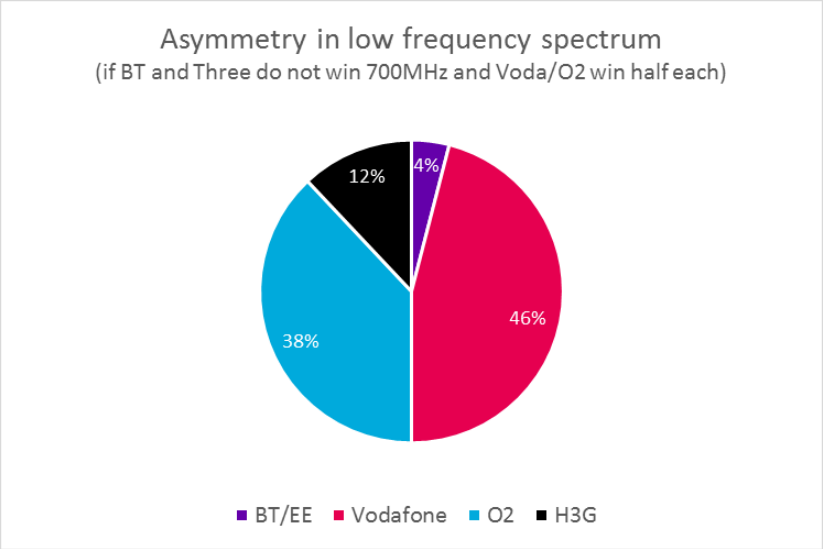
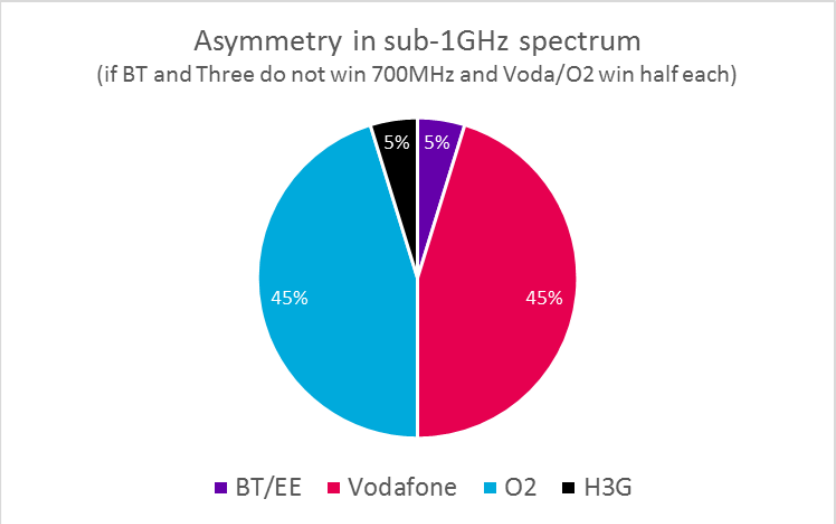


Figure 3.4 Significant asymmetry in sub-1 GHz holdings assuming BT/EE and H3G win no 700 MHz



Our technical network analysis (and Ofcom's) demonstrates sub 1 GHz spectrum is critical to offering seamless connectivity indoors and deep indoors

3.39 ✂[redacted]

3.40 ✂[redacted].

Figure 3.5 BT/EE's distribution of traffic load on 800 MHz and 1800 MHz

✂[redacted]

3.41 Ofcom's own technical analysis also demonstrates that 700 MHz is critical to offering seamless connectivity indoors and deep indoors. For instance, the results of Ofcom's modelling show that even with half the bandwidth and around 10% fewer sites, 700 MHz will still outperform 1800 MHz in a larger share of indoor and deep indoor locations and at higher speeds (Mbps). The theoretical modelling compared 2 x 10 MHz of 700 MHz based on 16,000 sites with 2 x 20MHz of 1800 MHz on 18,000 sites at throughputs of 2 Mbit/s and 10 Mbit/s.

3.42 There are a number of limitations to Ofcom's full analysis: it uses a theoretical network deployment and compares each frequency band or layer separately ignoring the fact that all MNOs operate a multi-frequency network. This may lead to an overstatement of the indoor coverage achievable using 1800 MHz where sub 1 GHz spectrum is deployed at the same site. Ofcom's compares 2 x 20 MHz of 1800 MHz with 2 x 10MHz of 700 MHz. BT/EE considers that by doing so Ofcom is essentially acknowledging that the propagation characteristics of 1800 MHz are worse than 700 MHz and that 700 MHz is scarce and more valuable than 1800 MHz. For example, Ofcom itself states:

"*In the case of deep indoor locations, a network based on 2 x 10 MHz of 700 MHz can outperform a network with 2 x 20 of 1800 MHz (i.e. with twice the bandwidth), though a network based on only 2 x 5 MHz of 700 MHz may not have sufficient bandwidth for more data-intensive services characterized by a SUT≥ 10 Mbps. Hence an operator with only 2 x 5 MHz of low frequency spectrum may want to acquire more*."[38]

3.43 ✂[redacted].

3.44 In relation to the technical coverage analysis, both Ofcom's theoretical network model predictions and BT/EE's real-world network load analysis demonstrate that sub 1GHz spectrum has far superior propagation characteristics in relation to harder to reach places than 1800 MHz at data speeds of greater than 2 Mbit/s and 10 Mbit/s.

3.45 However, Ofcom appears to ignore these analyses when assessing prospects for competition in seamless connectivity using data indoors and deep indoors.

3.46 Finally, we note that Analysys Mason (AM) has also undertaken relevant technical network cost modelling to support Ofcom's costs benefit assessment (CBA) to support 700 MHz for mobile use i.e. the Digital Terrestrial Television (DTT) clearance decision.[39]

3.47 The CBA assumed a total of 2 x 40 MHz of 700 MHz available with each operator receiving 2 x 10 MHz of 700 MHz i.e. the generic operator receiving 2 x 10 MHz.

3.48 To estimate the value of 700 MHz in mobile use, AM identified that up to 30% of all mobile traffic could only be carried by sub 1-GHz spectrum (typically at the cell edge). AM then identified the cost savings made possible by 700 MHz from avoiding further site development when serving this traffic increment. AM estimated the present value of cost savings for the generic operator to be £539m over 20 years with a value of £2156m for the mobile industry i.e. £539m x 4.

3.49 AM argued that the value per MHz of 700 MHz falls as more spectrum is allocated to the generic operators reflecting the decreasing marginal benefit of additional spectrum.[40] Arguably the full benefits of 700 MHz to the mobile industry identified in Ofcom's CBA will only be fully realised if operators with minimal holdings of 700 MHz can also acquire some 700 MHz in the auction (and not if only 3 or even 2 operators acquire all the 700 MHz).

---

[38] BT/EE notes that Ofcom's analysis suggests 2 x 5MHz of 700 MHz would have poorer indoor and deep indoor coverage than 2 x 20 MHz 1800 MHz although Ofcom is comparing 4 times the amount of 1800 MHz compared with 700 MHz. There may also be limitations in Ofcom's theoretical modelling that may overstate the coverage of 1800 MHz. In any event Ofcom appear to implicitly recognise that no MNO would commercially deploy on 2 x 5 MHz of 700 MHz noting such operators "may want to acquire more".

[39] https://www.ofcom.org.uk/__data/assets/pdf_file/0023/47264/benefits_700 MHz.pdf

[40] We argue in the next section that an optimal distribution of spectrum may be unattainable due to an enduring 1800 MHz structural cost disadvantage of deploying 700 MHz that will lower BT/EE's and H3G's intrinsic value relative to Vodafone and O2 so that even with less sub 1 GHz spectrum holdings BT/EE may not have a higher marginal benefit for additional 700 MHz.

Macrocell deployments will remain the primary method of delivering coverage benefits for consumers in the foreseeable future

3.50 BT/EE's improvements in 4G mobile coverage, capacity and speeds, have been primarily driven by macrocell deployments on our 1800 MHz site grid including on the spectrum frequency bands 800 MHz, 1800 MHz and 2.6 GHz.

3.51 BT/EE expects that macrocell deployments to extend coverage for the benefit of consumers will continue to be the primary method for extending coverage. While we expect that this network topology will be required to change over time including as we move to greater small cell deployments in the future for 5G mobile, macrocell deployments will likely continue to be key at least for the next 3-5 years as early 5G mobile services are rolled out across the UK.

3.52 In addition to our 4G macrocell deployments, BT/EE has undertaken a range of complementary network deployments including outdoor small cells, indoor Femto cells and WiFi. While these additional deployments have complemented and enhanced our macrocell coverage offering these are not likely to be substitutes for deployment of sub-1 GHz on macrocells to deliver coverage benefits for consumers as they are not cost effective in replicating the macrocell coverage footprint offering in both indoor and outdoor environments.

Future 5G mobile

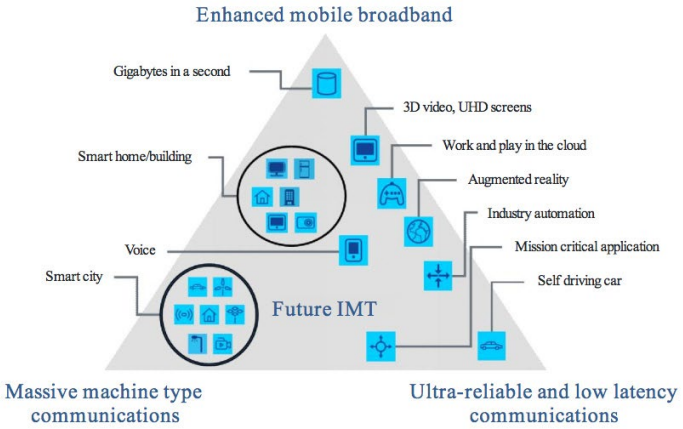
There are important 5G use cases for which sub-1 GHz will be a critical input

3.53 BT/EE expects the key areas of future competition in 5G mobile services will include following:

- delivering good, reliable coverage wherever people live, work and travel, as well addressing coverage issues in specific locations with limited deployment options (e.g., railways and roads, underground and deep indoor);
- delivering increased capacity and speeds in densely populated areas to meet escalating data usage requirements (requiring the widespread deployment of small cells);
- meeting the differentiated requirements of 5G applications as they emerge e.g. 5G IoT applications

3.54 There are three key services capabilities that 5G mobile will offer using 700 MHz illustrated in Figure 3.6.

Figure 3.6 Key 5G mobile services where 700 MHz spectrum is key



eMBB

3.55 Early enhanced Mobile Broadband (eMBB) use cases focus on consumers and the need for better and faster connectivity to handle higher quality video content and expectations of being able to use data with seamless connectivity. eMBB will initially be an extension to existing 4G services and will be among the first 5G services to be made available.

Service continuity for use in vehicles

3.56 High speed users e.g. train users moving between the coverage of two different base stations have to complete a handover procedure to maintain the service (e.g. voice call). The handover procedure requires the device to send measurements to the network and receive configuration and acknowledgement from the network. Because the distance over which sub-1 GHz can be measured is greater it performs better for service continuity. This performance gap cannot economically be overcome by densifying the network on transport routes.

IoT services

3.57 Narrowband IoT (Nb-IoT) & future massive machine type communications (mMTC) 5G services use dedicated sub-carriers which improves the coverage and power performance for IoT devices. Sub 1 GHz improves the power performance of devices and the coverage footprint for IoT applications. Without nationwide coverage of a single sub-1 GHz band MNOs will not be able to compete for IoT applications requiring very long battery life and very demanding coverage, leading to a lack of competition and investment.

3.58 ✂[redacted].

3.59 ✂[redacted].

3.60 ✂[redacted].

3.61 In contrast other MNOs can introduce 5G IoT by gradually re-farming their sub-1 GHz spectrum but with just 5MHz of 800 MHz EE does not have headroom to do that, which means that if we do not get 700 MHz, competition and innovation in provision of new 5G services that rely on 700 MHz for deep coverage will be diminished.

URLLC

3.62 Ultra-reliable and low latency communications services require resources to be provided from multiple radio sites to a single device as in joint transmission co-ordinated multipath (JT-CoMP). This requires overlapping coverage from multiple sites. This cannot be economically delivered in-building or outside of dense urban areas without 700 MHz.

Why does sub-1 GHz matter for future competition

3.63 BT/EE has historically had a coverage disadvantage and since the launch of 3G has competed on outdoor coverage "rollout" rather than coverage within rollout areas i.e. indoor and deep indoor coverage. As competitors have closed the coverage gap, we have partly mitigated this issue with 4G deployments using 800 MHz however this disadvantage persists.

3.64 This difference in good quality indoor coverage will be brought into even sharper relief as 5G mobile services are introduced, including early eMBB services, as customers will demand seamless connectivity using data intensive services indoors and deep indoors. This difference in good quality indoor coverage offering will become even more important to customers when choosing a network.

3.65 BT/EE considers that competition could be harmed if insufficient 700 MHz spectrum is available to all MNOs to provide a competitive offering for 5G mobile services. Otherwise customers will switch to operators with better sub 1 GHz coverage and capacity i.e. Vodafone and O2.

Ofcom's market analysis is flawed because it does not address these future 5G mobile issues

3.66 For Ofcom to determine whether there is a risk of significant asymmetric shares in low frequency spectrum weakening competition, and whether it is appropriate to actively promote competition in this band, it must take a forward-looking view of how best to promote competition in the provision of new 5G mobile services.

3.67 BT/EE makes the following observations on the current market. For example:

> *"we consider that the current provision of mobile services is functioning well, with competition between the four MNOs delivering good outcomes for consumers*[41]
>
> *We still believe it is in consumers' interests for there to be at least four credible MNOs…….. because MNOs are major competitors in supplying retail mobile services to consumers. It also*

[41] Ofcom, paragraph 5.17

supports retail competition indirectly because the MNOs compete to provide wholesale access to MVNOs[42].

Market concentration has decreased at the retail and wholesale level over recent years. Ofcom research shows that there has generally been a downward trend in mobile prices since 2013[43].

At the same time, all MNOs have continued to invest in providing new services and significant improvements for consumers. For example, 4G/LTE coverage in the UK has continued to develop, reaching around 90% of indoor premises for all MNOs.

Consumer satisfaction with UK mobile services remains high, despite small decreases in some satisfaction indicators (e.g. value for money)." [44]

3.68 BT/EE considers this current state of competitiveness in the UK market for mobile could be eroded in the future. Absent a sub-1 GHz cap in the upcoming 5G auction, the competitiveness in the provision 4G mobile services seen to date in the UK mobile market may be eroded with the introduction of new 5G mobile services if the current significant asymmetries in low frequency spectrum persist or even increase.

3.69 BT/EE considers that Ofcom takes an approach at odds with its 2018 2.3 - 3.4 GHz auction where Ofcom identified two main policy objectives for the award:

- first, to make the spectrum available in a timely manner to meet consumer demand; and
- second, to ensure that consumers and businesses continue to benefit from a competitive market in the provision of mobile services.

3.70 Ofcom further argued that:

> "if an auction left one or more operators with insufficient spectrum to compete strongly, consumers could face higher prices - and other operators might have reduced incentives to innovate and invest."

3.71 BT/EE considers that the 700 MHz auction must also pass the same test. It must ensure that:

- consumers and businesses continue to benefit from a competitive market for mobile services;
- all operators have sufficient spectrum to compete strongly;
- all operators have competitive incentives to innovate and invest.

3.72 Ofcom also has a statutory duty to promote competition under the Communications Act. [45] In light of the rapid rate at which technology in this sector continues to develop and the long-term impact that the award of indefinite spectrum licences can be expected to have on the market, it is important that Ofcom assess competition on a dynamic, forward looking basis. [46]

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[42] Ofcom paragraph 5.18

[43] Ofcom, paragraph 5.20

[44] Ofcom paragraph 5.21

[45] Communications Act 2003, Articles 3 and 4.

[46] Ofcom recognises the need for the competition assessment to be forward-looking in its Consultation at paragraph 5.64.

While it may be the case that mobile markets are competitive today the relevant test for whether competition measures are justified is whether competition can be enhanced or improved and/or balanced against other objectives such as encouraging investment and innovation in relevant markets. Specifically, if competition in future mobile services can be materially enhanced by undertaking a pro-competitive, light-touch intervention today, then Ofcom is required to propose such measures. Especially where the benefits of the intervention outweigh the costs and where the measure has the highest net benefit of all options considered.

The high risk of harm to competition from asymmetric low frequency shares

3.73 This section demonstrates why the challenges and risks to competition identified in the previous section along with new challenges outlined below will be exacerbated in relation to seamless connectivity and future 5G mobile services if we do not acquire 700 MHz in the upcoming auction. This section will provide evidence and reasoning as follows:

- First: There is a material risk that neither BT/EE nor H3G win any 700 MHz spectrum based on an assessment of:[47]
    - Intrinsic value, and
    - Strategic investments.
- Second: Competition will be weaker as a result with the risk that there are lower current and future customers benefits:
    - if neither BT/EE nor H3G win any 700 MHz, they would be less able to compete in offering seamless connectivity including for data intensive services indoors and deep indoors
    - if neither BT/EE nor H3G win any 700 MHz, 5G services for mobile consumers may be delayed or reduced with less consumer value, choice and innovation

There is a material risk that neither BT/EE nor H3G win any 700 MHz spectrum

Intrinsic value

3.74 In relation to intrinsic value Ofcom states:

> *"In our view, the overall impact of differences in grid configurations on the MNOs' relative intrinsic values is unlikely to be so large as to significantly influence their likelihood of winning 700 MHz spectrum."* [48]

3.75 We strongly disagree with Ofcom's provisional finding on intrinsic value for the following reasons.

3.76 There is a significant and enduring cost disadvantage for an 1800 MHz MNO deploying 700 MHz on new antenna positions including either a second large antenna or multiband antenna

[47] This risk is potentially exacerbated by the CCA auction with coverage obligation lots if BT and or H3G faces significantly higher costs than other MNOs to meet the specified obligations.

[48] Consultation document para 5.331.

that will require extensive mast replacement or strengthening. The cost of mast strengthening and replacement will not be borne by 900 MHz operators.[49] [50] [51]

3.77 This cost disadvantage for BT/EE is at least ✂[redacted]. This would mean that BT/EE's overall valuation is heavily discounted such that BT/EE's valuation of the net benefits of 700 MHz would be significantly less than a 900 MHz operator's valuation of the net benefit (given a 900 MHz operator's significantly lower cost of 700 MHz deployment).

3.78 Even if 1800 MHz operators such as BT/EE derived a higher customer benefit from 700 MHz than 900 MHz operators, BT/EE's 1800 MHz cost disadvantage would still be likely to outweigh such benefits.

3.79 The above result brings into sharp relief that there is a material risk that neither BT/EE nor H3G win any 700 MHz spectrum.

3.80 Ofcom recognises that it has limited holdings of low frequency spectrum and this may be one factor contributing to BT/EE's poorer indoor and deep indoor network coverage in relation to its current 4G mobile network service. Ofcom also accepts that if customers value indoor and deep indoor coverage then arguably BT/EE should be able to capture these benefits in additional revenue. This in turn may suggest that BT/EE has a higher incremental intrinsic value of sub-1 GHz spectrum relative to the 900 MHz operators and that BT/EE would therefore be likely to win some 700 MHz even with an 1800 MHz structural cost disadvantage.

3.81 However we disagree with Ofcom's finding that BT/EE is likely to win 700 MHz based on the assumption that we will necessarily have a higher intrinsic value for the 700 MHz spectrum owing to: our relatively limited holdings of sub-1 GHz spectrum; the need for BT/EE to acquire 700 MHz to compete effectively with the other MNOs especially given the challenges BT/EE faces when competing on indoor and deep indoor coverage and our difficulties future route to 5G IoT.

3.82 While BT/EE accepts these may drive a higher commercial valuation - subject to the arguments and evidence raised below - there remains a material and significant risk that this higher valuation will be offset at least in part by our significant 1800 MHz structural cost disadvantage of deploying 700 MHz such that we are likely to have a lower intrinsic value than either Vodafone or O2.

3.83 BT/EE had significantly lower net intrinsic values for 800 MHz than other MNOs in the 2013 4G auction despite having no sub-1 GHz spectrum and poorer indoor and deep indoor coverage

3.84 ✂[redacted]

[49] For the avoidance of doubt we do not include the costs of 700 MHz antenna equipment in the estimated 1800 MHz cost disadvantage as all MNOs will bear these antenna related costs.

[50] ✂[redacted].

[51] These arguments should be read in conjunction with BT/EE's confidential submissions to Ofcom providing evidence including quantitative cost estimates support of our 1800 MHz structural cost disadvantage (3 August 2018 and 5 October 2018).

3.85 The table below illustrates standalone bid values for 2 x 5 lot(s) of 800 MHz i.e. block A1 bids only. For simplicity, we exclude all incremental bid values (IBVs) that include both 800 MHz and 2.6 GHz lots. We also exclude the 2x10 lot of 800 MHz with the coverage obligation.

- BT/EE bid £230m for a 2 x 5 of 800 MHz, £650m for a 2 x 10 of 800 MHz (average price of £325m) and £1.2bn for 2 x 20 of 800 MHz (average price per lot of £295m).52
- This compares against a £1.2bn bid by Telefonica for 2 x 10 of 800 MHz (average price of £610m for a 2 x 5 of 800 MHz).
- BT/EE bids are clearly well below Telefonica's intrinsic bid values for 800 MHz.

Table 3.1 800 MHz and 2.6 GHz bid values – operator bids for 2 x 5 of 800 MHz

Bidder	A1	A2	C	D1	D2	E	bid value
EE	1	0	0	0	0	0	230,000,000
EE	2	0	0	0	0	0	650,001,000
EE	4	0	0	0	0	0	1,176,622,000
H3G	1	0	0	0	0	0	565,500,000
Telefonica	2	0	0	0	0	0	1,219,002,000

3.86 Due to combinatorial bidding by Vodafone in the 2013 4G auction there is no standalone bid information for Vodafone in the 800 MHz band and therefore it is not possible to reliably derive an estimate of Vodafone's intrinsic value for 800 MHz.

3.87 Vodafone's bids in the 4G auction reflected that they had a large budget (most supplementary bids placed were about £2bn) and a higher overall valuation for combined lots of 800 MHz and 2.6 GHz spectrum than either BT/EE or H3G. This compares to EE's winning bid of £1.05bn for 1 lot of 800 MHz and 7 lots of 2.6 GHz and H3G bid of £565m for 1 lot of 800 MHz. [53]

3.88 When comparing the same combination of lots of 800 MHz and 2.6 GHz Vodafone's bids are nearly double that of BT/EE. For example, Vodafone bid of £1.87bn for 2 lot of 800 MHz and 3 lots of 2.6 GHz compared to BT/EE's £1.03bn. This suggests Vodafone's overall private value is almost double BT/EE's for the combination of 2 lots of 800 MHz and 3 lots of 2.6 GHz.[54]

[52]Note there is a significant contiguity premium associated with BT/EE achieving a 2x20 MHz block of contiguous 800 MHz spectrum which is why the average value is higher than for a 2 x 5 of 800 MHz.

[53] While it is possible to derive information on marginal / opportunity costs of 800 MHz using the linear reference price, decomposition and marginal bidder methods set out in Ofcom's 2015 ALF consultation these values will relate to the incremental value for the excluded or deprived bidder of 800 MHz (typically EE or H3G) and therefore will provide only limited information to infer Vodafone's intrinsic i.e. private value for 800 MHz.

[54] We note that Vodafone is likely to have a higher intrinsic value for 2.6 GHz relative to BT/EE given our holding of 1800 MHz however for plausible relative values our valuation for 800 MHz is likely to be lower as evidenced for Telefonica in the standalone bids for 800 MHz.

3.89 ✂[redacted].

3.90 ✂[redacted]

3.91 Notwithstanding these factors BT/EE considers that information on our previous bids for 800 MHz casts serious doubt on Ofcom's assessment that BT/EE - and H3G- are likely to have the same or higher intrinsic value for 700 MHz than Vodafone or O2. There is clearly a material risk that based on previous auction bid data for sub-1 GHz spectrum that BT/EE may win no 700 MHz.

3.92 Ofcom could consider validating our above analysis to, compare and quantify the commercial benefits of 700 MHz against the 1800 MHz cost disadvantage to assess with a sufficient degree of confidence that an 1800 MHz operators' net intrinsic value will be high enough for it to be likely to win at least some 700 MHz.

3.93 For comparison, Ofcom undertook a cost benefit assessment for the coverage obligation to ensure at least one MNO has a positive intrinsic value for an encumbered lot. Based on that analysis Ofcom propose up to a £350m avoided cost to mitigate the risk that the lots go unsold. We think a similar type of analysis could be taken for the 1800 MHz operator's structural cost disadvantage.

Strategic value

3.94 In contrast to Ofcom's flawed technical analysis in Annex 6 and 10 – see next section - low frequency spectrum is likely to confer an advantage on O2 and Vodafone over BT/EE and H3G who bear a structural cost disadvantage when deploying 700 MHz on an 1800 MHz site grid. Strategic bidding will typically be expensive because an operator must bid high to beat a rival with a high valuation and this will typically deter strategic investment behaviour.

3.95 However, given the 1800 MHz operators structural cost disadvantage of deploying 700 MHz, strategic bidding by O2 and Vodafone could be done cheaply and needing only to spend a minimal additional amount to exclude BT/EE and/or H3G from winning any 700 MHz (or limit BT/EE and/or H3G to winning a minimal holding). O2 and Vodafone would need to pay the strategic bid price on all lots won including those won to exclude BT/EE and H3G and also on spectrum won for their own use based on their intrinsic value which may mitigate some of the risk of strategic bidding.

3.96 However going into a CCA auction with a second price rule O2 and Vodafone might each realise independently that they can act unilaterally to exclude BT/EE and H3G from winning 700 MHz very cheaply if they bid a high duopoly price but only pay the market value on all lots.

3.97 For instance Vodafone and O2 may still have an incentive and the ability to bid the duopoly value for 700 MHz knowing that if they bid slightly more than BT/EE and H3G they are likely to win and pay only the market value for the 700 MHz based on the competitive downstream market bids from BT/EE and H3G. Importantly neither coordination nor tacit collusion may be necessary for this to be the preferred bid strategy for Vodafone and 02.

3.98 The payoff for this strategy is likely to be high. First, O2 and Vodafone would only need to bid a minimal additional amount to exclude BT/EE and H3G. Second this is the last time that low frequency spectrum will be auctioned for the foreseeable future and given the lack of sufficient alternatives this could increase the payoff to O2 and Vodafone from harming long run competition in provision of 5G services.

Competition will be weaker as a result with the risk that there are lower current and future customer benefits

If neither BT/EE nor H3G win any 700 MHz, they would be less able to compete in offering seamless connectivity including for data intensive services indoors and deep indoors

3.99 There is a similar likelihood of material harm to competition as identified for asymmetries in immediately usable spectrum in the 2.3 and 3.4 GHz auction

3.100 BT/EE considers Ofcom's claim that consumers place higher importance on internet browsing and voice to be inconsistent with Ofcom's justification for intervention in the 2.3 and 3.4 GHz auction where it was concerned about the ability of operators to compete in relation to highly data intensive segments if there were highly asymmetric shares in immediately usable spectrum including 2.3 GHz. Ofcom stated:

> "We consider that there is a significant risk of weaker competition and consumer harm if there is a very asymmetric distribution of immediately useable spectrum in the first transitional period[55]
>
> If the increased asymmetry arose, it could result in weaker competition. In particular, it might lead operators with small spectrum shares to compete less strongly, especially for specific customer segments, such as consumers who demand consistently high data speeds (who generally place greater demands on network capacity). This could result in increased prices for those customers to moderate the increase in data traffic of such operators"[56]

3.101 Ofcom must explain why this competition concern is not shared in relation to its assessment of the risk of highly asymmetric shares in low frequency spectrum given sub-1 GHz spectrum is necessary to compete in the provision of seamless connectivity when using data intensive services indoors and outdoors.

3.102 In summary, BT/EE considers that harm to competition is likely to arise from asymmetries in low frequency spectrum since competition in the provision of seamless connectivity for data use indoors and outdoors will be eroded leading to lower levels of innovation, and poorer consumer choice and value.

There is a similar likelihood of material harm to competition as identified for asymmetries in mid-frequency spectrum in the current consultation

3.103 In relation to low frequency spectrum Ofcom argues that data-intensive services requiring high data speeds such as video streaming are either not important to customers, or if they were to become important to customers in the future, there are alternative network solutions to 700 MHz spectrum to provide these services. For instance, as discussed earlier in relation to low frequency spectrum, Ofcom claim that:

- speeds are least important to consumers (only 10%-14% depending on survey used) when compared with reliability and coverage that are most important (34%), and

[55] Consultation document para 6.67

[56] Ibid 6.70

- if speeds become more important in the future BT/EE can use alternatives to 700 MHz including 800 MHz, Wi-Fi offload, small cells (3.4 - 3.6 GHz) and femto cells to meet these faster speeds

3.104 However, in Ofcom's assessment in support of an overall safeguard cap, data intensive services and high data speeds are deemed to be of utmost importance and this underpins Ofcom's competition concerns relating to asymmetric mid frequency holdings. Interestingly Ofcom makes no mention, in this context, of the customer survey data referred to earlier that finds data speeds to be of lesser importance to customers. Ofcom states:

"5.169 Significant asymmetry in holdings of 'capacity spectrum' could have a material impact on competition in the market. An MNO with a very large share of 'capacity spectrum' could have an unmatchable competitive advantage, especially for services that:

a) require high throughput rates (i.e. high data rates in Mbit/s) and service consistency and reliability; and

b) if the user is in an area where demand is close to capacity; and

c) at times of the day when the network is close to capacity.

5.170 On the other hand, an MNO with a low share of capacity spectrum would be unable to add capacity at the same pace as its competitors and may compete less actively in certain segments of the market (e.g. high-consumption services in high density areas).

5.171 We might therefore be concerned about severe asymmetries in 'capacity spectrum', as with overall spectrum. Nonetheless, we do not consider that these are likely to arise (beyond any potential concerns for overall spectrum) and will be prevented by our proposed cap on overall spectrum."

3.105 While BT/EE does not consider an overall safeguard cap is necessary, BT/EE considers that a similar competition concern expressed by Ofcom in relation to asymmetries in mid-frequency spectrum arises with asymmetric shares in low frequency spectrum. Ofcom's own survey evidence and BT/EE customer insights both highlight the importance customers place on consistently receiving the service they pay for including seamless connectivity when using data-intensive services indoors and deep indoors. Given the importance of sub-1 GHz spectrum in delivering seamless connectivity when using data-intensive services indoors and deep indoors, asymmetries in low frequency spectrum could seriously harm competition and hence should be of equal concern to Ofcom.

3.106 BT/EE considers that there is no reasonable justification for Ofcom to have competition concerns in relation to asymmetries in mid frequency spectrum harming competition for data intensive services when used outdoors but not in relation to asymmetries in low frequency spectrum harming competition for the very same data intensive services in indoor and deep indoor environments and where data usage is likely to be heaviest.

3.107 BT/EE considers that this result is even more surprising given that mid-frequency spectrum is plentiful and there are non-spectrum alternatives including network densification that would mitigate against any asymmetries in mid-frequency spectrum

3.108 This is in stark contrast to the relative scarcity of sub-1 GHz spectrum and the lack of non-spectrum alternatives including network densification and investments to mitigate a lack of sub-1 GHz spectrum.

3.109 In summary, BT/EE considers that harm to competition is likely to arise from asymmetries in low frequency spectrum as for mid frequency spectrum since competition in the provision of seamless connectivity for data use indoors and outdoors will be eroded leading to lower levels of innovation, and poorer consumer choice and value.

If neither BT/EE nor H3G win any 700 MHz, 5G services for mobile consumers may be delayed or reduced with less consumer value, choice and innovation

3.110 There is significantly less 700 MHz available than in spectrum bands that are useful for capacity and the fastest speeds (i.e. 80 MHz in total or 17% of total spectrum currently harmonised for 5G). Given the relative scarcity of low frequency spectrum for the near to medium term, Ofcom is rightly concerned about significantly asymmetric shares in low frequency spectrum:

> *"A significant asymmetry in low frequency spectrum after the award could be a cause for concern" [5.37]*

3.111 BT/EE considers that highly asymmetric shares in low frequency spectrum resulting from the 700 MHz auction would undermine the benefits of competition for key 5G services to consumers resulting in overall welfare losses to society. This harm would initially materialise over a transitional period over the next 3-5 years by diminishing competition in the provision of eMBB services including seamless connectivity for high speed users as well as indoor and deep indoor coverage leading to less choice, innovation and higher prices in these key 5G service elements. Longer term harm to competition would arise through diminishing competition in IoT and URLL services in 3-5 years and beyond. Again, this would inevitably lead to less consumer choice and innovation and higher consumer prices in 5G mobile.

3.112 BT/EE considers that highly asymmetric shares in low frequency spectrum would adversely impact end consumers in retail markets who would have fewer options for switching to a better network as competition in 5G mobile would be restricted to two MNOs with 700 MHz spectrum– Vodafone and O2. This reduction in competitive intensity might be equally concerning in the wholesale MVNO market where there is a fiercely competitive, albeit lumpy, bidding market for contracts. BT/EE and H3G's inability to compete with Vodafone and O2 in the absence on 700 MHz would negatively impact the competitive dynamic in this market.

There is a strong case for intervention

3.113 In this section BT/EE sets out the case for intervention by identifying and explaining:

- First, the criteria for determining when it is optimal to leave spectrum allocations to the market and when it makes sense to propose pro-competitive safeguard caps
- Second that a sub-1 GHz safeguard cap of 75 MHz would be appropriate, necessary, least onerous and proportionate
- Third, Ofcom proposed a competition measure in the form of a sub 1-GHz safeguard cap in the 2013 4G combined award for reasons that remains relevant today, and
- Fourth, the common practice for pro – competitive intervention in other international jurisdictions.

BT/EE's criteria for supporting sub-1 GHz safeguard caps

3.114 BT/EE considers that spectrum allocations should generally be left to the market, to promote economic efficiency, except where it makes sense for this objective to be balanced by competition objectives. BT/EE has previously argued against safeguard caps where efficiency is the main policy concern and has supported safeguard caps where competition concerns are equally important (e.g. exogenous factors or risk of strategic bidding). For instance:

- BT/EE argued against an overall safeguard cap in the 2018 2.3/3.4 GHz auction on the grounds it was unnecessary as BT/EE was likely to have a lower intrinsic value for mid-frequency spectrum including 2.3 GHz. We also in that instance questioned the plausibility of strategic bidding given lack of incentives and the barriers arising from the auction design.
- BT/EE argued for a looser overall safeguard cap in the 2013 800 MHz and 2.6 GHz auction (ie given the relative abundance of high frequency spectrum)
- BT/EE argued for a sub-1 GHz safeguard cap in the 2013 800 MHz and 2.6 GHz auction (i.e. to take account of the 1800 MHz structural cost disadvantage incurred by BT/EE).

3.115 BT/EE continues to use the same criteria to determine whether competition measures in the form of a safeguard cap are justified including in the upcoming 700 MHz auction.

3.116 Spectrum allocations should be left to the market in primary auctions where the following criteria are met:

(i) **intrinsic values** – the auction is likely to ensure that spectrum is secured by those with the highest intrinsic value from its use
(ii) **no strategic bidding** – spectrum allocations will be driven by intrinsic value alone.

3.117 BT/EE argues that these conditions are met in relation to overall spectrum holdings but not in the case of low frequency spectrum.

3.118 In relation to low frequency spectrum:

- There is a significant 1800 MHz structural cost disadvantage such that even if 1800 MHz MNOs have the same or higher intrinsic valuation for 700 MHz as other MNOs they are unlikely to win any 700 MHz spectrum, as the net intrinsic value will be lower relative to Vodafone and O2 that do not suffer the structural cost disadvantage.
- MNOs like Vodafone and O2 would only have to bid slightly more than their intrinsic value to limit 1800 MHz MNOs from acquiring any 700 MHz.

3.119 In relation to overall spectrum:

- High and mid-level capacity spectrum is relatively plentiful, and all MNOs are likely to have similar intrinsic values
- Compared to 700 MHz spectrum there are necessarily fewer, if any, competition issues with strategic bidding for capacity-based spectrum where all operators presently have significant holdings of capacity spectrum and where an exclusionary behaviour would have limited payoff (as it would be extremely expensive). The exception to this being spectrum specific to early 5G service launces in the 3.4 -3.8 GHz pioneer band as we address elsewhere.

A sub-1 GHz cap is appropriate, necessary, least onerous and proportionate to promoting competition

3.120 BT/EE proposes a proportionate, light touch and pro-competitive measure to improve the likelihood that BT/EE and H3G acquire enough 700 MHz spectrum to compete effectively with Vodafone and O2 and meet their respective customers' future demand requirements in relation to new 5G services. [57] Specifically, BT/EE proposes a sub-1 GHz safeguard cap of 75MHz limiting each of Vodafone and O2 to acquiring no more than 20 MHz of 700 MHz i.e. up to 40 MHz in total. BT/EE and H3G would then compete for the remaining 700 MHz i.e. at least 40 MHz of the 80 MHz of 700 MHz.[58]

3.121 The safeguard cap is the minimal necessary intervention to achieve the following:

- mitigate the negative effects of the 1800 MHz structural cost disadvantage of deploying 700 MHz incurred by BT/EE and H3G, and
- improve the chances that one or both of BT/EE and H3G win enough holdings of sub-1 GHz spectrum to promote competitive pressure in 5G mobile services between the MNOs.

3.122 The safeguard cap would incentivise competition for the early introduction of the latest good quality 5G services to end consumer in the retail market and MVNO customers in the wholesale market.

3.123 The safeguard cap would be the least onerous way of promoting competition in new 5G services and could be easily accommodated within the auction design given a similar safeguard cap was used in the 4G auction in 2013. BT/EE considers a safeguard cap preferable to alternative options such as a tight cap or a reservation.

3.124 The safeguard cap will have no unintended or adverse effects as it will not restrict Vodafone or O2 in a way that increases their costs and/or lower their quality of service. For instance, a safeguard cap allows both Vodafone and O2 to acquire large packages of 700 MHz including 2 x 10 MHz of 700 MHz. A 2 x 10 MHz package would be one possible outcome and would offer significant contiguity benefits when deploying 700 MHz so that either or both Vodafone and O2 can offer high quality 5G mobile services at the lowest possible cost.

3.125 In addition to allowing Vodafone and O2 to further enhance their portfolios of sub-1 GHz spectrum the safeguard cap has the benefit of ensuring competitive tension in the auction as neither H3G nor BT is guaranteed to obtain any spectrum.

3.126 The sub-1 GHz safeguard cap mitigates but does not completely solve the problem of very asymmetric shares leading to competition problems. Even if both BT/EE and H3G win 700 MHz spectrum under the safeguard there is unlikely to be sufficient FDD 700 MHz spectrum to support 5G deployment by all four MNOs at least in the initial transitional period

[57] We consider this proposed measure would be wholly consistent with Ofcom's framework for assessing measures as set out at paragraph 5.63 of the Consultation and Ofcom's principles, pursuant to which "*regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed*" (Communications Act 2003, Article 3(3)).

[58] BT/EE would also support an alternative sub-1 GHz cap allowing for any combination of 700 MHz holdings between Vodafone and O2 of up to 40 MHz in total.

ie 3-5 years. BT/EE does not consider that 5G deployment on 700 MHz SDL will be realistic in the near term for the following reasons:

- The 700 SDL device ecosystem is non-existent, so an SDL spectrum holder will be at least a couple of years behind compared to 700 MHz paired (FDD) spectrum holders
- 700 SDL spectrum cannot be paired with the 700 MHz FDD spectrum. ✂[redacted].[59]

3.127 While a tighter spectrum cap of 2 x 5 MHz of 700 MHz on each of Vodafone and O2 could further promote competition, we consider that deployment on 2 x 5 of 700 MHz is likely to increase costs and lower network quality of service for any MNO such that the benefits to competition would be outweighed by efficiency losses.

3.128 We also consider a safeguard cap would be unlikely to incentivise MNOs to bid less than their intrinsic value to influence future decisions by Ofcom, i.e. caps which would entail fewer bidders for certain spectrum in the future. There will still be healthy competition between Vodafone and O2 and between BT/EE and H3G given the importance of 700 MHz as a route to offering a wide range of 5G services.

Ofcom proposed a competition measure in the form of a sub 1-GHz safeguard cap in the 2013 4G combined award for reasons that remain relevant today

3.129 In the 2013 4G combined award Ofcom proposed a sub-1 GHz spectrum cap of 2 x 27.5 MHz limiting each of Vodafone and O2 to acquiring no more than 2 x 10 MHz of 800 MHz on top of their existing holdings of 2 x 17.5 MHz of 900 MHz.

3.130 This measure was designed to mitigate the risk of highly asymmetric spectrum holdings after the auction leading to lower competitive intensity.

3.131 There is a clear precedent for Ofcom to adopt a similar measure in the upcoming 700 MHz spectrum auction. In addition there are factors that suggest an even greater competition concern arising from BT/EE and H3G not winning any 700 MHz including: our ongoing and enduring 1800 MHz structural cost disadvantage to deploy sub 1GHz spectrum, the minimal additional strategic investments required from Vodafone and O2 to limit us acquiring any 700 MHz, and the additional risk to long term competition given that no more sub 1 GHz spectrum will be auctioned for the foreseeable future.

[59] For these reasons, BT/EE therefore disagrees with Ofcom's statement *"5.330: BT/EE holds no downlink-only spectrum at present but does have the largest share of overall data traffic (see Figure A6.30 in annex 6), and so may place greater value on the 700 MHz downlink-only spectrum than either Vodafone or H3G, who already hold 20 MHz each in the 1400 MHz band."*

Common practice in other international jurisdictions

3.132 Recent international 700 MHz auctions have included sub 1GHz spectrum caps. This suggests other regulators have undertaken competition assessments that find there is a material risk of asymmetric shares in low frequency spectrum leading to competition problems.

3.133 First, BT/EE understands that the following competition measures were implemented in the 2018 Italian 5G auction[60]:

Reservation of 2 x 10 MHz of 700 MHz for a "market newcomer" i.e. won by Illiad, and

- Established operators with (2 x) 10 MHz of 900 MHz and (2 x) 10MHz of 800 MHz were only able to bid for up to (2 x) 10 MHz of 700 MHz, i.e., an incremental sub 1-GHz spectrum cap limiting Vodafone and TIM to no more than (2 x) 10 MHz of 700 MHz (which they both won).

3.134 Second, in the 2019 Swiss 5G multi band auction for 700 MHz, 1400 MHz, 2.6 GHz and 3.5 GHz the Federal Office of Communications OFCOM auctioned 2 x 30 MHz for Frequency Division Duplex (FDD), as well as a total of 15 MHz for use as additional downlink channels (ie SDL).[61] ComCom imposed the following spectrum caps:

- a maximum cap of 2x15 MHz FDD spectrum in the 700 MHz band;
- furthermore, a cumulative bidding restriction applies which ensures that two bidders together cannot acquire more than five blocks in category A (i.e. a maximum of 2x25 MHz FDD spectrum in the 700 MHz band), as long as there is at least one other bidder who is interested in a block in this band.
- These restrictions were imposed so that a financially strong bidder can acquire at most half of the frequencies. Assuming there are three bidders, this means that each operator, given a corresponding willingness to pay, has the possibility of acquiring frequencies for a 5G rollout.

3.135 BT/EE is proposing a similar loose safeguard cap in the UK 5G auction.

Competition issues in relation to 3600 MHz band

The risk that other MNOs cannot secure wide contiguous spectrum for 5G carriers

3.136 The 3.4 - 3.8 GHz band is widely recognised to be the band most widely supported for 5G in the first years following launch and is particularly important given that it is TDD spectrum, which allows asymmetric allocation of uplink and downlink resources. It is spectrum for which massive MIMO technology is most effective due to channel reciprocity, and higher order MIMO systems are more readily achieved, which deliver the greatest spectral efficiency.

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[60] http://techblog.comsoc.org/2018/08/08/italys-forthcoming-5g-auction-projected-to-raise-e2-5-billion-with-7-bidders/
https://www.totaltele.com/501168/37-GHz-bidding-nears-3bn-in-Italy-5G-contest

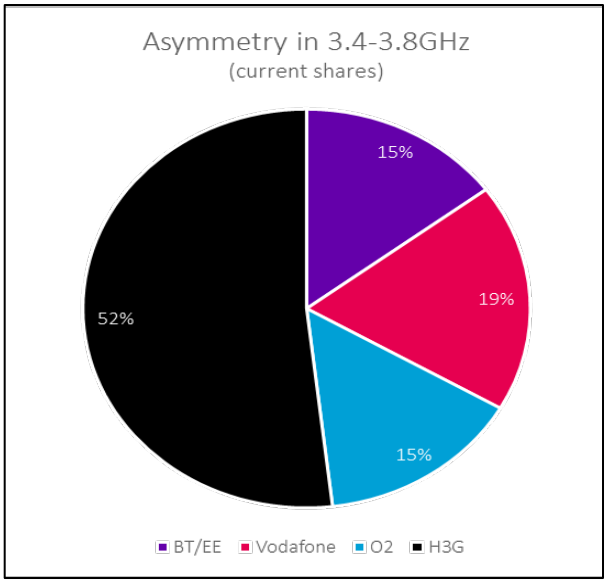
https://www.telegeography.com/products/commsupdate/articles/2018/06/15/another-blow-to-italian-5g-auction-plans/.

[61] https://www.newsd.admin.ch/newsd/message/attachments/55581.pdf

3.137 In order to compete effectively in high bandwidth 5G services both in terms of network costs and capabilities it is important that multiple MNOs can acquire contiguous spectrum at the widest supported 5G NR channel bandwidths. It is important to help ensure multiple operators have sufficient spectrum to deliver ultra-high speed/ultra-high bandwidth services.

3.138 H3G/UKB already holds 140 MHz (36%) of this 3.4-3.8 GHz pioneer 5G band and, uniquely, has access to a contiguous 100 MHz to support the widest 5G NR carrier bandwidth. This follows Ofcom's recent decision to vary their licence, despite concerns from the other three MNOs on the enduring detrimental effects this would have to competition. The Figure 3.7 below illustrates the current asymmetry in holdings of the useable 5G spectrum in the currently assigned 3.410-3.680 GHz band.

Figure 3.7 Current asymmetry in 3.4-3.8 GHz band assignments



3.139 BT/EE notes that by Three's own admission it has more than 2x as much usable 5G spectrum as any other operator.[62] In fact it has approximately 3x that of the other operators. This contrasts with the 37% overall cap that Ofcom noted in a previous consultation was half as much more than what an operator would have if spectrum were distributed equally between 4 operators.

3.140 We believe that Ofcom must consider the risk of strategic bidding by H3G to prevent other competitors from similarly acquiring sufficient new spectrum that supports the widest 5G carriers, or to impede other MNOs achieving this objective by spectrum trading. H3G would need only acquire a small new allocation positioned away from their existing holding to make defragmentation of the band by trading even more problematic than it is already today. By way of illustration consider the outcome in Figure 3.8 below.

[62] "With more than twice as much usable 5G Spectrum as anyone else, the UK's first cloud core network, state of the art data centres and radio technology, our 5G network will be faster than all the rest - see three.co.uk/5G to find out more."

Figure 3.8 Example auction outcome where H3G is eligible to bid for new spectrum

3.141 In this example outcome H3G wins just 5 MHz (perhaps by combining in the CCA with all or some of its 700 MHz bids), likely leaving 5 MHz unsold as there would be little value. Another similar example would be where H3G wins just 10MHz and all spectrum is sold.

3.142 The important point we are illustrating is that Three's small new allocation would be obtained by them at relatively low cost (as it is 1 or 2 lots only) and by their assignment round bidding they will either be located next to their existing spectrum or, more likely given the obvious strategic incentive and inability to use more than 100 MHz on a single carrier, bid to be located so as to prevent others trading existing and new spectrum to secure contiguous assignments. By being located between other operators, this will make exchanges/trades of spectrum to achieve contiguity even more difficult than it is already because of their other assignments, thereby preventing other operators from securing wide contiguous bandwidths as H3G already enjoys today following Ofcom's decision to vary their existing 3.6 GHz licence.

3.143 A further consideration is that even though H3G may have relatively low intrinsic value for the spectrum, it could, depending on the auction design, game the auction to place bids that stand little chance of winning but affect prices of other operators or even the auction outcome itself.

Solutions to address competition concerns specific to the 3.6 - 3.8 GHz band

3.144 We note that Ofcom has recognised the importance of the 3.6 - 3.8 GHz band for 5G capacity but stopped short of imposing competition measures on the basis that other operators than H3G should have greater intrinsic value so that H3G would be unlikely to win all the available spectrum (consultation para 5.222-5.223). We agree that other MNOs should have higher intrinsic value for more 3.4 - 3.6 GHz spectrum, especially noting that the 5GNR technology in this TDD spectrum band can deliver much higher capacity than is possible with equivalent amounts of spectrum in other bands.

3.145 However, the strategic advantage that could arise from H3G securing additional spectrum, limiting the ability of others to achieve wide contiguous bandwidths in the 3.4-3.8 GHz bandwidth is a clear concern that Ofcom needs to address. One solution would be to preclude H3G from bidding for any further spectrum in the 3.4-3.8 GHz band by Ofcom imposing a 140 MHz cap on 3.4 - 3.6 GHz band holdings. This would be greater than the 120 MHz cap imposed in Italy and in our view would be a proportionate measure to address this competition concern.

Competition issues in relation to highly asymmetric overall shares

3.146 BT/EE believes that an overall safeguard cap of 416 MHz (i.e. 37%) on total cumulative spectrum holdings by one MNO is unnecessary. We also find that Ofcom's analysis is internally inconsistent when compared against its assessment in certain spectrum frequency ranges. We set out these inconsistencies earlier in our response in relation to sub-1 GHz spectrum and how asymmetry in spectrum holdings will have an adverse impact on competition because of the importance of capacity indoors to consumers.

3.147 The 37% overall cap also does not recognise the different properties of the various spectrum bands, neither their ability to provide coverage, as illustrated by the much greater value of low frequencies, nor their different abilities to deliver capacity on a per MHz basis. For example the 3.4-3.8 GHz TDD spectrum can more readily support high levels of MIMO and contributes far greater capacity increments than is possible in lower frequencies. If the cap were applied also when mmWave bands are considered, where per operator bandwidths are potentially far larger than those in other lower bands today, the 37% cap becomes increasingly inappropriate.

4 Facilitating 3.4-3.8 GHz band defragmentation

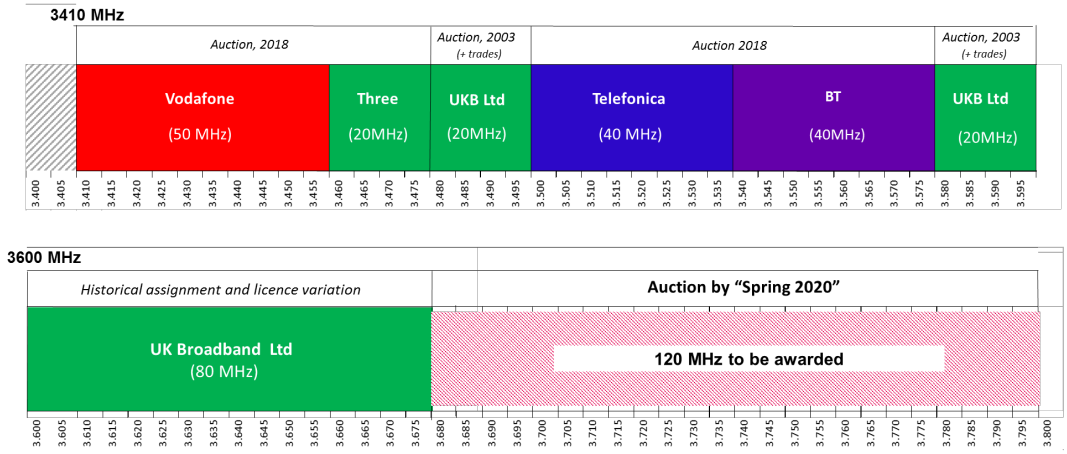
***Question 4**: (Section 6) Do you agree with our proposal to proceed with a conventional assignment stage?*

The auction process must encourage and facilitate band defragmentation

4.1 Contiguous spectrum assignments, commensurate with available 5G NR channel sizes, have significant benefit over fragmented bandwidth assignments to an MNO, in terms of technical efficiency and costs[63]. Ofcom appears to understand this problem, as it has set out in the consultation.

4.2 Considering the present scenario illustrated in Figure 4.1 below, it is apparent that there would be many possibilities as to how combinations of trades of existing and new auction assignments could facilitate defragmentation.

Figure 4.1 Existing MNO assignments and the spectrum to be awarded



4.3 Achieving the objective of defragmented MNO assignments in the 3.4 – 3.8 GHz band is complicated by the existing fragmented assignments to Three/UKB. Also, the different timescales of the 3.4 GHz and 3.6 GHz awards mean that operators will have committed 5G network investments and deployments before all the available 3.4-3.8 GHz spectrum is awarded. Nevertheless, we consider it important that the auction process affords operators the best opportunity to achieve a more efficient assignment of spectrum to maximise the benefits to UK consumers from the use of the 3.4-3.8 GHz band for future 5G services.

4.4 The draft EC Decision for the 3.4-3.8 GHz[64] band sets out in recital 10 that:

> *Taking into account Article 54 of the European Electronic Communications Code, Member States should aim at ensuring a defragmentation of the 3 400-3 800 MHz frequency band so as to provide opportunities to access large portions of contiguous spectrum in line with the goal of gigabit connectivity. This includes facilitating trading and/or leasing of existing rights of use. Large contiguous spectrum portions of preferably*

[63] The exact costs will to a degree depend on the development of equipment standards and their implementation; widely spaced assignments may be particularly problematic.

[64] Commission Implementing Decision of xxx "on amending Decision 2008/411/EC as regards an update of relevant technical conditions applicable to the 3 400-3 800 MHz frequency band", https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=56839

80-100 MHz facilitate the efficient deployment of 5G wireless broadband services, for example using Active Antenna Systems (AAS), with high throughput, high reliability and low latency in line with the policy objective of gigabit connectivity. This objective is of particular importance for a defragmentation.

4.5 We provided suggestions to Ofcom ahead of the consultation as to how the auction process could facilitate and incentivise defragmentation of the band. Ofcom published these alongside the consultation but did not adopt any of the suggestions we put forward, essentially on the basis that Ofcom considers these would require H3G to cooperate but does not think they are incentivised to do so. It is helpful that Ofcom has published our proposals and if interested parties express support for these, or provide alternative ideas to achieve our objectives, we encourage Ofcom to consider these further.

4.6 Spectrum trading could help resolve the fragmentation but, if it occurs at all, it may be difficult as it would ideally require cooperation of multiple parties to achieve the greatest efficiencies and, while most advantageous if agreed before extensive network deployments have taken place, may be inhibited by the rules Ofcom proposes to impose in relation to sharing confidential information in advance of and during the auction as well as the unpredictable outcome of competition assessments Ofcom may undertake before approving trades and the fact that until the new spectrum is awarded it is uncertain what options will become possible.

4.7 We therefore consider it incumbent upon Ofcom to do more than just say that trading can resolve fragmentation. Instead it should be active in facilitating this possibility if there is appetite amongst the key stakeholders for such an approach. BT/EE certainly would give cautious support to such an idea and would be willing to explore such options with Ofcom in greater detail once all the responses to the consultation, and therefore any views of other MNOs on this matter, will be available.

Proposed means to help facilitate defragmentation

4.8 We are open to further discussions with Ofcom as to how the problem of fragmentation of assignments can best be addressed. In our response below we share our current thinking on this matter but our proposals should not be regarded as definitive or inflexible and we are willing to have further dialogue if helpful.

4.9 Although Ofcom has set out some options that it has considered as means to support band defragmentation, it has ultimately proposed to hold a conventional assignment round.

4.10 We do not agree that simply proceeding with a conventional assignment round is the best approach. Of the various options that Ofcom has discussed, we consider the most promising one would be a variant/extension of Ofcom's current Option 2b. That option as currently formulated by Ofcom would allow a period between the Principal stage and the Assignment stage in which commercial trades between the MNOs could be explored and potentially agreed. If that process were successful, the assignment bids that were made before the trading negotiations would be discarded. If it failed the assignment bids would be used to determine where winners of new spectrum are positioned. We will refer to this trading process as the "Grand trading process".

4.11 We suggest a variant to Option 2b as set out below. This would facilitate and improve the likelihood of success of other potential trades as fall-back option if the Grand trading process failed. For example, trades involving fewer operators such as a bilateral trades. We think this would require that Ofcom allows the **new spectrum packages won in the principal stage of**

the auction to be traded ahead of the assignment stage, and that in the assignment stage Ofcom will guarantee that **every winner will have all the newly awarded spectrum allocated to him contiguously** (i.e. the new auction spectrum they had won and any new auction spectrum won by another bidder that is to be traded to them). The standard assignment bidding would then just sort out where the winners of contiguous new spectrum blocks would be located.

4.12 In practical terms, the assignment bids made at the end of the auction principal stage and before the trading discussions could still be used, but with certain necessary adjustments to take into account any trading of winning packages as follows:

a) Ofcom removes assignment options (and associated bids) that are incompatible with every owner of winning packages of the auctioned spectrum (after any trading of winning packages) having a single contiguous assignment of the auctioned spectrum.

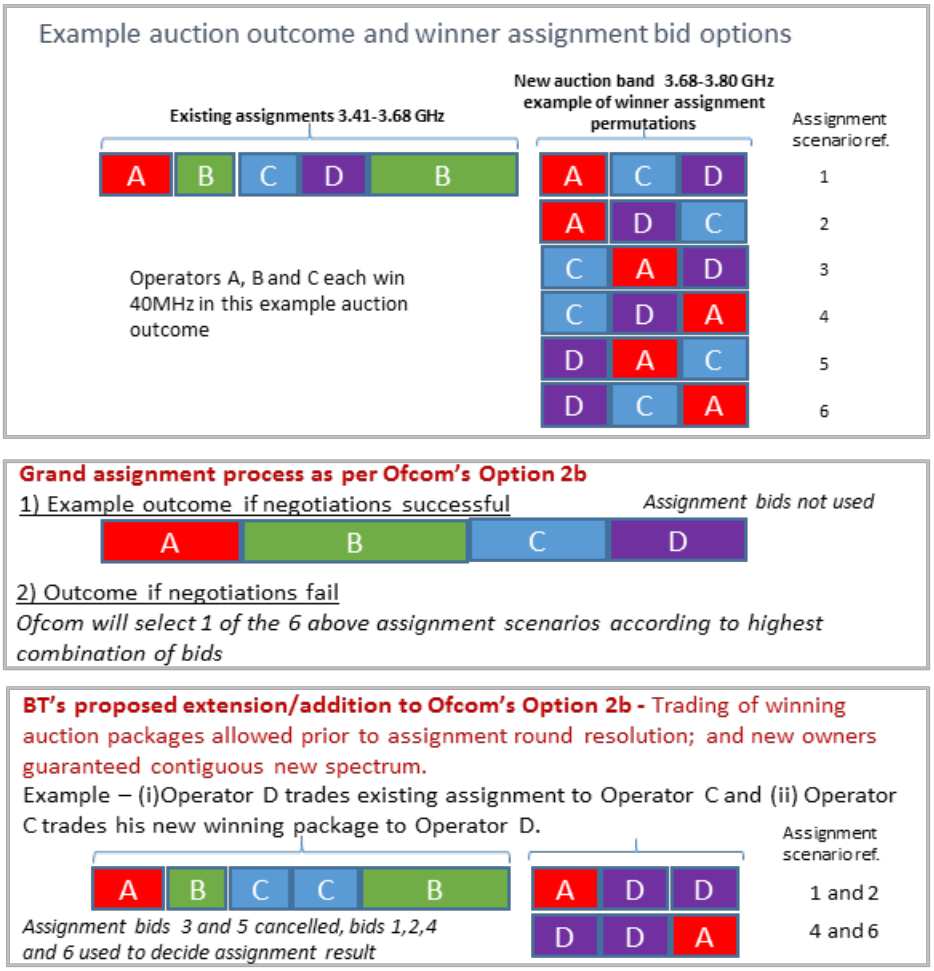
b) Where a winning package(s) owner (after any trading of winning packages) had submitted an assignment round bid for his previously won package that bid for that assignment location will remain valid, but any assignment bid made by the previous owner of a winning package acquired by any trade which will now be made contiguous with the new owners original winning package would be reduced to zero. If the new owner had assignment bids for different slots within its potential final assignment location then the higher of these bids would be considered in deciding the final winning assignments of new spectrum post trades.

c) Where a winning package owner (after any trading of winning packages) was not previously a winner of a package it would have no assignment bids to be considered.

4.13 In effect this alternative proposal would facilitate any trades based two operators who win "new" (3.6 - 3.8 GHz) spectrum and also hold "old" (3.4 - 3.6 GHz) spectrum being able to confidently agree mutual trades so that one operator consolidates in the old spectrum and one operator in contiguous new spectrum.

4.14 The Figure 4.2 below illustrates how the existing Option 2b and its variant/extension would work in one practical example. Other examples could of course be envisaged, including more complex combinations of trades involving both existing assignments and newly won spectrum packages, but the same principle would remain valid and applicable.

Figure 4.2 Illustration of Grand trading process and its adaptation to include other trading



A simpler alternative?

4.15 The above variant/extension of Ofcom's Option 2b is obviously rather complex. We have therefore considered whether there might be some simpler alternative that might still meet Ofcom's objectives.

4.16 One much simpler option that we believe might have merit would be not to hold an assignment round at all, but rather for Ofcom to announce before the start of bidding in the primary stage (or possibly later) the order in which new frequencies will be assigned to bidders, and for that ordering to prevail to the extent that it is not altered by any agreement between winning bidders entered into between the end of the primary stage and the assignment stage.

4.17 So, for example, Ofcom could announce before the start of the first primary bid round that any new frequencies to be assigned to Operator A would be assigned from the bottom of the new frequency range, any new frequencies to be assigned to Operator B would be assigned immediately above those, and so on, listing all bidders qualified to bid in the auction in turn.

4.18 BT does not at the current time have a specific proposal as to the most appropriate ordering of the assignment of frequencies to the likely bidders in the auction, but intends to give this further consideration, and would hope to have the opportunity to discuss this further with Ofcom in due course.

Ofcom could incentivise trading using ALFs for Three's existing spectrum

4.19 Ofcom rejected BT's suggestions prior to the consultation launch that set out options to facilitate defragmentation as part of the auction, on the basis mainly that H3G would be unlikely to have incentive to engage. We have given further thought to how Ofcom could incentivise Three's participation in a process to resolve band fragmentation as part of the auction should that be mutually beneficial to all operators given their circumstances at the time of the auction and the outcome of the principal stage of the auction.

4.20 It appears to us that one relevant matter is the ALFs attaching to the existing 3.4 GHz spectrum held by Three. According to Ofcom's recent consultation proposals on this matter these are to be based on consideration of opportunity costs and full market value.

4.21 Ofcom has noted in the present consultation that the benefits of contiguous spectrum compared to non-contiguous spectrum could be a capacity gain of c. 2-15%[65]. We therefore suggest it would be consistent with Ofcom's duties to promote optimal and efficient use of spectrum if Ofcom were to recognise that the fragmentation caused by Three's assignments has an element of opportunity cost beyond that reflected in the 3.4 GHz auction prices.

4.22 Ofcom could potentially use ALF's to incentivise band defragmentation given the long-term efficiencies that it could generate, for example by committing to review these ALFs post the 3.6 GHz auction if trading has occurred. This would be justified on the basis that lower 3.6 GHz prices might not then be due to the effect of fragmentation but because of genuine lower value of incremental 5G spectrum beyond that needed for initial operator launches that could have driven the 3.4 GHz auction prices.

Other countries have allowed assignment negotiations

4.23 We see advantage in avoiding resorting to bidding in an assignment round that may require some winners to pay additional sums to Ofcom and note there is international precedents for this. Time-limited negotiation between winning bidders has been used following 'allocation stages' to determine assignment positions in spectrum auctions in Germany. A similar approach is planned for the upcoming Belgian multiband spectrum auction.

4.24 The German 2010 auction of 800 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz spectrum included 'abstract' (frequency-generic) and 'concrete' (frequency-specific) lots. Following the allocation stage of the auction, winners of abstract lots that already owned existing holdings in a band were automatically assigned new spectrum adjacent to their existing holdings[66]. Bidders were then given three months to negotiate among themselves the respective positions of the remaining abstract lots within each band. If after three months a decision was not reached, the German regulator (BNetzA) reserved the right to determine the position of bidders within each band using a random draw.

4.25 In the German 2015 auction (700 MHz, 900 MHz, 1500 MHz and 1800 MHz), a similar process was followed, the only difference being that winning bidders were given 10 working days to negotiate.

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[65] Consultation para 5.258

[66] A similar process occurred for the winner of the concrete lot in the 800 MHz band. If this bidder also acquired abstract lots in this band, these would be positioned adjacent to the concrete lot (at the bottom of the band)

4.26 The upcoming auction of 2.1GHz and 3.4-3.7GHz spectrum in Germany (scheduled for March 2019) will again include a similar negotiation process to determine positions with each band. This time winning bidders will be given one month to agree. Again, winners of both abstract and concrete lots within a band will be directly assigned adjacent frequencies prior to the negotiation process (in this case, this is only relevant in the 3.4-3.7GHz band, as there are no concrete lots in the 2.1 GHz band).

4.27 In Belgium, the winners of the upcoming multi-band auction (scheduled for 2019 or 2020) will also be given a period of negotiation to agree their assignment positions. The duration of the negotiation period will be determined by the regulator (BIPT). If an agreement is not reached, assignment positions for each band will be determined by a series of auctions, each of which will use a combinatorial, first-price format.

5 Auction design

***Question 5**: (Section 7) Do you agree with our proposal to use a CCA design for this award?*

***Question 6**: (Section 7) Do you have any comments on the proposed detailed rules for our CCA design?*

Introduction

5.1 Ofcom itself acknowledges that there is no 'one size fits all' auction design that is appropriate for all spectrum awards. The specific spectrum (and obligations) to be awarded, and the circumstances of each award, need to be carefully considered in order to identify the auction format and specific auction rules that are best suited to the situation in each case. Moreover, in BT's view at least, in deciding on the best auction format and rules to be used for a particular award, it is essential to look at the details of each specific issue when deciding how best to address that issue; it is not sufficient to simply characterise the issues affecting an award in general terms – such as 'aggregation risk' – and then rely on generalised conclusions about different auction designs to choose between them – such as that 'the CCA is better than the SMRA at mitigating aggregation risk'.

5.2 With those thoughts in mind, we have structured this section of our response as follows:

- We first set out certain key characteristics of the spectrum and coverage obligations that Ofcom proposes to award that need to be taken into consideration when deciding on the appropriate auction format and rules to be used in this case.
- We next consider the appropriate packaging of the available spectrum and associated eligibility points.
- We then consider Ofcom's proposed approach to the award of stand-alone coverage obligations, including the proposed positive price constraint, highlight some concerns and suggest some possible improvements (from an auction design perspective).
- We next put forward an alternative proposition for the format and rules of a suitable auction (an SMRA).
- We then set out our own comparison of the merits of the SMRA and CCA formats in the specific circumstances of this award – concluding that a suitably designed SMRA would be significantly better than the CCA currently proposed by Ofcom.
- Finally we comment on certain specific details of Ofcom's proposals for a CCA, in case Ofcom decides to continue with that format.

Specifics of this award: complements, substitutes and minimum spectrum requirements

5.3 To help inform decisions about auction format and rules, we first set out our thoughts on the degree to which the bands and coverage obligations to be awarded are complements and/or substitutes, and any minimum spectrum requirements. In BT's view:

- ✂[redacted].
- ✂[redacted].

- ✂[redacted].
- ✂[redacted].
- ✂[redacted]
- ✂[redacted].
- ✂[redacted].
- ✂[redacted].
- ✂[redacted].
- ✂[redacted].
- ✂[redacted].
- ✂[redacted].

5.4 Having identified these important characteristics of the spectrum and coverage obligations that Ofcom proposes to award, we now consider the implications of these characteristics for the appropriate design of an auction in the specific circumstances of this award.

Packaging and eligibility

Packaging

5.5 As regards the packaging of the available spectrum, BT's views are as follows:

700 MHz FDD BT agrees with Ofcom's proposal for six lots of 2 × 5 MHz (but notes that bidders may have a requirement for a minimum of two lots).

700 MHz SDL BT proposes two lots of 10 MHz rather than four lots of 5 MHz – it will only make sense to deploy this spectrum if an operator has at least 10 MHz (and if an operator were to want 15 MHz then they might as well have all 20 MHz since no one else is going to want the remaining 5 MHz).

3.6 - 3.8 GHz BT proposes 12 lots of 10MHz rather than 24 lots of 5 MHz – noting that standardised 5G carriers in this band are all multiples of 10 MHz (with the sole exception of a 15 MHz carrier) and hence there is little point in allocating an odd multiple of 5 MHz.

Eligibility points

5.6 Eligibility points need to strike a balance between reflecting the relative value of different lots whilst at the same time allowing reasonable switching opportunities (but ideally precluding undesirable strategic switching behaviour such as the 'parking' of demand). BT is broadly in agreement with Ofcom's proposal in this regard (when adjusted to reflect our proposed revisions to spectrum packaging), but believes the ratio of eligibility points between 700 MHz and 3.6 - 3.8 GHz spectrum should be higher as follows:

Table 5.1 Eligibility points proposal

Lot type	Ofcom proposal (adjusted for revised lot sizes)	BT proposal
700 MHz FDD (2 × 5 MHz)	4	4
700 MHz DSL (10 MHz)	2	2
3.6 - 3.8 GHz (10 MHz)	2	1

5.7 This proposal would allow switching between one 2×5MHz lot of 700 MHz FDD and the two 10 MHz lots of 700 MHz SDL (in both directions). It would not allow switching from one 10MHz

lot of 700 MHz SDL into one 2 × 5 MHz lot of 700 MHz FDD; we do not believe such switching to be necessary or desirable as we consider the value per MHz of 700 MHz SDL spectrum to be materially lower than that of 700 MHz FDD spectrum, and allowing such switching could facilitate undesirable bidding behaviour, for example 'parking' of demand on the 700 MHz SDL spectrum.

5.8 Our proposal would allow switching between one 2 ×5MHz lot of 700 MHz FDD (10 MHz in total) and four 10 MHz lots of 3.6 - 3.8 GHz spectrum (40 MHz in total) – which we consider to be a better reflection of the relative values of spectrum in these two bands than Ofcom's proposal[67].

5.9 BT is minded to agree with Ofcom's proposal that the coverage obligation lots should not have any eligibility points attached to them, but notes that ✂[redacted].

Stand-alone coverage obligations and positive price constraint

5.10 In this sub-section we address the following issues:

- The impact of Ofcom's proposed coverage obligations on the value of different outcomes and hence the appropriate selection of winning bids
- The potential for the positive price constraint to lead to an inefficient allocation of spectrum
- Some possible alternative funding options and the choice between simultaneous and sequential awards.

Inappropriate to use total bid amount to rank outcomes when social benefits of coverage obligations are not the same for all bidders

5.11 One unusual feature of Ofcom's proposed coverage obligations is that the outcome for consumers and society will differ significantly depending upon which bidders are assigned the two coverage obligation lots. For example, in the case of BT a high proportion of the premises that BT would have to cover to meet the premises coverage obligation will be premises that do not currently have coverage from any operator. Similarly, a high proportion of the new sites that BT would have to occupy will be sites in locations where no site currently exists. By contrast, in the case of those operators with relatively poor existing coverage, many of the premises that they will need to cover to meet the premises coverage obligation will already have coverage from another operator (for example BT), and many of the 'new' sites they will need to occupy will be in areas where other operators already have sites. BT contends that the societal benefits of these two outcomes will therefore not be the same.

5.12 In these circumstances, BT further contends that it would not be appropriate for Ofcom to use the total amount bid (including reserve prices for unsold lots) as the measure of the 'value' of an outcome when deciding between outcomes – in these circumstances the total amount bid will not be a good proxy for total value (taking external societal value into account). Ofcom

[67] There might even be an argument for this ratio to be even higher e.g. 8:1, but that would effectively preclude almost any switching between the two bands.

will need to assess the specific value to society that will be delivered as a result of each individual operator being assigned a coverage obligation lot, and include this in its assessment of total value for the purpose of deciding between outcomes (and hence determining the winning bids).

5.13 In BT's view, Ofcom can only avoid this additional complexity by re-specifying the coverage obligations in a way that delivers the same benefits to society irrespective of which operator is assigned each coverage obligation lot i.e. to revert to coverage obligations specified in absolute rather than relative terms.

Positive price constraint could lead to an inefficient allocation of spectrum

5.14 Linking coverage (or other) obligations to spectrum in an award, whether attaching those obligations directly to certain spectrum lots or auctioning those obligations stand-alone but with a positive price constraint, has the potential to lead to an inefficient outcome if acquisition of the associated spectrum is not an essential prerequisite to the delivery of the obligations or gives rise to a significant reduction in the cost of meeting the obligations.

5.15 Consider for example a scenario in which the operator that can deliver the obligations most efficiently (at least cost) has no need for (and hence no intrinsic value for) any of the spectrum that is being awarded. That operator is either not going to take part in the competition for the delivery of the obligations – in which case the obligations are not going to be delivered as efficiently as possible – or may take part in the competition by bidding for spectrum that it doesn't really need, and potentially winning some of it – thereby denying that spectrum (in the first instance) to others that could make better use of it.

5.16 More generally, if the efficient outcome in the absence of the positive price constraint would be that one or more winners of the coverage obligation lots would have a negative net price, the effect of the positive price constraint will be to reduce the marginal price of additional spectrum to those bidders by the amount of their negative net price. BT's concern is that those bidders may then win additional spectrum, as a result of that lower marginal price, that it would be more efficient for another bidder to win, resulting in an inefficient allocation of the available spectrum.

5.17 For example, a bidder for whom the net price of their efficient allocation of spectrum plus a coverage obligation lot is -£100m can afford to bid £200m for an extra spectrum lot that is actually worth only £100m to them, since they will in practice only have to pay £100m more at most if they win the extra lot. In doing so they may win that additional spectrum lot in preference to another bidder whose marginal value for that lot is for example £150m. If this happens there will have been a loss in total value of £50m, and the resulting spectrum allocation will be inefficient.

5.18 In some circumstances it might be possible for this inefficiency to be corrected through the secondary market – for example by the inefficient winner of the additional spectrum subsequently selling that spectrum to the bidder that was precluded from winning it by the former bidder's distorted bidding behaviour. In other circumstances however this may not be possible (or at least not as straight-forward); for example if the losing bidder failed to obtain their minimum spectrum requirement as a result of the bidding distortion and consequently required more than just the marginal spectrum that was inefficiently acquired by the bidder winning the coverage obligation.

5.19 A further potentially distortionary effect of Ofcom's proposals may arise in the case that one or more bidders faces a hard budget constraint. In this case a bidder with a hard budget constraint that has a lower cost of meeting the coverage obligations may be able to bid for and win more spectrum than a bidder with a similar budget constraint that has a higher cost of meeting the coverage obligations, notwithstanding that the second bidder may have a higher value for the additional spectrum. The potential distortion in this case is not caused by the positive price constraint, but rather by the asymmetry of the benefit of a lump sum price discount to bidders with materially different costs of capital[68].

5.20 For the avoidance of doubt, BT therefore does not agree with Ofcom's view that one benefit of holding a simultaneous auction, as compared with sequential auctions, would be that budget constrained bidders would be able to bid for more spectrum if they could simultaneously bid for a coverage obligation lot. In BT's view this has as much chance of leading to an inefficient outcome as it has of leading to a more efficient one.

5.21 Indeed, as we discuss further in the following sub-section, BT does not believe there would be any need, absent the positive price constraint, to award coverage obligation lots simultaneously with the spectrum.

5.22 In the next sub-section we discuss some alternative funding models that Ofcom might be able to employ to reduce or eliminate these potential distortions.

Alternative funding options and simultaneous vs sequential awards

5.23 In light of BT's concerns about Ofcom's specific proposals for the inclusion of stand-alone coverage obligation lots in a combined auction for the award of 700 MHz and 3.6 - 3.8 GHz spectrum, and in particular the potentially adverse effects of the positive price constraint, BT has considered other potential routes to the funding of such obligations.

5.24 One potential alternative funding option in particular would be for Ofcom to make use of the power it has to make grants to promote efficient use of spectrum or efficient management thereof, under s1(5) of the Act, as it has in the past (e.g. Filton radar in 800 MHz, PMSE clearance of 700 MHz). Ofcom could for example use those powers to subsidise the delivery of additional coverage by one or more operators, noting that it seems clear, in Ofcom's eyes at least, that the delivery of that additional coverage would constitute efficient use of spectrum, and that absent public funding that efficient use of spectrum would not occur (i.e. the funding would be to promote efficient use of spectrum). Such payments could in particular be made in response to the achievement of certain pre-specified coverage targets, rather than as a single lump sum – Ofcom could for example set out a number of interim and final deliverables that

[68] It might be thought that a similar argument should apply in the case of coverage obligations attached to one or more spectrum lots, and indeed it should in the case where there is no synergy between the relevant spectrum and the coverage obligations. Where however there is a material synergy between the spectrum and the coverage obligations, for example where the ability to deliver the coverage obligations at reasonable cost (or at all) is dependent on acquisition of a certain minimum amount of the relevant spectrum, and that is true for all operators, there is less likely to be a material distortion as a result of this effect – albeit there still might be alternative ways of funding such obligations that would be even less distortionary.

each licensee with coverage obligations must meet, with payment of spectrum efficiency grants linked to the achievement of those deliverables.[69]

5.25 In this case, Ofcom could award the right to receive such spectrum efficiency grants through either a stand-alone award process (e.g. a spectrum efficiency grant auction), or as part of a combined spectrum and spectrum efficiency grants auction (effectively as currently proposed). The key difference from Ofcom's current proposals however would be that bidders would be bidding a positive amount for the available spectrum efficiency grant lots, and hence there would be no need for the positive price constraint. (Moreover, Ofcom would not be making any lump sum payment to the winners of the spectrum efficiency grant lots, and hence there would be no distortion of bidding through that mechanism either).

5.26 In this case however there seems little need to hold a combined award of spectrum and spectrum efficiency grants (other than perhaps for administrative convenience – but with the consequent impact of a more complex auction). Sequential awards, in which the spectrum was awarded first and the right to spectrum efficiency grants awarded afterwards, would also seem to be both entirely practical and appropriate.

Specific risk of price driving behaviour if Ofcom uses a CCA for this auction

✂[redacted]

5.27 ✂[redacted]

5.28 ✂[redacted].

5.29 ✂[redacted].

[69] A second potential alternative funding mechanism identified by BT would be for Ofcom to refund some or all of a bidder's licence fee payment on the achievement of predefined coverage obligation targets, as permitted under s12(3)(b) of the WT Act 2006 (as allowed by s14(3)(i)). In this case however the positive price constraint would in effect still be in force – since Ofcom could not refund more than had originally been paid – but this option would at least get rid of the potential bidding distortion arising from the lump sum nature of the discount offered to the winners of the coverage obligation lots currently proposed by Ofcom.

5.30 ✂[redacted].

5.31 ✂[redacted]

[70]

5.32 ✂[redacted].

5.33 This behaviour has been observed in a number of previous CCAs.

Alternative proposition – an SMRA

5.34 In light of BT's assessment of the specific circumstances of this award (even with the inclusion of stand-alone coverage obligation lots), BT believes that it should be possible to design a relatively simple SMRA auction that allows bidders to manage the key risks that they face in this award, is considerably less complex and risky for bidders than the CCA format proposed by Ofcom, and is just as likely to lead to an efficient outcome as the CCA format proposed by Ofcom. In this section we outline what we believe would be a suitable SMRA auction format.

- Our starting point is the SMRA auction format that Ofcom used in its recent auction of the 2.3GHz and 3.5GHz spectrum[71].
- As in that auction, we would include the option for each bidder to specify a minimum spectrum requirement of up to 2 × 10 MHz (2 lots) of 700 MHz FDD spectrum.
- Similarly we would include the option for each bidder to specify a minimum spectrum requirement of up to 20 MHz (2 lots) of 3.7 GHz spectrum (but not more, as that would have the potential to create strategic risks for both Ofcom and bidders).

[70] ✂[redacted] [71] Another potential starting point would be the simple clock auction with retained demand format, successfully used by regulators in a number of other countries (e.g. Singapore).

[71] Another potential starting point would be the simple clock auction with retained demand format, successfully used by regulators in a number of other countries (e.g. Singapore).

- We propose that, if a bidder that has specified a minimum spectrum requirement of 2 lots of 700 MHz FDD spectrum is standing high bidder on only 1 lot of that spectrum at the start of any round (which can only apply to one bidder if Ofcom follows the same rules as in the 2.3 GHz and 3.5 GHz auction), that bidder has the option of withdrawing from that lot without penalty in that round.
- We propose that such a bidder should have the option to bid for alternative lots in that same round (up to the limit of its eligibility), but also to have the option of not submitting sufficient bids to maintain its eligibility (with no penalty).
- We propose further that a bidder in that situation at the end of the principal stage should not be awarded any 700 MHz FDD spectrum, and should not be required to make any payment in respect of their single standing high bid for 700 MHz FDD spectrum (i.e. no penalty) – as per Ofcom's rules for the 2.3 GHz and 3.5 GHz auction.
- We propose that similar rules should apply in respect of any minimum spectrum requirement in the 3.7GHz band.
- Likewise, if a bidder is standing high bidder on a coverage obligation lot at the start of a round but its net bid is negative, and moreover its net bid at the end of the round would still be negative even if all of its bids in that round were to become standing high bids, we propose that that bidder should have the option of withdrawing its standing high bid for that coverage obligation lot in that round without penalty (but not have the option to bid for alternative lots since we agree with Ofcom's proposal that the coverage obligation lots have zero eligibility points associated with them).
- Similarly, we propose that any bidder whose net bid is negative at the end of the principal stage should have the option of withdrawing its winning bid for a coverage obligation lot without penalty (in which case its base price should be the total of its other winning bids), but should also have the option of retaining that winning bid and paying only the minimum positive total bid amount specified by Ofcom (e.g. £1000).
- For the avoidance of doubt we currently consider that it would be unnecessary to include any more general withdrawal, augmented switching, waiver or phased activity rules.
- One further option might be for Ofcom to hold a 'supplementary stage' if any lots are unsold at the end of the 'principal stage', in which those unsold lots (but only those unsold lots) are auctioned (probably using a very simple auction format, such as simple clock for each individual lot).

5.35 If Ofcom remains concerned about the risk that one or more of the coverage obligation lots would remain unsold under these rules, it might wish to consider the following alternative set of rules:

5.36 Bidding for spectrum lots to be as described above.

5.37 In each round each bidder may, in addition, submit a bid for a coverage obligation lot.

5.38 Once a bidder has submitted a coverage obligation bid that bid remains 'in play' until either the bidder submits a higher coverage obligation bid or the auction ends.

5.39 Each coverage obligation bid is 'live' whenever the combination of that coverage obligation bid and that bidder's SHBs for spectrum meet the positive price constraint[72].

5.40 Bidders to be told something about the amount and status of all coverage obligation bids at the end of each round (so that each bidder can assess their likelihood of winning a coverage obligation lot and increase their bid if they wish).

5.41 The two highest live coverage obligation bids at the end of the final round are the winning coverage obligation bids and the winning bidders 'pay the amount bid' (if there are fewer than two live bids at the end of the final round then there are fewer winning bids – possibility for Ofcom to hold a supplementary auction to award the unsold coverage obligation lots alongside any unsold spectrum lots as before).

5.42 This refined set of rules has the following important features and advantages:

5.43 Bidders for coverage obligation lots are guaranteed that they will not have to accept a coverage obligation lot if they win insufficient spectrum to have a positive net price[73].

5.44 Each bidder can set their own price for accepting a coverage obligation lot – they cannot be priced out of the competition to win a coverage obligation lot prior to the end of the auction.

5.45 Given these features of the rules, there seems to us little if any reason why those bidders that have a positive value for accepting a coverage obligation lot at the reserve price would not bid for one, once the price of spectrum has got to a level where their net price would be positive – which might even be the first round of the auction if the reserve price of e.g. 2 x 10 MHz of 700 MHz spectrum were higher than the reserve price for a coverage obligation lot.

5.46 If all such bidders were indeed to do this (and assuming that there were at least two such bidders), the only circumstance in which Ofcom would not be able to assign both coverage obligation lots would be if fewer than two of those bidders were able to secure enough spectrum to satisfy the positive price constraint at the end of the auction.

5.47 This refined set of SMRA rules therefore seems to us to be highly likely to meet Ofcom's objectives for this award.

5.48 Our following evaluation of the merits and risks of the SMRA vs CCA auction formats is therefore based on this specific SMRA auction proposal.

SMRA vs CCA

5.49 In this section we evaluate the relative merits and risks of the SMRA and CCA auction formats, taking into account the specific circumstances of this award, and the specific SMRA auction format that we have proposed. The headings under which we compare the SMRA and CCA auction formats are as follows:

- Aggregation risk

[72] A possible refinement would be to replace this rule by one in which a coverage obligation bid is 'live' whenever the combination of that bid and that bidder's SHBs for spectrum are in total no less than the total of that bidder's bids (including SHBs) in the round when it submitted the coverage obligation bid if that total was negative, otherwise zero.

[73] Or with the previously footnoted refinement, a net price that is more negative than they have indicated that they are willing to accept.

- Substitution risk
- Strategic demand reduction
- Tacit collusion
- Price driving
- Straight-forward bidding
- Complexity
- Budget constraints.

5.50 In summary, in BT's view Ofcom underplays the advantages, and overplays the disadvantages of the SMRA auction format as compared with the CCA format, in the context of this specific award, in part because in BT's view Ofcom's analysis is too hypothetical – it does not consider sufficiently the specific circumstances of this particular award.

Table 5.2 Supposed problems with an SMRA

Ofcom concern	BT's analysis of the specific circumstances of this award
Aggregation risk	The specific aggregation risks that we have identified as potentially applying in the specific circumstances of this award are as follows: • Aggregation risk arising from low value for odd multiples of 5 MHz of 3.6 - 3.8 GHz spectrum can be addressed by using a lot size of 10 MHz • Aggregation risk arising from having a low value for just 2 × 5 MHz of 700 MHz spectrum (as compared with 2×10 MHz) can be addressed by giving bidders the option of specifying a minimum spectrum requirement and to have the option to withdraw a standing high bid for less than their specified minimum spectrum requirement • Similarly, any aggregation risk arising from having a low value for just 10 MHz of 3.6 - 3.8 GHz spectrum can be addressed in the same way • As Ofcom itself identifies, we do not believe there are any strong synergies between 700 MHz and 3.6 - 3.8 GHz spectrum that would create an aggregation risk between the two bands that Ofcom would need to address through its auction design • Aggregation risk arising from positive price constraint associated with coverage obligation lots can be addressed by allowing bidders to withdraw bids for coverage obligation lots if their net price is negative[74] • Do not see any strong need to win specific spectrum in order to be able to meet Ofcom's proposed coverage obligations and therefore do not see any significant aggregation risk in this regard

[74] Or have coverage obligation bids be 'live' only if the positive price constraint is met

Substitution risk	• Unlikely that bidders will want to switch between 700 MHz and 3.6 - 3.8 GHz given that these are not close substitutes • Possibility that bidders will want to switch between 700 MHz FDD and 700 MHz SDL, but if 700 MHz SDL spectrum is packaged as two 10MHz lots with the same eligibility points in total as one lot of 700 MHz FDD, then there is no barrier to switching between the two sub-bands • No issue with switching between spectrum with and without coverage obligations attached given that Ofcom is now proposing stand-alone coverage obligation lots.
Strategic demand reduction	• Ofcom should only be concerned about strategic demand reduction to the extent that it might lead to an inefficient outcome, not lower revenues • Ofcom should be equally (if not more) concerned about risk (almost certainty) of price-driving with a CCA • Even if strategic demand reduction does lead to a less than optimal allocation of spectrum, if the difference in value is material (which is the only case the Ofcom should be concerned about) there will be a strong incentive for a post-auction trade of spectrum between the bidders to 'correct' the anomaly • Note also that unilateral strategic demand reduction only works if there is a low-priced stable outcome absent the additional demand. Not at all clear that that is the case here – no clear 'equitable' allocation of the 700 MHz spectrum among the four operators that would be the outcome if any one of them individually (or collectively) engaged in strategic demand reduction; and ✂[redacted]
Tacit collusion (to reduce demand)	• Tacit collusion to reduce demand for spectrum is NOT market division. Spectrum is not a market, it is an input. As Ofcom itself has repeatedly said, there is no direct link between spectrum holdings and market share. If there were to be any tacit collusion to reduce demand (which BT does not accept would be the case here) it would be to reduce the price of spectrum, not to divide up any market • In essence therefore this is the same concern as the previous concern re strategic demand reduction and our previous comments in that regard apply equally here • That said, recognising Ofcom's concerns in this regard, BT would have no objection to rules in an SMRA to limit the risks of tacit collusion – for example requiring 100% activity throughout the auction and not allowing waivers.

Table 5.3 Problems with the proposed CCA format

BT believes that the principal problems with the CCA format in the context of this award are as follows:

Relevant concern	BT's analysis of the specific circumstances of this award
Unnecessarily complex	• Only real aggregation risks in this award relate to potential minimum spectrum requirements in the 700 MHz FDD and 3.6 - 3.8 GHz bands which can be addressed through the use of minimum spectrum requirement provisions in an SMRA – there is no material aggregation risk between spectrum bands • Ofcom has created an artificial aggregation risk between its proposed coverage obligation lots and spectrum lots by proposing a positive price constraint; this could either be eliminated through the use of a different funding mechanism for coverage obligations, or could be addressed quite simply in an SMRA through a simple withdrawal option in the case of a negative net price[75] • The only real substitution risk in this award is likely to be between 700 MHz FDD and 700 MHz SDL spectrum, which BT believes to be an entirely manageable risk in an SMRA auction with appropriate eligibility point allocations.
Significant uncertainty over outcome	• Ofcom correctly identifies a number of respects in which the outcome of a CCA is unpredictable, and the fact that unlike in an SMRA there is no opportunity for a bidder to bid again if the outcome is not what it expected – leading to potential regret and dissatisfaction with the outcome of the process • This situation will moreover be significantly exacerbated if Ofcom decides to adopt the information obfuscation policy it has proposed, given that this will make it even harder for bidders to be sure about the likely outcome of the auction as it develops • As Ofcom correctly identifies this uncertainty also has the potential to lead to what may appear to some to be irrational behaviour – but it may not be irrational to the bidder at the time, who may think that by bidding in the way that they do they are reducing the risk of what for them would be an unacceptable outcome, even if by doing so they are not maximising their chances of winning their most preferred outcome – the combination of uncertainty and risk aversion may indeed change the outcome of the auction • As Ofcom itself identifies, these issues do not arise in the context of an SMRA, certainly not to the same degree, since each bidder can be sure of not only what they stand to win at the start of each round, but also how

[75] Or have coverage obligation bids be 'live' only if the positive price constraint is met

	much they will have to pay if the current round were to be the end of the auction.
Significant governance challenge for all bidders	• The CCA format creates significant governance challenges for all bidders, not just those with a budget constraint, and they do not arise solely from the use of a second price rule • The CCA format is very complex (and even more so if the relaxed activity rule and final price cap are included) making it extremely difficult for senior management to understand and properly engage with – and engage they must as a straight-forward bidding strategy may well not be the best option in all circumstances • Bidding in the supplementary round can be particularly challenging, requiring as it does a bidder to submit a potentially large number of bids – simply coming up with a reliable estimate of the value of each of a such large number of spectrum packages is, for example, extremely challenging, if not impossible • The potentially high level of uncertainty over the likely outcome of the auction can also be extremely challenging for a company's senior management and has the potential to engender irrational behaviour in an attempt to avoid particularly bad outcomes (even if those outcomes are in practice relatively unlikely).
High likelihood of non-straight forward bidding	• Strong incentive (almost necessity) to deviate from straightforward bidding given risk of price-driving behaviour by competitors.

5.51 Given the above, a suitably designed SMRA auction, using for example the refined set of rules that we presented earlier, will be just as likely, if not more likely, to lead to an outcome that is in line with Ofcom's objectives for this award, including in particular the assignment of coverage obligation lots, as would Ofcom's proposed CCA, and the risks, for both bidders and Ofcom, will be significantly lower.

BT position on specific CCA design issues if Ofcom retains CCA format

5.52 In this section we comment on Ofcom's specific CCA design proposals, in case Ofcom decides to retain this format despite BT's arguments to the contrary.

Relative price cap

5.53 If Ofcom persists with its proposal to use a CCA, BT agrees with Ofcom's proposal to impose a relative price cap with constraints arising only from eligibility reducing bids.

Relaxed activity rule and Final price cap

5.54 BT does not agree with Ofcom's proposal to make use of a relaxed activity rule and final price cap.

5.55 We first note that these two rules are closely related – you can't have a final price cap without a relaxed activity rule, and without the final price cap there is no particular incentive for bidders to make use of the relaxed activity rule. The problem with these rules is that they significantly increase the complexity of the auction – we note in particular the potential need for a bidder to submit multiple bids in a round if they make use of the relaxed activity rule: a principal bid and one or more chain bids. An important question therefore is whether this additional complexity is justified.

5.56 The objective of these rules is to increase the chances that the final auction outcome is similar, if not identical to the outcome at the end of the final clock round, so that bidders can have greater confidence as to the outcome of the auction going into the supplementary bids round. However, Ofcom is also (rightly) concerned about the potential for bidders to make strategic, in particular price-driving bids in the supplementary bids round (see discussion above). Ofcom is therefore proposing not to release any information about aggregate demand after the final clock round. This proposed information policy is therefore directly at odds with the stated purpose of the relaxed activity rule and final price cap. Ofcom is furthermore proposing to obfuscate aggregate demand information following every other round of the auction (by reporting excess demand only in units of 20 MHz), again reducing bidder's certainty about the situation in the auction.

5.57 Given that Ofcom is proposing to deliberately obfuscate the information that it provides to bidders about the situation in the auction, it seems odd that it is simultaneously proposing to use a set of very complicated rules intended to give bidders greater certainty about the outcome of the auction.

5.58 We recognise the dilemma that Ofcom faces in this regard, but believe the correct solution in this specific case (given the balance of issues and risks) is for Ofcom to use a different auction format, rather than to try to mitigate the risks with the CCA format through the use of a mixture of complicated rules and information obfuscation.

Information policy

5.59 In BT's view, Ofcom's proposed information policy undermines a material part of the value of holding a multi-round auction. BT believes that whilst Ofcom is right to be concerned about the risk of price-driving in a CCA the right answer to this in the specific circumstances of this spectrum award is to use a different auction format, rather than to try to mitigate the risks with the CCA format through a policy of deliberate information obfuscation.

5.60 As previously noted, if Ofcom persists with a CCA, BT believes the best option would be NOT to use a relaxed activity rule and final price cap. In this case we believe Ofcom could at a minimum safely reveal precise information about aggregate demand at the end of each and every round – as per Ofcom's CCA of 800 MHz and 2.6 GHz spectrum in 2013.

5.61 Moreover, even if Ofcom persists with a CCA with a relaxed activity rules and final price cap, we believe Ofcom should still reveal precise information about (at least) aggregate demand at the end each round apart from the final round.

5.62 BT believes however that Ofcom should consider making more information available to bidders during this auction rather than less, irrespective of the auction format used. For example, if Ofcom were to agree with BT's proposal that an SMRA format should be used, BT believes that it could well be appropriate for Ofcom to reveal more precise information about demand in each round, for example the identity of the standing high bidders in each band and

the number of lots on which each is a standing high bidder. Despite what theoreticians might like to believe, the practical reality is that an operator's valuation for spectrum depends not only on the spectrum that it might acquire, but also on the spectrum that its competitors might acquire. Also, one of the main advantages of a multi-round auction process is supposed to be a reduction in uncertainty through the regulated sharing of demand and value information. Overly limiting the quantity and quality of information that is revealed to bidders during a multi-round auction process consequently has the potential to significantly undermine the quality of the result. In practice, if no or very little information is provided to bidders during the auction, bidders engage in guessing what other bidders are active on and make bid decisions partially on the basis of these guesses. Where their guesses turn out to be wrong, there is significant risk of inefficient spectrum assignment.

Reserve prices

5.63 Ofcom says (para 7.232) that it proposes to set reserve prices that are "materially lower than our benchmarks for possible market value" but then proposes a range for the reserve price for 700 MHz FDD (£100m-£240m) based on benchmark auction outcomes in Germany and Finland without any downward adjustment (i.e. the range is NOT materially lower than Ofcom's benchmarks).

5.64 In BT's view the reserve price for 700 MHz FDD spectrum therefore needs to be significantly lower than Ofcom is proposing if it is to comply with its own objectives.

5.65 As regards the 700 MHz SDL spectrum, BT is content with Ofcom proposed reserve price of £1m per 5 MHz (equal to £2m for each of our proposed 10 MHz lots).

5.66 For the 3.6 GHz lots Ofcom rejects low reserve prices sufficient to deter frivolous bidders and instead proposes much higher reserve prices that are set at a discount to Ofcom's estimate of market value while sufficient to leave margin for price discovery to occur during the auction. Ofcom's proposed reserve price of £15m - £25m per 5 MHz lot corresponds to 40% - 66% of the prices in the 2018 auction. Ofcom argues against a low reserve price because of their concern of collusion between bidders to achieve low prices, but it is not clear to us why this is a particular concern in this auction that leads Ofcom to depart from past practice. We believe the greater concern should be that spectrum goes unsold, or that price discovery is impeded, if it turns out that Ofcom's estimate of market value is significantly wrong. We propose that Ofcom adopts a reserve price for the 3.6 GHz spectrum closer to that used in the 3.4 GHz auction last year, i.e. much closer to £1m/5 MHz than the £15m-£25m Ofcom suggests.

Deposit

5.67 BT is content with Ofcom's general proposals as regards deposits.

Assignment stage

5.68 Notwithstanding our proposals in relation to facilitating trading in advance of any assignment round, and the requirement to have all spectrum won by or traded to a given bidder contiguous, we otherwise are content with the basic format of the assignment round proposed by Ofcom (a single-round sealed-bid second-price assignment auction) if required.

6 Managing coexistence issues

Potential 700 MHz mobile interference with DTT

***Question 7**: (Section 8) Do you agree with our proposed approach to coexistence in the 700 MHz band?*

***Question 8**: (Section 8) Do you have any comments on the proposed licence obligation and guidance note (annex 19)?*

6.1 BT agrees that management of any 700 MHz interference issues to DTT that arise from mobile network deployments in the 700 MHz auction spectrum is an important consideration and the obligations must be clearly addressed within the 700 MHz auction licences.

6.2 BT, along with other MNOs, asked DMSL to consider Ofcom's proposals in relation to management of potential interference from 700 MHz mobile networks into DTT and to prepare a response to the consultation document. We have reviewed their consultation response and can confirm to Ofcom that we are supportive of it.

6.3 Ofcom can consider that the views expressed in the DSML submission reflect the views of BT and can be taken as our formal position in response to Ofcom's consultation proposals.

3.6 - 3.8 GHz issues

***Question 9**: (Section 9) Do you agree with our proposed approach to managing interim protections for registered 3.6 - 3.8 GHz band users?*

In-band restriction zones around satellite Earth stations

***Question 10**: (Section 9) Do you agree with our 3.6 - 3.8 GHz in-band restriction zone proposals?*

6.4 BT agrees with the proposal to restrict the power of any mobile base stations located closer than 1km from certain existing satellite Earth stations for those sites where Ofcom is satisfied that such protection is justified.

6.5 The proposed interference power limit of -43dBm/5 MHz at the Earth station location produced by any base stations closer than 1km is, we assume, the signal power that would be received with a receiver of nominal 0dBi gain. This detail should be clarified in the proposed coordination procedure that Ofcom has provided in the Annex 25 to the consultation.

6.6 The 1km exclusion zone and the in band 3.6 - 3.8 GHz interference power limit might have some benefit in limiting potential for blocking of the satellite Earth station receiver operating above 3.8 GHz even if the interference power limit does not itself sufficiently protect satellite reception in the 3.6 - 3.8 GHz band.

6.7 BT further requests that its Madley Earth station site is included in the list of sites for which protection will be afforded within such a 1km coordination zone. The investment in the Madley facility is very considerable and the receive capability at 3.6 - 3.8 GHz, based on very large aperture antennas, is unique within the UK and is unlikely to be replicated. Given its very rural location, it seems unlikely that this would in practice create any material restriction on future mobile spectrum use and as such its inclusion in the list of sites requiring protection is essentially a precautionary measure.

***Question 11**: (Section 9) Do you agree with our view that we do not need to include any specific conditions in 3.6 - 3.8 GHz licences to mitigate the risk of adjacent band interference?*

6.8 We wish to continue interference free operation of the Madley satellite Earth station in the bands above 3.8 GHz and are therefore concerned to avoid satellite Earth station receiver blocking from mobile systems in 3.6 - 3.8 GHz and unwanted emissions falling in the band above 3.8 GHz. We note that Ofcom has not looked in detail at blocking interference to the satellite Earth station receivers operating above 3.8 GHz but has suggested that additional receiver filters could be used to resolve any interference problems that may arise. We note that the restrictions on emissions of mobile base stations within the 1km coordination distance to address in band 3.6 - 3.8 GHz reception mentioned above may also help reduce satellite receiver blocking.

7 Licence conditions

Technical conditions

***Question 13**: (Section 11) Do you agree with the technical licence conditions we propose?*

Ofcom must offer technical licence conditions that support key 5G capabilities

7.1 The proposed technical conditions included in the draft licences are designed for 4G technology and, like the 3.4 GHz auction licences, will prevent operators from realizing a key feature of new 5G technology: low latency capabilities. It is important that Ofcom supports operators that want to use the spectrum for 5G technology configured to deliver the benefits to consumers that arise from low latency. We therefore request that Ofcom supports technical licence conditions that are optimised for 5G New Radio deployments and not 4G technology in the 3.4 – 3.8 GHz band as these are brought forward by BT.

7.2 The recent work in CEPT ECC PT1 resulting in the [draft] ECC Report 296[76] illustrates some potential solutions to this concern. In particular, the report explains that partially synchronised frame structures even used with the permissive spectrum mask will result in only very limited interference between operators. The limited impact (cost) of such interference would be outweighed by the substantial benefits that will arise from facilitating deployment of low latency capabilities.

7.3 We welcome the alignment of the out-of-block and out-of-band emissions conditions to those of ECC PT1, and agree that common conditions across the 3.4-3.8 GHz band would be beneficial. We also welcome the adoption of TRP emission definition for AAS equipment and would support the adoption of such a definition across the 3.4-3.8 GHz band.

Non-technical conditions

***Question 12**: (Section 10) Do you agree with the non-technical conditions that we propose to include in the licences to be issued after the award of the 700 MHz and 3.6 - 3.8 GHz bands?*

Coverage obligation wording

7.4 The wording of the coverage obligation as set out in the schedule 1 of the draft licence in Annex 22/23 of the consultation seems to apply the geographic coverage targets only to the voice calls requirement and not the 2Mbit/s data requirement and is therefore inconsistent with the consultation proposals. The wording of the relevant licence clause is as follows:

> *11. The Licensee shall by no later than [X] 2024 provide, and thereafter maintain, an electronic communications network that provides with a high level of confidence:*
> *a) mobile telecommunications service with a sustained downlink speed of not less than 2 megabits per second, to users; and*
> *b) a mobile telecommunications service on which 90 second voice calls can be made without interruption, to an area covering at least:*
> *(i) 90% of the geographic landmass of the United Kingdom;*
> *(ii) 90% of the geographic landmass of England;*

[76] https://www.cept.org/Documents/ecc/49612/ecc-19-014-a13_draft-ecc-report-296-c-band-sync-after-pc

(iii) 90% of the geographic landmass of Northern Ireland;

(iv) 74% of the geographic landmass of Scotland; and

(v) 83% of the geographic landmass of Wales.

8 Proposed next steps

8.1 BT would welcome the opportunity to debate any of the points raised in this consultation response in more detail with Ofcom if this would assist Ofcom in reaching conclusions as it works to prepare its final Statement and revised detailed auction regulations.

8.2 We also encourage Ofcom to facilitate discussion between operators and with Ofcom on any points that may benefit from such a process. The need to find technical licence conditions more suited to 5G technology is one example and another is work on the options to improve the possibility to achieve defragmentation of the 3.4-3.8 GHz band.

Annex 1 – Coverage obligations: impact assessment for EE network

A1.1 This annex summarises the approach we have taken to understand the requirements on EE (in terms of new sites and upgrades to existing sites) required to meet Ofcom's coverage obligations, based on where we expect to be at the time the obligations are awarded.

A1.2 We note that Ofcom's proposed compliance methodology, which is subject to a separate consultation, introduces a new method to calculate whether coverage is achieved at Ofcom's threshold for 95% probability. This takes into account signals from up to 20 base stations surrounding a given location which is a different approach to that used hitherto where only the strongest base station signal is considered. The analysis we present as part of our response uses the existing methodology on our current propagation model. We will provide our views on the proposed new compliance methodology in our separate response to the relevant consultation.

A1.3 The analysis comprises three key steps:

1) Identify uncovered areas and premises of the UK.
2) Add new sites in nominal locations to meet premises and geographic obligations.
3) Refine as required to remove unnecessary sites.

Identify uncovered areas and premises of UK

A1.4 We first use our current planning model to determine the likely extent of coverage prior to the auction. Coverage based on the -105dBm threshold from current and planned LTE1800 and LTE800 sites (including planned upgrades) are merged to give a total UK view.

A1.5 The merged network is then cut using the UK map. The resulting network is shown on a UK map highlighting covered and uncovered sections. This process is summarised in the diagram below.

Figure A1.1: Coverage layers are combined to give an overall view of existing BT/EE coverage in the UK

A1.6 At this point, it is possible to determine the remaining geography and premises available to be covered through the coverage obligation.

Add new sites in nominal locations to meet premises and geographic obligations

A1.7 The uncovered sections are then extracted as disaggregated polygons. These polygons represent holes in existing coverage today and are measured in square kilometres. The number of uncovered premises in any given polygon is also extracted at this point. The coverage potential of the polygons are then ranked based on the size of the area and the number of uncovered premises they contains.

A1.8 A nominal site is assumed as a 15m tower with azimuths of 0/120/240 degrees. The centroid of the polygon is extracted with coordinates (Easting/Northing). The centroid then becomes the nominal location of the new site. The nominal site can be manually moved closer to the uncovered premises if required.

A1.9 Polygons with the most uncovered premises are ranked first and counted to reach the 140,000 new premises requirement. The new sites with nominal locations are then added to the network and a prediction is run to confirm the premises coverage and establish the resultant geographic coverage. Upgrades to existing sites are considered first, as these are generally cheaper and can be deployed more quickly. If the geographic coverage obligation has not yet been met then these steps are repeated with further sites until it is. The model is re-run to predict final premises and geographic obligations are met.

Refine as required to remove unnecessary sites

A1.10 If order to refine the modelling, a further ranking is made from the final coverage prediction best server plots. The new sites added previously will be ranked based on the number of premises covered. If required, sites are then removed and disabled in the network another prediction is run to confirm the obligations are still met. Re-ranking continues in this manner until the requirements are met.

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