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

Revised proposals on auction design

[Award of the 700 MHz and 3.6-3.8 GHz spectrum bands](#) – Welsh overview

CONSULTATION:

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1. Overview

Reliable mobile services have become essential to how people live, work and travel across the UK, and mobile phone networks must keep pace with the growing needs for capacity and coverage. Ensuring *Better broadband and mobile services – wherever you are*, is therefore one of Ofcom's main priorities, as set out in our annual plan.

Ofcom manages the radio spectrum – the airwaves used by wireless devices like mobile phones to communicate. This involves ensuring spectrum is allocated and used for the benefit of UK citizens and consumers. We are preparing to award **200 MHz** of spectrum in two frequency bands next year. This document sets out our updated proposals for the design of the auction.

What we are proposing – in brief

We plan to auction 200 MHz of spectrum in two bands:

- **80 MHz in the 700 MHz band** - currently used for Digital Terrestrial Television (DTT) and by wireless microphones used in the entertainment industry. This should become available for mobile use nationwide by May/June 2020.
- **120 MHz in the 3.6-3.8 GHz band** – this is currently being cleared of its fixed links and satellite uses, and should become available for mobile use across the country by June 2020. Some localised constraints may remain in place until the end of 2022.
- **Better broadband and mobile** - both these bands are likely to be used by mobile phone networks to meet the increasing demand for mobile broadband services, and to deploy new services, including 5G - the latest generation of mobile technology.
- **Coverage commitments** - in our December 2018 consultation, we proposed that up to two bidders could get a discount on the cost of the spectrum in return for accepting obligations to improve mobile coverage. This prompted the four mobile network operators to put forward voluntary binding commitments to improve mobile coverage by sharing infrastructure and rolling out a 'Shared Rural Network' programme, which they have agreed with Government. By industry working together, this will deliver higher coverage than could have been delivered by our proposals. On the basis of these commitments we are now consulting on revised proposals for the auction design which no longer include coverage obligations.
- **Auction format** – as we no longer plan to include coverage obligations, we now propose running the auction using a Simultaneous Multiple Round Ascending (SMRA) format. This is the same as the one used in our 2018 auction. This will involve a **principal stage**, where companies will bid for spectrum in separate 'lots' to determine how much each bidder wins; and an **assignment stage**, to determine the specific frequencies winning bidders will be allocated.
- **Defragmenting the 3.4-3.8 GHz band** – we are also planning to include measures to help defragment the wider 3.4-3.8 GHz band, including a **negotiation period** where winners of 3.6-3.8 GHz spectrum will have the opportunity to decide among themselves their placements within in the 3.6-3.8 GHz band.

Today, we are also publishing a [separate document for consultation](#) giving formal notice of our intention to give effect to the revised proposals on the auction design by making The Wireless Telegraphy (Licence Award) Regulations 2020 (the 'Auction Regulations').

Next steps

We invite responses to this consultation by **9 December 2019**, so that we can take these into account before reaching a final decision. We will also take full account of all the responses we received to our December 2018 and June 2019 consultations, as well as all responses we receive to these further consultations in our next document.

We are also seeking responses to the consultation on the Auction Regulations by **9 December 2019**.

We hope to be in a position to start the auction by **Spring 2020** and will set out more detailed next steps following the close of these consultations.

2. Introduction and choice of auction design

Background

- 2.1 We consulted on proposals for this award in December 2018 (the '**December 2018 consultation**'). At that time, we set out the following main objectives for the award, in light of our statutory duties:
- improving mobile coverage;
 - ensuring efficient allocation of spectrum;
 - sustaining strong competition in mobile markets; and
 - ensuring the timely availability of spectrum.
- 2.2 In the December 2018 consultation we set out proposals to improve mobile coverage through the auction, having for some years identified the 700 MHz band as being particularly suited for this purpose.
- 2.3 Our consultation proposals prompted the four national mobile network operators – BT/EE, O2, Three and Vodafone (the '**MNOs**') – to work with the Government on a voluntary 'Shared Rural Network' programme to improve mobile coverage through infrastructure sharing and Government funding of new coverage in total 'not spots' (the '**MNOs commitments**').
- 2.4 The MNOs and the Government have now committed in principle to full funding of the programme. The MNOs' commitments will be given effect through binding licence obligations, which we expect to put in place and publish in due course. We will also set out the criteria and methodology for assessing and, as necessary, enforcing compliance with these commitments.
- 2.5 Improving mobile coverage for consumers is a key policy priority for Ofcom and we are still aiming to achieve comprehensive mobile coverage for people right across the UK. In light of the fact that the MNOs have now offered infrastructure-sharing commitments, we are no longer intending to include coverage obligations in the auction. These infrastructure-sharing commitments are capable of delivering better outcomes for consumers than we would be able to require through coverage obligations in the spectrum auction. In particular, the creation of a shared network based on voluntary infrastructure sharing will reduce the costs of providing coverage, allowing more comprehensive coverage to be delivered.
- 2.6 The other policy objectives that we set out in the December 2018 consultation remain unchanged.

Our revised proposals for the auction design

- 2.7 In the December 2018 consultation, we considered a range of potential formats for the principal stage of the auction and narrowed these down to two - the combinatorial clock auction ('**CCA**') format and the Simultaneous Multiple Round Ascending ('**SMRA**') auction

format. This was on the basis that they are both well-understood and widely tested formats commonly used for spectrum auctions. A full description of both formats can be found in our December 2018 consultation.¹

- 2.8 We proposed the CCA format because we considered that it would be the most likely to strike an appropriate balance between our objectives at that time to improve mobile coverage and secure the efficient allocation of the spectrum. It would have allowed a bidder to bid on a package of ‘lots’ that could have included a freestanding coverage obligation ‘lot’ alongside the spectrum ‘lots’ on which it was bidding. The bidder would only be bound by the coverage obligation if it won the whole package.
- 2.9 We recognised the main benefit of the CCA was that it better allowed bidders to manage the risks associated with the coverage obligations. Key advantages of the CCA over the SMRA are the elimination of aggregation risk and reduced substitution risk. This was an advantage for increasing the likelihood of selling coverage obligations, due to the aggregation risk associated with our proposed freestanding coverage obligations.
- 2.10 On the basis of the MNOs’ commitments, it is no longer necessary for us to include coverage obligations in the auction, and we have therefore reconsidered whether a CCA or an SMRA format is the most appropriate for the award of this spectrum.

December 2018 consultation assessment of auction formats and stakeholder responses

- 2.11 In the December 2018 consultation, we set out our view of the main pros and cons of the CCA and SMRA formats.² We first summarise these below, and then discuss stakeholder responses to our assessment of both auction formats.
- 2.12 We considered the main advantages of the SMRA to be: simplicity, as the SMRA is intuitively easier to understand; a reduced risk of surprise outcomes, as bidders have a large degree of certainty when they submit their bids; and budget constrained bidders have clearer information on the prices they will pay.
- 2.13 The main disadvantages to the SMRA we set out were: bidders risk winning fewer lots than they bid for (‘aggregation risk’); bidders may be limited in their ability to substitute demand across different lot categories (‘substitution risk’); and bidders may strategically reduce their demand to obtain lower spectrum prices (‘strategic demand reduction’).
- 2.14 We also note that the risk of bidders tacitly colluding to obtain lower spectrum prices (‘market division’) is more prominent in an SMRA. Market division and strategic demand reduction can negatively impact efficiency if this causes the allocation of spectrum to change from the outcome that would otherwise have occurred.
- 2.15 We considered the main advantages of the CCA to be: elimination of aggregation risk due to package bidding; elimination of substitution risk as bidders can express their valuations

¹ December 2018 consultation, paragraphs 7.33-7.53.

² December 2018 consultation, paragraphs 7.54-7.83.

across all packages of spectrum; decreased risk compared to an SMRA of strategic demand reduction; and reduced risk of tacit collusion.

- 2.16 We considered the main disadvantages of the CCA to be: bidders face a degree of uncertainty on the final outcome and prices of spectrum; budget constrained bidders may face challenges in their bidding decisions; and there may be a greater risk compared to in an SMRA of bidders bidding to raise rivals' costs ('price driving').

Stakeholders' comments on auction format in response to December 2018 consultation

- 2.17 We received comments from O2, BT/EE and Vodafone on auction format. Overall, they preferred an SMRA format and expressed concern over particular risks of the CCA. O2 considered that Ofcom had overstated some of the disadvantages of the SMRA, while understating the disadvantages of the CCA.³ Vodafone said there did not appear to be a compelling reason to adopt a CCA format for this particular award.⁴
- 2.18 Respondents claimed the SMRA was an easier format to manage with internal governance. For example, Vodafone said the SMRA makes securing business approvals for bidders far easier.⁵ NERA (on behalf of O2) and BT/EE also argued that the complexity of the CCA presented challenges for internal governance.⁶
- 2.19 Some stakeholders preferred the SMRA for its greater predictability compared to the CCA. BT/EE preferred the SMRA because in each round bidders can be sure of what they stand to win and the price they will pay.⁷ It also argued that an advantage of the SMRA was the opportunity to bid back, while in the CCA there may be greater scope for regret or dissatisfaction due to the increased risk of unexpected outcomes. O2 also considered that in certain situations the CCA can have unpredictable results for allocation and pricing.⁸
- 2.20 Respondents considered the aggregation risk in relation to the award bands to be manageable in an SMRA. BT/EE and Vodafone argued that there was no significant aggregation risk between spectrum bands in this award, meaning that a CCA format is not necessary.⁹ Similarly, BT/EE also considered that any substitution risk could be managed in an SMRA with the appropriate eligibility point allocations, with the only real substitution risk being between 700 MHz paired and unpaired spectrum.
- 2.21 While BT/EE identified some in-band aggregation risk as potentially applying in this award, it considered that this risk could be addressed in the SMRA through lot sizes and minimum

³ O2 non-confidential response to the December 2018 consultation, page 41.

⁴ Vodafone non-confidential response to the December 2018 consultation, page 46.

⁵ Vodafone non-confidential response to the December 2018 consultation, page 46.

⁶ BT non-confidential response to the December 2018 consultation, page 72, and NERA (on behalf of O2) non-confidential response to the December 2018 consultation, page 28.

⁷ BT non-confidential response to the December 2018 consultation, page 71-72.

⁸ O2 non-confidential response to December 2018 consultation, Annex B, page 30.

⁹ BT/EE non-confidential response to the December 2018 consultation, page 69; Vodafone non-confidential response to the December 2018 consultation, page 46.

requirements. NERA, on behalf of O2, considered that aggregation risk is likely to be minimal for the four MNOs.¹⁰

- 2.22 Respondents including O2 and Vodafone expressed concerns about price driving in the CCA.^{11 12} Some stakeholders, for example BT/EE and O2, also considered the CCA to be too complex for the spectrum we are awarding.^{13 14} Others, such as Vodafone and O2, said that the CCA format causes problems for bidders with budget constraints.^{15 16}
- 2.23 O2 also argued that we should separate the award of 700 MHz and 3.6-3.8 GHz into different stages, as these bands are neither substitutes nor strong complements. It said that selling the award bands in the same bidding stage invites strategic bidding that could distort the final allocation. It said that Ofcom has not provided any strong rationale for selling the 700 MHz and 3.6-3.8 GHz bands together in the same auction.¹⁷

Our response to comments on the auction format

- 2.24 Since there are advantages and disadvantages associated with both the CCA and the SMRA, the choice of an appropriate auction format depends on the specific circumstances of the award.
- 2.25 We note that stakeholders agreed with the benefits of the SMRA that we identified in the December 2018 consultation, primarily its simplicity and the greater level of certainty it provides bidders as the auction progresses. We recognise that some stakeholders strongly preferred the SMRA to the CCA for this reason.
- 2.26 We consider that stakeholders' comments on the risks of the CCA are overstated. We do not consider that risks of price driving, difficulties for budget constrained bidders and complexity undermine the rationale for a CCA format in appropriate circumstances. We note that spectrum has been awarded successfully in CCAs around the world, often with lot structures and licences considerably more complex than our December 2018 CCA proposals. The risks associated with the format, and preparation needed to manage those risks, are well established. Most bidders in our auction are likely to have participated in other CCAs, both in other countries and the 2013 UK 4G auction.
- 2.27 We disagree with O2's suggestion of awarding the 700 MHz and 3.6-3.8 GHz in separate stages. The 700 MHz and 3.6-3.8 GHz bands may not be strong substitutes or complements, however we recognise that bidders may still find it desirable to have the option of substituting between the spectrum bands. While some bands are closer substitutes than others, all spectrum bands can be used to provide additional capacity and

¹⁰ O2 non-confidential response to the December 2018 consultation, Annex B, page 24.

¹¹ O2 non-confidential response to the December 2018 consultation, page 41, paragraph 191.

¹² Vodafone non-confidential response to the December 2018 consultation, page 45.

¹³ BT/EE non-confidential response to the December 2018 consultation, page 72.

¹⁴ NERA (on behalf of O2) non-confidential response to the December 2018 consultation, page 28.

¹⁵ Vodafone non-confidential response to the December 2018 consultation, page 45.

¹⁶ O2 non-confidential response to the December 2018 consultation, page 41, paragraph 191.

¹⁷ O2 non-confidential response to December 2018 consultation, page 42, paragraphs 194 and 195.

are therefore all substitutable to an extent (e.g. we do not draw a distinction between the award bands for the purposes of the overall spectrum cap that we are minded to adopt). It is also possible that there may be substitution between bands for budget reasons. We therefore do not wish to preclude bidders from having the option to substitute across bands.

- 2.28 We are also not convinced that a combined award would raise additional strategic bidding concerns with an undue risk to the final allocation.¹⁸ There are also mitigations to strategic bidding concerns in our proposed rules, such as not allowing bidders to withdraw their bids and only revealing limited information about excess demand during the principal stage.

Developments since the December 2018 consultation and provisional conclusion on auction format

- 2.29 A key consideration for our auction design proposals set out in the December 2018 consultation was our objective to improve mobile coverage by including coverage obligations. We considered that there was significant aggregation risk associated with the coverage obligations. Given this, and our objective of improving mobile coverage, we therefore proposed to use a CCA with freestanding coverage obligation lots, which would not be attached to specific spectrum.
- 2.30 Since the December 2018 consultation, the MNOs and the Government have committed in principle to full funding of the 'Shared Rural Network' programme. As we explain above, on the basis that this 'in principle' commitment is confirmed, we consider that including coverage obligations in this award will no longer be necessary.
- 2.31 As the coverage obligations were a key driver of our December 2018 auction design proposals, we have given further consideration to the appropriate format for this award.
- 2.32 Absent coverage obligations, the main combinatorial advantages of the CCA may be less relevant for this award given the limited evidence of complementarity between the 700 MHz and 3.6-3.8 GHz frequencies. In our December 2018 consultation we did not consider there to be a strong basis for cross-band synergies. Stakeholders have also argued there is little to no complementarity or substitutability between the 700 MHz and 3.6-3.8 GHz spectrum bands.
- 2.33 There may be some aggregation risk within the award bands. Technical considerations and evidence of BT/EE's bids in the UK 4G auction for 800 MHz spectrum suggest that a

¹⁸ In its response O2 did not elaborate on specific strategic gaming concerns in a simultaneous award. One possible example might be a bidder hoping to increase its chances of acquiring 700 MHz spectrum or achieving a lower price for it, through adopting a bidding strategy as follows: first, engaging in price driving in 3.6-3.8 GHz to use up other bidders' budgets and/or to harm package and price discovery for them by hiding its own true demand for 700 MHz; and later switching its demand to 700 MHz. We do not consider this a substantial risk to the simultaneous award, as bidders would face material disincentives to adopting such a strategy. This strategy would put bidders at risk of not only inadvertently winning unwanted spectrum but also missing out on spectrum they could have won otherwise. We also consider the reduced information policy increases the risks to bidders of bidding in this way, as less information increases the likelihood a strategic bidder misjudges demand and inadvertently wins unwanted spectrum.

2x10 MHz block could plausibly be worth more than double a 2x5 MHz block of 700 MHz FDD. BT/EE also noted in its response the possibility of aggregation risk within 3.6-3.8 GHz due to bidders having a low value for odd multiples of 5 MHz or for just 10 MHz.¹⁹ In relation to 700 MHz SDL, BT/EE and O2 both suggested the minimum deployment and/or use case for this spectrum is more likely to be 10 MHz.²⁰

- 2.34 However, we do not consider this aggregation risk to be substantial enough to require a package auction. We note that no stakeholders suggested a package auction is needed to address these risks. We have also incorporated some mitigations in our proposed SMRA design to help bidders manage any aggregation risk, such as the ranking mechanism for standing high bids, and allowing the use of ‘waivers’ (see section 3 below).
- 2.35 While we think that both the CCA and SMRA would be viable formats for delivering an efficient outcome in the absence of coverage obligations, we consider that the benefits of the SMRA outweigh the benefits of the CCA for this particular award. This is due to the SMRA’s comparative simplicity and the greater certainty for bidders, and the limited evidence of complementarity between 700 MHz and 3.6-3.8 GHz.
- 2.36 Although that there are some residual risks associated with the SMRA format, we consider these to be manageable for bidders, and we have also proposed some mitigations to these risks in the detailed rules.
- 2.37 In putting together our SMRA auction format proposals we have considered the responses we received to our December 2018 consultation and June 2019 consultation on defragmentation of the 3.4-3.8 GHz band.²¹ In particular, we have made some adjustments to the proposed assignment stage, in light of the responses we received to our June 2019 consultation. The details of our proposals are set out in section 3 below.

¹⁹ BT/EE non-confidential response to the December 2018 consultation, page 69.

²⁰ BT/EE non-confidential response to the December 2018 consultation, page 61; O2 non-confidential response to the December 2018 consultation, page 45.

²¹ Ofcom’s document of 11 June 2019 entitled “Defragmentation of spectrum holdings in the 3.4–3.8 GHz band”.

3. SMRA auction design

Summary

- 3.1 In this section, we set out our revised auction design proposals for the award of the 700 MHz and 3.6-3.8 GHz bands without coverage obligations, using an SMRA auction format.
- 3.2 In developing our proposals, we have considered those stakeholders' comments to our December 2018 consultation and June 2019 consultation that are relevant to the revised auction design. We have set out proposals here which would implement the following measures:
- a) a **cap of 37%** on overall holdings of mobile spectrum (416 MHz), without any sub caps on holdings of either low frequency or 3.4–3.8 GHz spectrum;
 - b) a **restriction in the assignment stage on any winners of 20 MHz or less** of 3.6-3.8 GHz spectrum, which would limit any such winners to bidding only for frequencies at the top or bottom of the 3.6–3.8 GHz band; and
 - c) a **four-week negotiation phase** after assignment stage bidding in which winning bidders of 3.6-3.8 GHz spectrum would have the opportunity to agree the assignment of frequencies in the 3.6–3.8 GHz band between themselves. If winning bidders cannot reach unanimous agreement, a subset of winning bidders would be allowed - in the last week of the negotiation phase - to reach a 'partial agreement' with each other to receive adjacent assignments.²²
- 3.3 The proposed SMRA design has the following features:
- a) **A principal stage and an assignment stage** – The principal stage would determine the amount of spectrum won by bidders, bidding for frequency-generic lots. It would comprise successive rounds with ascending prices and would end when there are no new bid decisions in a round. The assignment stage would determine the precise frequencies awarded, and would be a sealed-bid, single-round format with a second-price rule. As noted above, in the 3.6-3.8 GHz band, there would also be a restriction on the assignments for 'small winners' and an opportunity for negotiation between bidders to determine the outcome of the assignment stage.
 - b) **Spectrum lots** – There would be three categories of generic spectrum lots:
 - i) 60 MHz in six lots of 2x5 MHz in the 700 MHz FDD spectrum, with a reserve price in the proposed range of £100m-£240m per lot. These lots would have four eligibility points each (see below under 'Activity rule' and 'Waivers' for an explanation of eligibility points).

²² Our proposals for the 3.6-3.8 GHz assignment stage have been updated in light of responses to the June 2019 consultation, as described in more detail from paragraph 3.123.

- ii) 20 MHz in four lots of 5 MHz 700 MHz downlink-only spectrum, which can be used for Supplemental Downlink (SDL), with a proposed reserve price of £1m per lot. These lots would have one eligibility point each.
 - iii) 120 MHz in 24 lots of 5 MHz TDD 3.6-3.8 GHz spectrum, with a reserve price in the proposed range of £15m-£25m per lot. These lots would have one eligibility point each.
- c) **Ranking mechanism for standing high bids** – Where there is excess demand in a lot category, Ofcom would randomly rank the bidders that placed bids in a given round and allocate lots as ‘standing high bids’ to these bidders until there were no more lots available. This rule also means that, at most, only one bidder in each band could be standing high bidder on fewer lots than it bid for. If all lots have been allocated as ‘standing high bids’ at the current round price in a category, the price will increase in that category for the next round.
- d) **Activity rule and ‘waivers’** – We propose an eligibility points-based activity rule, which would constrain the maximum number of bids a bidder can make in a round. Bidders will only be able to maintain or reduce their demand, measured in eligibility points, as bidding progresses. Bidders would be allowed up to three ‘waivers’ where they may abstain from bidding without affecting their eligibility for the next round.
- e) **No withdrawals or minimum requirement** – We are proposing not to allow bidders to withdraw their bids, or allow bidders to specify a minimum requirement in any band.
- f) **Information policy** – After the end of each principal stage round, we propose to inform bidders of the level of excess demand in rounded categories:
- i) 3.6-3.8 GHz – we propose to reveal excess demand rounded up to the nearest higher multiple of 20 MHz (i.e. excess demand is strictly less than 20 MHz, less than 40 MHz, less than 60 MHz, etc.)
 - ii) 700 MHz FDD – we propose to reveal excess demand rounded up to the nearest higher multiple of 20 MHz, equivalent to increments of 2x10 MHz (i.e. excess demand is strictly less than 20 MHz (2x10 MHz), less than 40 MHz (2x20 MHz), less than 60 MHz (2x30 MHz), etc.)
 - iii) 700 MHz SDL – we propose to reveal excess demand rounded up to the nearest higher multiple of 10 MHz (i.e. excess demand is strictly less than 10 MHz, less than 20 MHz, less than 30 MHz, etc.)

Principal stage rules

- 3.4 In developing our proposed auction rules, we have considered and sought to mitigate appropriately the risks associated with the SMRA format. We first discuss these risks, and how we propose to mitigate them in the proposed rules.

Aggregation risk

- 3.5 Aggregation risk occurs when a bidder values a combination of lots more than the sum of its values for the individual lots in that combination. In an SMRA, this means bidders face a risk of winning less spectrum than they bid for, at prices that exceed their valuation for this smaller amount of spectrum. As discussed above, while we do not consider there to be significant cross-band aggregation risk in this award, due to the limited complementarities between bands, we note that there may be some in-band aggregation risk. For example, BT/EE noted that there may be aggregation risk arising from bidders having a low value for odd multiples of 5 MHz or for just 10 MHz in 3.6-3.8 GHz, or 2x5 MHz of 700 MHz FDD as compared to 2x10 MHz.²³

Substitution risk

- 3.6 Bidders face substitution risk if they wish to change the band they are bidding in, but are not able to switch demand effectively between bands. This situation can arise in an SMRA if bidders are 'stuck' with standing high bids in one band when they would prefer to substitute that demand to a different award band. Some stakeholders have suggested that, in their view, there is low substitution risk in this award, with limited substitutability between 700 MHz FDD and 700 MHz SDL, and no substitutability between 700 MHz and 3.6-3.8 GHz. Nonetheless we consider some bidders may still wish to substitute between bands at certain prices.

Strategic demand reduction and market division

- 3.7 There is a greater risk of strategic demand reduction and market division in the SMRA, compared to the CCA. Strategic demand reduction occurs where a bidder contracts its demand early, instead of competing for a large amount of spectrum, in an attempt to reduce the final prices it will pay.
- 3.8 Market division is a form of tacit collusion which would involve several bidders jointly reducing demand to lower the final prices that they must pay. Strategic demand reduction and market division could reduce efficiency, if bidders end up winning less spectrum than they would otherwise have won (with straightforward bidding that reflected their intrinsic values).
- 3.9 We consider that strategic demand reduction or market division may be particular concerns in this award. Stakeholders, for example O2, have commented on the predictability of demand in 3.6-3.8 GHz spectrum.²⁴ We consider that with predictable demand in an SMRA, bidders may be further incentivised strategically to reduce demand in order to lower the final prices they will pay. Predictable allocations make it easier for bidders to coordinate to achieve market division, i.e. bidders reach a particular predictable

²³ BT/EE non-confidential response to the December 2018 consultation, page 69.

²⁴ NERA (on behalf of O2) non-confidential response to the December 2018 consultation, page 36 and [REDACTED]

allocation earlier in the auction at lower prices, rather than competing for larger amounts of spectrum at higher prices.

- 3.10 It is possible that market division and strategic demand reduction may reduce only the final prices paid without changing from the allocation of spectrum, and so avoiding any negative impact on efficiency.

Price driving

- 3.11 Conversely, we note that the predictability of demand could instead increase the risk of price driving in this award. While the SMRA is typically less vulnerable to price driving than the CCA, if demand from other bidders is sufficiently predictable, a price driving bidder may still be able to submit 'low risk' bids in the SMRA aimed purely at driving up competitors' prices.
- 3.12 Price driving, even if it affects the prices paid in the auction, may not change the allocation of spectrum, so may not raise any efficiency concerns. Indeed, the objective of such a strategic bidder is not to win the spectrum on which it is price driving, but to fail to win it and push up prices for others. However, we recognise there is potential for price driving to have an adverse effect on efficiency. For example, the price-driving bidder may misjudge and inadvertently win spectrum, having used up the budgets of competitors who face tight budget constraints.
- 3.13 We have considered mitigations to these risks in our proposals set out below. The detailed rules that we are proposing are also set out at annex 5, and in draft Auction Regulations which we have also published for consultation.²⁵

Generic lots

- 3.14 We propose that the principal stage would involve generic spectrum lots for each of the three lot categories (700 MHz FDD, 700 MHz SDL and 3.6-3.8 GHz). This means that bids in the principal stage would not relate to specific frequencies, but to lots of specified bandwidths with unspecified frequencies. Winners of generic spectrum lots in the principal stage could bid to determine the exact location of their frequencies in the assignment stage.
- 3.15 The approach of generic lots minimises the risk of fragmentation of the auctioned spectrum,²⁶ allows for simplicity of bidding, encourages a speedier auction and is more flexible than a frequency-specific auction with a single bidding stage. A generic principal stage also reduces the opportunity for strategic bidding aimed at splitting a competitor's assignment of auctioned spectrum.
- 3.16 Generic spectrum lots mean that prices are not calculated for each individual lot within each category. Rather, there is a single, common price level in any round for each lot within each category, and bidders respond to this round price by bidding for a number of

²⁵ <https://www.ofcom.org.uk/consultations-and-statements/category-2/auction-regulations-award-700-mhz-3.6-3.8-ghz-spectrum>

²⁶ We set out proposals to assist defragmentation of holdings across the wider band of 3.4-3.8 GHz from paragraph 3.123.

lots. If demand is equal to or greater than supply at the current price, then the price goes up in the following round. If demand is lower than supply, the price stays the same.

Lot structure

- 3.17 In deciding appropriate lot sizes for this SMRA award, we seek to achieve a balance between mitigating the aggregation risk bidders face and providing bidders with the flexibility to acquire spectrum in the exact amounts they want. This contrasts to our considerations for the CCA design we proposed in the December 2018 consultation, in which bidders would face no aggregation risk. That left flexibility as the key consideration at the time.
- 3.18 For this award, on balance, we still propose that it is appropriate to provide bidders with flexibility in each of the lot categories. We prefer not to preclude options for bidders by using unduly large lot sizes, noting that aggregation risk for the spectrum we are awarding is limited.
- 3.19 Responses to the December 2018 consultation regarding lot sizes were primarily in the context of our initial CCA design. However, we have taken into account any stakeholder comments on lot sizes in the context of an SMRA design. BT/EE proposed an alternative SMRA design in its response, including coverage obligations, which used the same lot sizes as it suggested for our CCA design.²⁷ O2 also included its preferred lot sizes if the award was an SMRA format in its response to the December 2018 consultation.

700 MHz FDD

- 3.20 We propose to offer six lots of 2x5 MHz for 700 MHz FDD.
- 3.21 We note that BT/EE²⁸ and O2²⁹ both agreed with our proposal for 2x5 MHz lot sizes in the December 2018 consultation. BT/EE agreed with the lot size, however it noted that bidders may require a minimum of two lots (which we consider below when discussing minimum requirements).³⁰
- 3.22 We recognise that some bidders may wish to acquire more than one 2x5 MHz lot, and that there is potential for in-band aggregation risk. However, we consider that all increments of 2x5 MHz in this band would be useable blocks of spectrum.³¹ NERA, on behalf of O2, claimed that there was a potential business case for 2x5 MHz blocks of spectrum. Therefore, we favour allowing bidders the flexibility to bid for spectrum in multiples of 5 MHz: either 2x5 MHz or 2x15 MHz, rather than using a larger lot size to mitigate the aggregation risk.

²⁷ BT/EE non-confidential response to the December 2018 consultation, page 66, paragraph 5.34.

²⁸ BT/EE non-confidential response to the December 2018 consultation, page 61, paragraph 5.5.

²⁹ O2 non-confidential response to the December 2018 consultation, page 45, paragraph 210.

³⁰ BT/EE non-confidential response to the December 2018 consultation, page 61.

³¹ For example, BT/EE and H3G currently hold 2x5 MHz in low frequency spectrum in 800 MHz, which they won in the UK 4G auction.

700 MHz SDL

- 3.23 For 700 MHz SDL, we are proposing to offer four lots of 5 MHz.
- 3.24 In response to the December 2018 consultation, we received comments from BT/EE and O2 on SDL lot sizes arguing for a 10 MHz lot size. O2 argued that a 10 MHz lot size would be more aligned with use cases, and would also facilitate switching between the 700 MHz paired and unpaired spectrum. NERA also claimed that *“If an SMRA is used, then a change [to 10 MHz blocks] is essential so as to prevent bidders from being exposed to winning only 5 MHz, which would likely be too little to support deployment.”*³²
- 3.25 BT/EE argued that operators need 10 MHz as a minimum to deploy the spectrum, so if an operator required 15 MHz, that operator may as well have all 20 MHz as no one else is going to want the remaining 5 MHz.³³
- 3.26 We note there are equipment options for deploying 5 MHz or 15 MHz of SDL. While there is considerable uncertainty in use cases for this band, we have no technical evidence suggesting that either 10 MHz or 20 MHz of SDL is necessary for any specific use cases. On balance, we favour giving bidders more flexibility in their bidding options for this spectrum.
- 3.27 We recognise that a bidder may face some aggregation risk in this band if it does not wish to win an odd increment of 5 MHz. However, a bidder is only affected by this aggregation risk if another bidder has a relatively high intrinsic value for 5 MHz or 15 MHz blocks. In this case, we do not think it would be appropriate to preclude options for either bidder. We would welcome stakeholders’ views on the benefits and risks that bidders may face with either a 5 MHz or 10 MHz lot size.

3.6-3.8 GHz

- 3.28 We propose to offer twenty-four lots of 5 MHz of 3.6-3.8 GHz spectrum. In response to the December 2018 consultation, BT/EE and O2 argued for 10 MHz lot sizes, claiming the technology they anticipated deploying in the band, 5G NR, uses carriers which could be deployed in increments of 10 MHz (with one exception, 15 MHz). NERA added that if an SMRA is used, *“10 MHz blocks would be the better approach as it will eliminate any risk of a bidder winning an unwanted 5 MHz block and constrain allocation outcomes to ones that are more likely to ensure full use of the spectrum.”*³⁴
- 3.29 A 5 MHz lot size allows any bidder to bid on multiples of 5 MHz. In the 2.3 and 3.4-3.6 GHz auction, while no bidders were awarded spectrum in multiples of 5 MHz, bids were submitted in multiples of 5 MHz specifically by Vodafone, O2, and Airspan (although, we recognise that O2 now favours a lot size of 10 MHz). There is also potential for deployment of technologies, such as LTE, which supports options for deploying spectrum in multiples of 5 MHz.

³² NERA (on behalf of O2) non-confidential response to the December 2018 consultation, page 14.

³³ BT/EE non-confidential response to the December 2018 consultation, page 61, paragraph 5.5.

³⁴ Nera (on behalf of O2) response to the December 2018 consultation, page 13.

- 3.30 While we recognise that the MNOs have announced their intention to deploy 5G NR in the wider 3.4-3.8 GHz band, prospective bidders with alternative use cases may emerge by the time of the auction. We also note that a bidder seeking to deploy alternative technologies that are not synchronised with 5G users in the band may require 5 MHz guard bands, which 5 MHz lot sizes would better allow for. While we would favour synchronisation between users in this band, we recognise that bidders may have business models that involve deploying different technologies, some of which may emerge in the future. 5 MHz lot sizes would provide greater flexibility for the deployment of these different technologies.
- 3.31 There may be minimal aggregation risk in this band for MNOs, as they may be able to combine any spectrum won in 3.6-3.8 GHz with their existing holdings in 3.4-3.8 GHz, for example through post-auction trades or deploying multiple carriers.
- 3.32 If an operator does win a multiple of 5 MHz, it would be able to use this spectrum to deploy 5G because a carrier of 15 MHz is defined in the 5G standards. We also note we are proposing to include features in our auction design which would help to mitigate residual aggregation risk, such as the ranking mechanism and waivers (see below).
- 3.33 We note that there may be slightly greater risk of non-straightforward bidding with 5 MHz lots, compared to a larger lot size of 10 MHz. For example, 5 MHz lot sizes may reduce the risks or costs to a price driving bidder of accidentally winning spectrum it does not want.
- 3.34 With our limited information policy, there may also be more scope for bidders to bid in a non-straightforward way, in order to glean more precise information on excess demand. This is because bidders would be better able to drop their demand in small increments in an attempt to switch between increments of reported excess demand, particularly earlier in the auction when excess demand is high.
- 3.35 However, even with 5 MHz lot sizes, we think that the residual risks bidders face of accidentally winning spectrum later in the auction when excess demand is lower, in addition to our proposed mitigations to price driving, sufficiently disincentivises this type of non-straightforward bidding.
- 3.36 On balance, while we recognise some disadvantages, we prefer a 5 MHz lot size, in particular to avoid precluding options to bidders who might wish to bid in multiples of 5 MHz. We would be interested in views from stakeholders on this.

Standing high bidders and ranking mechanism

- 3.37 In standard SMRAs, 'standing high bids' are assigned to bidders at the end of each round. This is helpful as it means bidders know what they will win and what they will pay if the auction were to close at that point. Standing high bids are established on the basis of bids received for lots in each category at the end of principal stage rounds.
- 3.38 When demand exceeds the number of available lots in a lot category, Ofcom would determine which bids are standing high bids. We propose to do so through a ranking mechanism. Under this proposed approach, only one bidder in each lot category may

become standing high bidder on fewer lots than the number of lots they bid for (a 'partial standing high bidder').

- 3.39 In each round after the first round, for each lot category bidders would be able to either maintain their standing high bids (full or partial standing high bids) from the previous round, or place new bids at the current round price. After all bids have been placed in a round, we would randomly rank all bidders that have submitted bids at the current round price for a particular category of lot, and allocate lots as 'standing high bids' to these bidders.
- 3.40 If there are still lots available after this, we would then randomly rank and allocate lots to any bidders that have maintained their standing high bids at a previous round price, subject to any partial standing high bidder at a previous round price being last in the ranking. If all lots have been allocated as standing high bids at the current round price, then we would increase the round price for this lot category in the next round.
- 3.41 This rule reduces aggregation risk, because it ensures that there is at most only one partial standing high bidder in every round in each lot category. This is also the same approach as we adopted for the last SMRA we ran for the award of the 2.3 GHz and 3.4-3.6 GHz bands.
- 3.42 A possible drawback of this approach is that it may disclose some information about the structure of demand which could facilitate strategic demand reduction. For example, if levels of excess demand are low, a bidder that is a partial standing high bidder in a particular lot category at the start of the round would know by how much it would need to reduce its demand in order to settle demand in that category, and potentially bring the principal stage to an end.
- 3.43 We recognise that this is a residual risk inherent to this approach. However, we consider the benefits of this approach in reducing aggregation risk outweigh the downsides. We are also proposing to adopt a limited information policy, where bidders will receive only some information about excess demand as the auction progresses, which is a mitigation to the risk of strategic demand reduction (as explained further below).
- 3.44 We also propose that, whenever bidders wish to place new bids at a new round price, they will need to resubmit any standing high bids they may hold at the previous price level at the new round price. This means that a bidder cannot hold standing high bids at different round prices in the same lot category, and would allow for a speedier bidding process with little downside.
- 3.45 Under our proposed approach, winning bidders may end up paying prices that are one round price increment higher or lower than other winning bidders in the same lot category.
- 3.46 NERA, on behalf of O2, suggested an alternative pricing rule, such that all winners in a lot category pay a uniform price equal to the lowest winning bid.³⁵ NERA claimed that this would make the auction fair to all operators.

³⁵ NERA non-confidential response to the December 2018 consultation, page 36-37.

- 3.47 We think that the pricing in the SMRA format should remain pay-as-bid even when there are multiple prices in a lot category, as we consider this encourages straightforward bidding.³⁶ We are aware that in the 2.3 and 3.4-3.6 GHz auction O2 paid a higher amount per lot than other bidders in the 3.4-3.6 GHz lot category. However, we consider that all operators had an equal possibility of paying the higher price (O2 was randomly selected to face the higher price in the category first) and we therefore consider that the equal risk faced by all operators was fair. We are therefore minded to maintain the proposed pricing rule in the SMRA.

Activity rule

- 3.48 The bidding process for the principal stage would proceed over one or more rounds. Bidding would be subject to a points-based activity rule to ensure that bidding is progressive, preventing bidders from withholding demand until relatively late in the auction.
- 3.49 The activity rules are designed to prevent bidders from expanding their demand as prices increase, and therefore deter bidders from withholding their true demand strategically early in the bidding process.
- 3.50 Bidders are attributed an eligibility level for each round, which constrains the number of bids they can submit in the round. The eligibility level of bidders in the first round is based on their initial deposit. Thereafter, bidders' eligibility levels are adjusted round by round with reference to their activity in the preceding round that they submitted bids.
- 3.51 As prices may only increase in the course of the auction, the eligibility level of a bidder may remain constant or decrease, but may not increase. Specifically, if the activity of a bidder is lower than the bidder's eligibility level in a given round, this would lead to a reduction in the bidder's eligibility (unless the bidder has submitted a 'waiver').
- 3.52 Each lot would have a number of eligibility points associated with it (as set out below). The bidder's activity is the sum of the eligibility points of all the lots for which it submits bids in a given round, and of all the lots for which the bidder holds standing high bids in lot categories where the bidder does not submit any new bids in the round.
- 3.53 We are proposing to allow each bidder to use a maximum of three 'waivers', which would allow that bidder to not submit any bids in a round, while still carrying forward its eligibility into the next round. This is explained more below.

³⁶ We outline an example whereby non-straightforward bidding may occur if the rule was changed to bidders paying the lowest winning bid price in a lot category. Suppose a bidder valued a lot for 102, and faced a price increase from 100 to 105. If the bidder expected the auction to end soon, the bidder may take the risk and bid above its valuation at a price of 105. This is in expectation that the auction would end and the bidder would only pay 100. If the bidder misjudges, this could result in an inefficient outcome where the bidder wins spectrum at a price greater than its valuation.

Eligibility points

- 3.54 We propose the following eligibility points for the spectrum lot categories, which we consider would appropriately facilitate switching between the bands:
- a) Four points for a 2x5 MHz 700 MHz FDD lot;
 - b) One point for a 5 MHz 700 MHz SDL lot;
 - c) One point for a 5 MHz 3.6-3.8 GHz lot.
- 3.55 The ratio of eligibility points between lot categories can affect bidders' options to substitute their demand between bands (for lots on which they are not the standing high bidder). The ratios on a per MHz basis in our proposals are 2:1 between 700 MHz FDD and SDL and between 700 MHz FDD and 3.6-3.8 GHz.
- 3.56 In general, there are two broad reasons that underlie the ratio at which bidders substitute between lot categories in response to a change in relative prices:
- a) Bidders may seek to substitute between suitable relative amounts of spectrum in different bands for technical or commercial reasons. Eligibility point ratios reflecting suitable relative MHz amounts in each lot category could facilitate such substitution between two bands. As set out above, while we recognise some bands are more substitutable than others, we consider that all the award bands can be substitutes to some extent.
 - b) Bidders may also substitute based on budget reasons. For example, the price a bidder faces in one band, for the amount of spectrum it wants, may exceed its budget. The bidder may choose to switch all or part of its demand to another band. A bidder may also find this helpful to manage any budget constraints they may have. For this type of switching, we discuss below possible eligibility point ratios reflecting the relative differences in market prices on a per MHz basis between the two lot categories. However, this involves a significant simplification, as the relative market prices that are of interest to a specific bidder also reflect the relative spectrum amounts that it wishes to acquire in the different bands. For example, if a bidder is considering switching for budget-based reasons from 2x10 MHz of 700 MHz FDD to 40 MHz of 3.6-3.8 GHz spectrum, the relevant comparison is not relative market prices per MHz, because the desired spectrum amounts in the two bands are different. Instead the bidder would be more interested in relative market prices of the desired spectrum blocks. In this example, the relevant ratio would be *one-half* of the per-MHz ratio (i.e. the ratio of the per-MHz price of 700 MHz FDD to double the per-MHz price of 3.6-3.8 GHz, since there is double the amount of spectrum in the desired 3.6-3.8 GHz block compared to the 700 MHz FDD block).
- 3.57 Our proposed eligibility points are the same as proposed in the December 2018 consultation for the CCA format. We received comments from BT/EE and O2 on our eligibility point proposals in response to that consultation.

- 3.58 BT/EE agreed with our eligibility point proposals on 700 MHz FDD and 700 MHz SDL, but proposed a 4:1 eligibility ratio per MHz between 700 MHz FDD and 3.6-3.8 GHz. This would give rise to 0.5 eligibility points per 5 MHz of 3.6-3.8 GHz. BT/EE considered this would better reflect relative values than our proposed 2:1 ratio.³⁷
- 3.59 O2 argued for a 1:1 eligibility ratio between 700 MHz FDD and 700 MHz SDL as all other ratios impede switching. O2 argued there is no appropriate eligibility ratio between 700 MHz and 3.6-3.8 GHz spectrum as these bands are not substitutable and should not be auctioned in the same stage.³⁸

We propose a ratio of 2:1 between 700 MHz FDD and 3.6-3.8 GHz spectrum

- 3.60 We have considered BT/EE's suggestion that a 4:1 per MHz eligibility ratio between 700 MHz FDD and 3.6-3.8 GHz is appropriate because it is a better reflection of relative market prices between the two bands. As noted above, this is one of the factors in the consideration of eligibility points, reflecting the possibility of substitution for budget reasons.
- 3.61 There is significant uncertainty about the relative prices of these two bands in the auction. We have examined two types of evidence, neither of which is necessarily reliable, but can serve as reference points.
- 3.62 First, there are the relative-value benchmarks for 700 MHz market value that we considered when discussing reserve prices in the December 2018 consultation (plus a benchmark for the 700 MHz auction in Sweden which concluded on 12 December 2018). Each relative-value benchmark seeks to estimate a UK-equivalent market value of 10 MHz of 700 MHz FDD by combining the relative auction prices of 700 MHz to 800 MHz spectrum in the benchmark European country with the UK market value of 800 MHz.³⁹ Figure 3.1 shows the six relative-value 700 MHz FDD benchmarks, compared to the UK price of 3.4-3.6 GHz spectrum, which was £75.65m per 10 MHz in our 2018 auction.⁴⁰

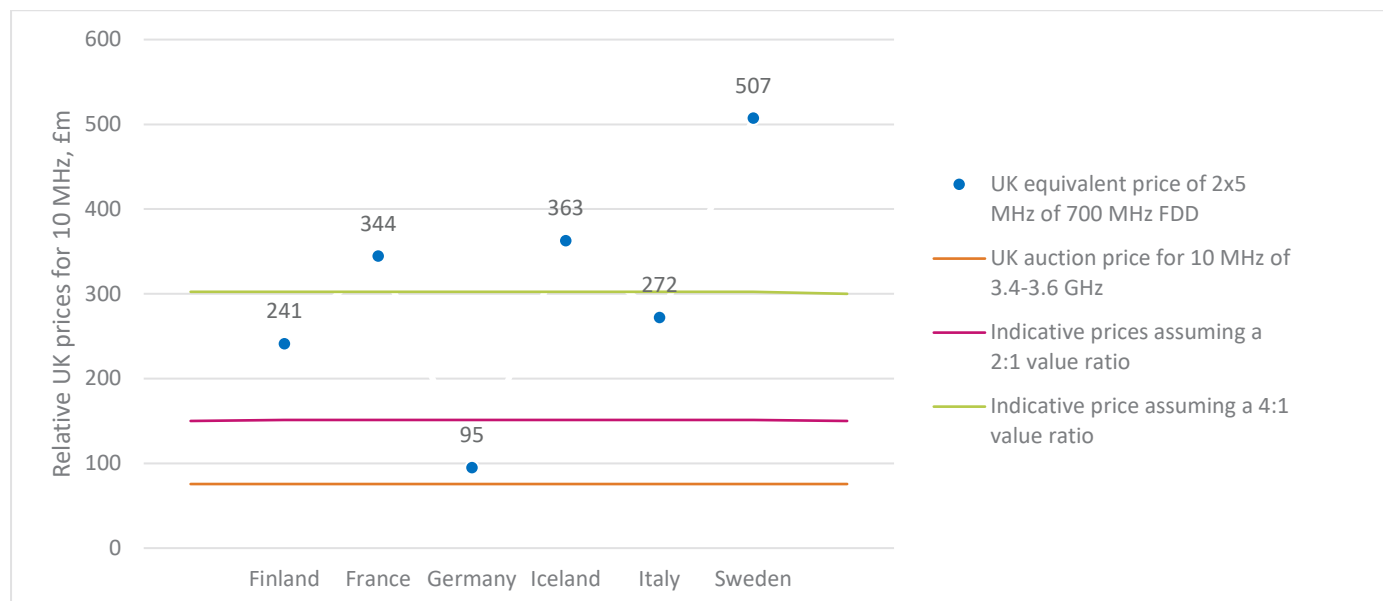
³⁷ BT/EE non-confidential response to the December 2018 consultation, page 61.

³⁸ O2 non-confidential response to the December 2018 consultation, page 45, paragraph 211.

³⁹ We also apply a series of adjustments to make the values more comparable and up-to-date – see paragraphs 7.236-7.238 in the December 2018 consultation.

⁴⁰ O2 won 40 MHz of spectrum in the 3.4-3.6 GHz band at £39.7m per 5 MHz, which was one round price increment higher than the other winning bidders.

Figure 3.1: Relative-value 700 MHz FDD benchmarks and UK auction price of 3.4-3.6 GHz per 10 MHz



Source: auction results of the UK 2.3 and 3.4-3.6 GHz award; benchmarks for 700 MHz FDD derived from: auction results from the respective European countries, Ofcom adjustments to control for cross-country variations, price ratio of 700 MHz to 800 MHz spectrum for each country, PPP, and inflation. The benchmark methodology follows the one described in the December 2018 consultation for determining reserve prices.⁴¹ The relative prices have been updated to account for inflation to September 2019 levels.^{42,43}

- 3.63 The comparison per 10 MHz shown in Figure 3.1 shows a greater density of points around the 4:1 ratio. The 4:1 ratio lies within the middle of the range of benchmarks (£302m), while a 2:1 ratio suggests a price for 2x5 MHz of 700 MHz towards the lower end of the international prices observed, (£152m). This could suggest that 4:1 is more reflective of the relative value between these two bands.
- 3.64 However, as noted above, the relevant budget-based switching also depends on the relative spectrum amounts of interest to the bidder in the two bands. For example, for a bidder considering switching between 2x10 MHz of paired 700 MHz and 40 MHz of 3.6-3.8 GHz, the more relevant ratios would be one-half of those shown in Figure 3.2. For such a bidder, the benchmarks would be more consistent with a ratio of 2:1 than 4:1.
- 3.65 Comparing the UK auction price of 3.4-3.8 GHz with international UK-equivalent benchmarks for the price of 700 MHz is an indirect comparison of the relative prices of the

⁴¹ December 2018 consultation, paragraphs 7.233-7.238.

⁴² December 2018 consultation, paragraphs 7.233-7.238

⁴³ The relative prices have also changed because the auction data of Italy and Germany were discovered to be incorrect for the December 2018 consultation and have now been corrected. For the Italian auction, the reserve prices were updated to reflect a correction on the number of instalments in which the bidders could pay their auction fees. After adjusting for inflation, this decreased the relative price by £17m. For the German auction, the reserve prices were updated to reflect a correction on the date the spectrum was available for use. After adjusting for inflation, this increased the relative price by £2m.

two spectrum bands.⁴⁴ Therefore, the second type of evidence compares directly the auction prices of 3.4-3.8 GHz with the prices of 700 MHz FDD in those European benchmark countries (for the three countries which have held non-combinatorial auctions of both bands). These ‘in-country’ ratios are shown in Figure 3.2 for Finland, Germany and Italy. They span a range that includes both a 4:1 and a 2:1 ratio.

Figure 3.2: In-country ratios of auction prices per 10 MHz of 700 MHz FDD and 3.4-3.8 GHz

In-country ratio	
Finland	5.3
Germany	1.6
Italy	2.0

Source: we identified European countries which held non-combinatorial awards for both the 3.4-3.8 GHz band and the 700 MHz FDD band. We discounted the auction price to consider the payment method and any annual licence fees. Adjustments were then made for the licence duration and inflation within each country. Finally, an adjustment is made for the delay between the auction date and the licence start date. We used inflation data from the World Bank to adjust prices within each country to 2019 levels.⁴⁵ We discounted prices using WACC data from the Annual Licence fee statement.⁴⁶

- 3.66 As regards technical and commercial substitution, the appropriate ratio of eligibility points depends on the suitable relative amounts of spectrum in each band. This is not clear-cut, given the significant difference in frequency between the two bands. Moreover, the importance of this consideration depends on the degree of substitutability of the 700 MHz FDD and 3.6-3.8 GHz bands. As discussed above, we do not consider these bands are close substitutes.
- 3.67 Another consideration is the practicality of switching in different directions between the two bands. A 4:1 ratio makes it materially more difficult in practice to substitute from 3.6-3.8 GHz spectrum to paired 700 MHz spectrum, compared to a 2:1 ratio, due to the larger quantities of spectrum required to switch. For example, an eligibility ratio of 4:1 requires a bidder to substitute 80 MHz of 3.6-3.8 GHz spectrum to have sufficient eligibility to bid for 2x10 MHz of paired 700 MHz spectrum. It is not clear to us that bidders will find it useful to substitute from such large quantities of spectrum in 3.6-3.8 GHz, which represent a significant proportion of the spectrum available in the auction.
- 3.68 In contrast, in the other direction, with a 4:1 ratio a bidder could switch from 2x10 MHz of paired 700 MHz spectrum to any amount of spectrum in 3.6-3.8 GHz up to 80 MHz. Therefore, we are concerned that bidders may face greater restrictions substituting in one direction - from 3.6-3.8 GHz to paired 700 MHz- than the other. Bidders could have

⁴⁴ In effect, the ratios discussed above reflect the 700 MHz price in the benchmark country, modified by the ratio of the benchmark country price of 800 MHz to the UK market value of 800 MHz (to seek to convert to a UK-equivalent value for 700 MHz), divided by the UK auction price of 3.4-3.6 GHz.

⁴⁵ <https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG> [accessed 24 August 2019]

⁴⁶ https://www.ofcom.org.uk/_data/assets/pdf_file/0021/130548/Annexes-1-6.pdf

incentives to deviate from straightforward bidding to manage the difficulties of switching from 3.6-3.8 GHz to paired 700 MHz. In turn, this could have impacts for efficiency.

- 3.69 The available evidence discussed above about relative prices is neither entirely reliable, nor conclusive about the appropriate eligibility ratio. On balance, given the risks of higher ratios for the practicality of switching in both directions between the 700 MHz FDD and 3.6-3.8 GHz bands, we are minded to favour a ratio of 2:1 as more appropriate. However, we would welcome further evidence and views on this eligibility ratio.

We propose a ratio of 2:1 between 700 MHz FDD and 700 MHz SDL spectrum

- 3.70 We consider 2:1 is an appropriate eligibility ratio between 700 MHz paired and unpaired spectrum. We recognise a 1:1 eligibility point ratio, on a relative per MHz basis, may facilitate technical substitution between the two lot categories. However, we note that other bidders may choose to substitute based on budget, for which a higher eligibility ratio may be more appropriate given the likely lower value of 700 MHz SDL. Higher eligibility ratios such as 4:1 may be appropriate for budget-based switching. Therefore, we consider a 2:1 eligibility ratio to be a reasonable balance between the two types of substitution.
- 3.71 Finally, we consider there to be a small risk of strategic bidding if we use a 1:1 eligibility ratio. The lower eligibility on the SDL spectrum mitigates the risk that a bidder can retain eligibility in the auction by bidding on the SDL spectrum, even if it prefers the paired 700 MHz spectrum. This would enable a bidder to somewhat mask its preferences in the early stages, and then transfer eligibility to its most preferred lots later on. As this strategy involves bidding on less preferred spectrum in some rounds, it is in our view undesirable.

Waivers, minimum requirement, and withdrawals

- 3.72 In this sub-section we consider possible additional mitigations to aggregation risk and substitution risk in an SMRA, specifically waivers, minimum requirement, and withdrawals.
- 3.73 As described above, aggregation risk entails a bidder winning a smaller amount of spectrum than that for which it originally, which it no longer wants at the given price due to complementarities between lots. Aggregation risk can be mitigated to some extent by allowing the use of waivers and minimum requirements.
- 3.74 Bidders face substitution risk if they wish to change the band in which they are bidding. For example, in the process of switching to the new band, a bidder may not have enough eligibility to bid for as many lots as it wants in the new band if it still has standing high bids in the previous band which are taking up eligibility points. Substitution risk can be mitigated by allowing the use of withdrawals and waivers.

Waivers

- 3.75 A bidder may waive the right to bid in a round by using a 'waiver'. A bidder who submits a waiver in a round will not have its eligibility level adjusted in the following round, even though its activity level will be lower than its eligibility. If a waiver is used in a round, no other bidding action can be taken in that round by the bidder who submitted the waiver.

- 3.76 Waivers may be useful to bidders in a number of circumstances:
- they may assist bidders in managing aggregation risk. An example of this is a bidder that is currently a standing high bidder on fewer lots than it bid for originally in a band, and does not wish to win this lower amount of lots at the current given price. The bidder then faces a choice: it could either re-bid its original bid at a higher price or could stop bidding on the band and hope to be outbid on all of its lots. The bidder may find it beneficial to use a waiver to help inform its choice, as doing so may give it more clarity as to whether it would be outbid on all of its standing high bids in the band;
 - they may be particularly helpful for substitution risk, in assisting bidders who wish to move demand across categories. For instance, if a partial standing high bidder in a given band wishes to switch to bid on another band, it may first use a waiver to see if it is outbid;
 - they may also be useful when bidders would want to use information (for example, a change in relative prices) before they commit to a decision on how to bid;
 - they could be useful when bidders experience difficulties, technical or otherwise, which prevent them from submitting a bid.⁴⁷ In the circumstances where the failure to submit a bid would result in a loss of eligibility, a default waiver would be used on behalf of the bidder.
- 3.77 There are some risks associated with waivers, such as repeated use of waivers undermining the price discovery process. This is because a bidder that has used a waiver effectively has its demand ‘hidden’ in that round, which could suggest lower levels of excess demand to other bidders than is actually the case.
- 3.78 We also note the potential risk that bidders could use waivers to attempt to signal to each other, and therefore be used to facilitate tacit collusion. However, we do not think this is likely to be a major concern in practice, as waivers are unlikely to be an effective signalling mechanism under our proposed limited information policy and restriction on bidders submitting a waiver and bids in the same round. The latter means that a bidder could not bid in one band and waive in another. If a bidder attempts to use a waiver to signal, it may be unclear to others that a waiver has been submitted. Even if bidders are able to glean that a waiver has been submitted, there would be no certainty to others as to which bidder it is, or what it is attempting to signal.
- 3.79 We think that the benefits of allowing bidders to manage bidding risks and technical difficulties using waivers, outweigh the associated downsides. Nonetheless, we still consider it important to limit the number of waivers a bidder may use in order to avoid undermining the price discovery process, and further limit the scope for signalling.

⁴⁷ In previous auctions there has been a specific provision in the Auction Regulations for bidders to submit their bids through an alternative method in the event of technical failure. This method has typically been fax. We are proposing a similar provision in the current draft Auction Regulations. However, we note that bidders may prefer to use a waiver under these circumstances, for example, due to the risk that the bidder may accidentally submit an invalid bid through this alternative method.

- 3.80 In this auction, we propose that each bidder would have three waivers for the principal stage. This is the position we adopted in the 2.3 and 3.4-3.6 GHz auction. Each of Airspan, BT/EE and Vodafone used one waiver during that auction.

Withdrawals

- 3.81 Typically, in SMRA auctions bidders are able to withdraw their standing high bids. Withdrawals can aid bidders in mitigating substitution risk. By withdrawing their standing high bids in a band, bidders free up eligibility points which they can then use to bid on another category of lot.
- 3.82 There are risks to implementing withdrawals in an auction. In particular, bidders might bid in one category with the sole intent of pushing up prices before leaving that category altogether. Another downside is that the use of withdrawals may leave spectrum unsold which, absent withdrawals, would have been won by another bidder. There is therefore a risk that allowing withdrawals could result a less efficient outcome than would otherwise be the case.
- 3.83 To reduce the downsides of withdrawals in the 2.3 GHz and 3.4-3.6 GHz auction, only partial standing high bidders were permitted to withdraw, and a bidder was liable to pay for any lots that remained unsold at the end of the auction if they were caused by that bidder using a withdrawal. Any liability payment that was due would approximate the economic value of the spectrum to other bidders.⁴⁸ Were we to propose withdrawals, we consider that the most appropriate way to incorporate them into this auction would be to take the same withdrawal approach as in the 2.3 GHz and 3.4-3.6 GHz auction.
- 3.84 We note that withdrawals also added complexity to the design of the 2.3 GHz and 3.4-3.6 GHz auction. For example, the withdrawal rule's interaction with the 37% overall spectrum cap in the last auction gave rise to a 'bid constraint effect', which restricted a bidder affected by the overall spectrum cap from switching its full demand via withdrawals in some circumstances. This was due to the possibility that a bidder could otherwise end up winning more spectrum than its overall cap, if it accepted a licence for any withdrawn spectrum.⁴⁹
- 3.85 The complexity and restriction associated with withdrawals would be greater in the current award because there are more bands that bidders could in theory switch between via withdrawals (there are three bands, as opposed to two in the last auction). A bidder could therefore theoretically be liable for standing high bids *and* withdrawn spectrum in all three bands in the course of the auction. Withdrawals would also add some implementation

⁴⁸ More specifically, lots which would otherwise remain unsold as a consequence of a withdrawn bid would have been instead offered to the bidder who placed the bid. In order to mitigate incentives to use withdrawals for gaming purposes, the offer price would have been equivalent to twice the level of the withdrawn bids. However, the bidder would have been entitled to decline the offer at the grant stage and, if it did this, the amount payable by that bidder would have been equivalent to the original level of the withdrawn bids for which it is liable (i.e. the single round price).

⁴⁹ See Ofcom's Statement 'Award of the 2.3 and 3.4-3.6 GHz spectrum bands: competition issues and Auction Regulations', 11 July 2017, pages 80-84.

complexity to the auction, for example to the Auction Regulations and software, to account for all possible permutations.

- 3.86 As described above, we do not consider the bands in this auction to be close substitutes. We therefore consider that there will be less substitution risk in this award compared to the 2.3 GHz and 3.4-3.6 GHz award. We also note that no bidders used withdrawals in the 2.3 GHz and 3.4-3.6 GHz award. Given the scope for strategic bidding and unsold spectrum, as well as the complexity withdrawals add to the auction design, we consider that for this auction the downsides of withdrawals outweigh the benefits of withdrawals.
- 3.87 We are therefore proposing not to allow withdrawals in the auction.

Minimum requirement

- 3.88 One potential measure to help bidders manage in-band aggregation risk is to allow bidders to specify a minimum requirement of spectrum in a lot category. The purpose of the minimum requirement would be to protect bidders from being stranded with a quantity of spectrum which is below a minimum threshold. Even if a bidder is a standing high bidder on some spectrum, the bidder would not be allocated less spectrum in a lot category than its specified minimum requirement. When minimum requirements are implemented, the minimum requirement threshold is usually set where there is the most significant source of value complementarity between lots.
- 3.89 While a minimum requirement would help to address aggregation risk, there are potential downsides to allowing bidders to specify a minimum requirement per band. For example, it may allow bidders to place bids which have a relatively low chance of becoming winning bids. This is particularly likely when bids are placed at the minimum requirement level so that if the bidder is outbid on one lot (i.e. it becomes standing high bidder on less than its minimum requirement), then it does not need to pay for any of its bids. Two reasons for a bidder submitting such strategic bids could be:
- a) To submit bids aimed purely at pushing up prices in a given category. This could have negative repercussions for efficiency if a bidder who is trying to price drive accidentally wins the spectrum.
 - b) To submit bids aimed at causing unsold spectrum in a band to deny spectrum to competitors.
- 3.90 In the 2.3 GHz and 3.4-3.6 GHz auction bidders were allowed to set a minimum requirement for the 3.4-3.6 GHz band in increments of 5 MHz up to 20 MHz.
- 3.91 We received comments from BT/EE and O2 on minimum requirements in response to the December 2018 consultation, in the context of the alternative SMRA formats to include coverage obligations.
- a) To address aggregation risk in the SMRA format BT/EE *“would include the option for each bidder to specify a minimum spectrum requirement of up to 2 × 10 MHz (two lots) of 700 MHz FDD spectrum”*.

- b) In addition, BT/EE “would include the option for each bidder to specify a minimum spectrum requirement of up to 20 MHz (two lots) of 3.7 GHz spectrum (but not more, as that would have the potential to create strategic risks for both Ofcom and bidders)”.⁵⁰
- c) NERA, on behalf of O2, suggested that the ability to specify a ‘minimum requirement’ up to 20 MHz could be offered to non-MNOs, to protect such bidders from winning a very small amount of spectrum. It said, “such a minimum [requirement] is not needed for MNOs given that [they are] expected to seek to aggregate any spectrum they acquire with their existing holdings in the wider 3.4-3.8 GHz band.”⁵¹
- 3.92 In considering whether to allow bidders to specify a minimum requirement, we need to balance the risks of unsold spectrum and the risk that minimum requirements could be used strategically, against the benefits of helping bidders to manage aggregation risk.
- 3.93 We consider that including the option for bidders to specify a minimum requirement in either category of the 700 MHz band is not appropriate. This is due to the small number of lots available in those bands. If, for example, BT/EE’s suggestion was implemented, it would be possible that 2x5 MHz of spectrum would remain unsold in the 700 MHz FDD category (when there might have been demand from other bidders for that unsold spectrum). This would be 16.7% of spectrum in the band.⁵²
- 3.94 We are also not proposing to allow bidders to specify a minimum requirement in the 3.6-3.8 GHz band for this award. This is a departure from the approach we took in the 3.4-3.6 GHz band in the last auction.
- 3.95 We think there may be additional disadvantages to allowing bidders to specify a minimum requirement in the 3.6-3.8 GHz band in this award, compared to in 3.4-3.6 GHz band in the last auction. As noted above, the potential predictability of demand in the 3.6-3.8 GHz band may magnify the risks of strategic bidding behaviour to raise prices in the band, which could be further facilitated by allowing bidders to specify a minimum requirement in 3.6-3.8 GHz.
- 3.96 Absent a minimum requirement, a price driving bidder that is bidding in a band only to increase prices for its competitors would ordinarily face the risk of accidentally winning a small amount of spectrum that it does not actually want. However, this risk is significantly reduced if a price driving bidder were able to specify a minimum requirement. A bidder that uses the minimum requirement to facilitate price driving could also then cause unsold spectrum as a result.⁵³ We therefore have concerns about a 3.6-3.8 GHz minimum requirement potentially being used for strategic bidding.

⁵⁰ BT/EE non-confidential response to the December 2018 consultation, page 66, paragraph 5.34.

⁵¹ NERA (on behalf of O2) non-confidential response to the December 2018 consultation, page 36.

⁵² In the 2.3 GHz and 3.4-3.6 GHz auction we also did not allow bidders to specify a minimum requirement in the 2.3 GHz band because it would have constituted a large proportion of the available spectrum (40 MHz).

⁵³ To illustrate, a price driving bidder could specify a minimum requirement of 20 MHz in 3.6-3.8 GHz and then consistently bid on 20 MHz, with the expectation that it would be outbid on at least one lot. The bidder would stop bidding once prices have risen sufficiently high, and it is standing high bidder on less than 20 MHz. If the bidder still has any standing high bids

- 3.97 We note that for MNOs the aggregation risk associated with winning a small amount of spectrum in 3.6-3.8 GHz is reduced as they all have pre-existing holdings across the 3.4-3.8 GHz band. MNOs can seek to make their spectrum holdings contiguous through post auction trades, or deploy multiple carriers to make use of their separate blocks of 3.4-3.8 GHz spectrum.⁵⁴ As set out below, our proposals include measures in the assignment stage to facilitate post-auction trades to achieve contiguity or proximity of holdings in the 3.4-3.8 GHz band.
- 3.98 We have considered whether to allow ‘new entrant’ bidders that do not have spectrum holdings in the 3.4-3.8 GHz band at the time of the auction to specify a minimum requirement in the 3.6-3.8 GHz band. We consider it unlikely that such bidders would have strategic incentives to create unsold spectrum or to increase prices for other bidders, as they would be less likely to be direct competitors to MNOs in downstream markets. However, we have limited evidence of demand for such a measure from prospective bidders with no pre-existing 3.4-3.8 GHz holdings.⁵⁵
- 3.99 We are therefore proposing not to have a minimum requirement in any band of the auction. However, we would consider allowing bidders that do not have any holdings in the wider 3.4-3.8 GHz band to specify a minimum requirement of up to 20 MHz in the 3.6-3.8 GHz band if we see strong reasons for including such a measure as a result of responses to this consultation.
- 3.100 We recognise that by not allowing minimum requirements in any band, bidders may face some aggregation risk within the award bands. However, we believe that this should be manageable for bidders. We note that while bidders may prefer larger quantities, evidence suggests 2x5 MHz of 700 MHz FDD and less than 20 MHz of 3.6-3.8 GHz are likely to be useable amounts.
- 3.101 While there is less certainty on the 700 MHz SDL spectrum, as set out in the discussion on lot sizes, there are also equipment options for deploying 5 MHz or 15 MHz for this spectrum. We also note that in the absence of minimum requirements, our proposals to maintain waivers may also help bidders to manage aggregation risk as set out above.

Information policy

- 3.102 We propose to disclose the total number of qualified bidders and their identity before the auction. This is the same approach as proposed in the December 2018 consultation, and as

at the end of the principal stage in 3.6-3.8 GHz, it would be guaranteed not to win this spectrum, which would then go unsold.

⁵⁴ In the longer term, it may also be possible for operators to aggregate carriers across multiple spectrum bands. We considered the potential concerns associated with aggregating non-contiguous 5G carriers in our December 2018 consultation. Our expectation, as set out in the December 2018 consultation, is that the limitations associated with non-contiguous holdings, inherent to the early stage of the new technology, would reduce in the future as the technology develops and matures. See paragraphs 5.255-5.263.

⁵⁵ We also note that, if such bidders won less than 20 MHz, and this was an insufficient amount of spectrum for their use case, they would have opportunities to trade the spectrum post auction. We consider post auction trading mitigates the impact to efficiency, if such a bidder was to win an insufficient amount of spectrum.

- we took in our previous auctions such as the 2018 award of the 2.3 GHz and 3.4-3.6 GHz bands.
- 3.103 During the auction, we propose to reveal some limited information on excess demand at the end of each round. This is in the interest of maintaining a balance between mitigating the risk of strategic bidding, while still allowing sufficient information to make informed bidding decisions.
- 3.104 We recognise that some information about the level of aggregate demand may be useful to help bidders address risks in the auction. For example, demand information can help bidders to manage aggregation risk as it helps bidders identify which packages they are most likely to win. In circumstances where there is common value uncertainty (i.e. the value of the spectrum is common but unknown to bidders), information about the level of aggregate demand in each frequency lot category also allows bidders to improve estimates about spectrum value.
- 3.105 However, we are concerned that revealing precise levels of aggregate demand during the principal stage could facilitate strategic demand reduction or market division. As set out above, these are greater risks in the SMRA format compared to the CCA, and we consider this may be a particular concern for this award.
- 3.106 We are also concerned that revealing precise levels of demand may facilitate price driving in the SMRA. For example, a bidder that wishes to price drive could use precise aggregate demand information to more accurately predict bids to increase prices for other bidders in a band, while also minimising the risk that it ends up winning spectrum it does not actually want.
- 3.107 We received some comments from stakeholders on the similar information policy we proposed in our December 2018 consultation. While responses were mostly specific to the CCA proposals, respondents generally favoured revealing precise information about demand to bidders. For example, BT/EE said Ofcom should consider making more information available to bidders irrespective of the auction format used, including the identity of standing high bidders and the number of lots on which they are standing high bidder.⁵⁶ It suggested that overly limiting the quantity and quality of information available to bidders can result in an inefficient allocation of spectrum.
- 3.108 O2 noted that for an SMRA, it would prefer that aggregate demand data is published in full, but that restrictions similar to those used for our award of the 2.3 GHz and 3.4-3.6 GHz bands would also be acceptable.⁵⁷ In the context of the CCA proposals, Vodafone argued that the limited information policy increases complexity for bidders,⁵⁸ while H3G argued

⁵⁶ BT/EE non-confidential response to the December 2018 consultation, page 73, paragraph 5.62.

⁵⁷ O2 non-confidential response to the December 2018 consultation, page 47, paragraph 221. We note that in the 2.3 and 3.4-3.6 GHz auction, we adopted a limited information policy where we revealed levels of excess demand for each band rounded up to the nearest higher increment of 20 MHz.

⁵⁸ Vodafone non-confidential response to the December 2018 consultation, page 46.

that precise levels of demand would help reduce common value uncertainty and make outcomes more predictable.⁵⁹

- 3.109 We note that the SMRA already offers bidders greater levels of certainty on prices and outcome compared to the CCA, due to it being a pay-as-bid auction and bidders being guaranteed to win their standing high bids in the final round. This reduces some of the risks raised by stakeholders associated with revealing limited demand information during the principal stage. Given the risks associated with revealing more precise information set out above, we consider that it would be appropriate to reveal some, but not all, information about demand during the principal stage.
- 3.110 We therefore propose to reveal the following demand information to bidders after the end of each principal stage round:
- a) For the 3.6-3.8 GHz band – excess demand rounded up to the nearest higher increment of 20 MHz. This would mean reporting excess demand as strictly less than 20 MHz, at least 20 MHz but less than 40 MHz, at least 40 MHz but less than 60 MHz, etc.
 - b) For the 700 MHz FDD band – excess demand rounded up to the nearest higher increment of 20 MHz, equivalent to multiples of 2x10 MHz. This would mean reporting excess demand as strictly less than 20 MHz (2x10 MHz), at least 20 MHz (2x10 MHz) but less than 40 MHz (2x20 MHz), at least 40 MHz (2x20 MHz) MHz but less than 60 MHz (2x30 MHz), etc.
 - c) For the 700 MHz SDL band - we propose to reveal information rounded up to the nearest higher increment of 10 MHz. This would mean reporting excess demand as strictly less than 10 MHz, at least 10 MHz but less than 20 MHz, at least 20 MHz but less than 30 MHz, etc.
- 3.111 For the 3.6-3.8 GHz band, the lowest level of excess demand reported would be the equivalent of less than four lots, while for the two 700 MHz bands it would be less than two lots. This means, if there was no excess demand or excess supply, bidders would only see that excess demand is less than 20 MHz for 3.6-3.8 GHz, less than 20 MHz (2x10 MHz) for 700 MHz FDD, and less than 10 MHz for 700 MHz SDL.
- 3.112 For 700 MHz SDL, we consider it appropriate to report smaller increments of excess demand than the other two bands. This is because, given the small amount of spectrum available in the 700 MHz SDL band, we consider that the smaller increments are likely to provide more meaningful information about demand.
- 3.113 We recognise that revealing limited information may incentivise bidders to bid in a non-straightforward way in order to gauge precise levels of excess demand. For example, a bidder may bid on more spectrum in a particular lot category, with the express purpose of dropping its demand incrementally to see if the reported level of excess demand changes at the end of the round. However, this strategy is not guaranteed to work, as it relies on other bidders' demand remaining the same in that lot category in order for the first bidder

⁵⁹ H3G non-confidential response to the December 2018 consultation, page 51.

to gain any meaningful information about demand. Any bidder that follows this strategy is also taking the risk that, if it misjudges the levels of demand in the lot category where it is trying to glean more precise demand information, it could win and pay for more spectrum than it wants.

Deposits during the principal stage

- 3.114 We propose to adopt the same approach to deposits during the principal stage of an SMRA auction, as set out in the December 2018 consultation (in respect of the CCA that we were then proposing), which we also summarise below. We note that this proposal is the same approach that we adopted for the 2018 auction of the 2.3 GHz and 3.4-3.6 GHz bands, which was also an SMRA.
- 3.115 We propose that applicants would need to submit an initial monetary deposit which might be forfeited, in whole or in part, if the applicant subsequently breaches the Auction Regulations. In addition, before the first round of the auction, qualified bidders would need to provide an additional deposit to Ofcom which would determine the bidder's initial eligibility level. Any interest made by Ofcom while holding the deposits would be paid into the Consolidated Fund.
- 3.116 We propose that the initial eligibility will correspond to the maximum number of spectrum lots that could be acquired by a bidder using its total deposit at the reserve price(s). We also propose that, at any point during the auction, Ofcom may require bidders to increase their deposits up to an amount equal to the value of the highest bid submitted so far by the bidder.
- 3.117 Respondents to the December 2018 consultation either had no comments on our deposit proposals or were broadly supportive. Specifically, BT/EE said it was content with Ofcom's general proposals as regards deposits,⁶⁰ while O2 said it was supportive of our proposals to require substantial deposits and that we retain an option to ask for increases in deposits during the auction if appropriate.⁶¹

Assignment stage

- 3.118 Upon completion of the principal stage of the auction, which determines the amount of spectrum that each bidder wins in each lot category, we propose to hold an assignment stage where bidders can bid for the exact location of the spectrum they have won.

700 MHz and 700 MHz SDL bands

- 3.119 For the 700 MHz FDD and 700 MHz SDL bands, we propose to follow the same approach as set out in the December 2018 consultation, i.e. a single-round, sealed bid auction where bidders would be invited to bid for the exact location of their frequencies among permissible assignment plans. For each band separately, we would then identify the

⁶⁰ BT/EE non-confidential response to the December 2018 consultation, paragraph 5.67.

⁶¹ O2 non-confidential response to the December 2018 consultation, paragraph 215.

highest value combination of bids that can be accommodated. Assignment stage prices, which are additional to base prices from the principal stage, are calculated using a second price rule.

- 3.120 This is the same approach that we followed in previous auctions. The second price rule is intended to incentivise bidders to bid their true valuations, which is more likely to result in an efficient outcome. By contrast, a pay-as-bid rule may incentivise bidders to bid below their valuations in an attempt to minimise costs, bidding in accordance with their expectations on how other bidders are likely to bid. If bidders' expectations are wrong, this may result in them not being assigned frequencies in line with their valuations.
- 3.121 BT/EE and O2 supported the use of a single-round, sealed bid auction for 700 MHz FDD and 700 MHz SDL in their responses to the December 2018 consultation.^{62 63}
- 3.122 O2 also put forward changes proposed by NERA that would prioritise adjacent placement between the upmost SDL lot (753–758 MHz) and the lowest downlink FDD lot (758–763 MHz) in the case where one or more bidders won spectrum in both bands.⁶⁴ We are minded not to adopt NERA's suggestion, noting that bidders can already express bids to achieve adjacent placements in the band (albeit with some aggregation risk), but welcome views on this.

3.6-3.8 GHz band

- 3.123 For the 3.6-3.8 GHz band assignment stage, we propose to follow a similar approach to the 700 MHz assignment stage bidding. We also propose to include additional measures to facilitate defragmentation of the wider 3.4-3.8 GHz band, which broadly reflect the proposals in our June 2019 consultation.
- 3.124 We have updated our proposals for the 3.6-3.8 GHz assignment stage in light of responses to that consultation. We are now proposing the following:
- a) **a restriction on winners of 20 MHz or less of 3.6-3.8 GHz spectrum** to bidding for (and winning) either the top or the bottom of the band in the assignment stage of the auction; and
 - b) a pause of up to four weeks before processing assignment stage bids, to allow a **negotiation phase where bidders can agree the assignment of 3.6-3.8 GHz spectrum**. During the first three weeks of this period, we propose to give winners of 3.6-3.8 GHz spectrum the opportunity to agree unanimously on the assignment of the 3.6-3.8 GHz band. In the event that bidders are unable to reach unanimous agreement during this period, we propose to include an additional one-week period during which we would allow a subset of bidders to agree to be assigned blocks of spectrum which are

⁶² BT/EE non-confidential response to the December 2018 consultation, page 74, paragraph 5.68.

⁶³ O2 non-confidential response to the December 2018 consultation, page 48, paragraph 224.

⁶⁴ O2 non-confidential response to the December 2018 consultation, page 48, paragraph 224. NERA (on behalf of O2) non-confidential response to the December 2018 consultation, page 47.

adjacent to each other.⁶⁵ We also propose to include a rule with the effect that if any bidders agree to be assigned adjacent blocks of spectrum, any bids they had made during assignment stage bidding would be reduced to zero, meaning they would not be able to express a preference for their location in the band.

3.125 Further detail on these proposals are set out below and in the draft Auction Regulations that we have published alongside this consultation.⁶⁶

‘Small winner’ restriction

3.126 Our June 2019 consultation proposed to impose a restriction on winners of less than 20 MHz of 3.6-3.8 GHz spectrum to bidding only for the top or bottom of the 3.6-3.8 GHz band in the assignment stage of the auction.

3.127 BT/EE, O2 and Vodafone supported our proposal to restrict small winners of spectrum to the top or bottom of the 3.6-3.8 GHz band (the ‘small winner restriction’) in their responses to the June 2019 consultation.⁶⁷ ⁶⁸ ⁶⁹ H3G did not think we should implement this restriction.⁷⁰

3.128 BT/EE suggested that we apply the restriction to winners of ‘20 MHz or less’ rather than ‘less than 20 MHz’ of 3.6-3.8 GHz spectrum.⁷¹ It said this was because (i) bidders are more likely to win a 20 MHz package of 3.6-3.8 GHz spectrum in the principal stage than a 15 MHz package, given that BT/EE does not expect bidders to seek to win multiples of 5 MHz, and (ii) bidders are unlikely to buy blocks of more than 20 MHz purely for the purpose of frustrating trades aimed at defragmenting the band.

3.129 We have considered whether it would be appropriate to increase the small winner restriction from ‘less than 20 MHz’ to ‘20 MHz or less’.

3.130 The small winner restriction is relevant only where the assignment of the 3.6-3.8 GHz spectrum is determined by bidding, rather than by agreement after the negotiation phase. The intention of the restriction is to mitigate the risk that bidders would strategically bid for a small amount of spectrum to insert themselves between other bidders. The purpose of this strategic bidding could be to stop defragmentation trades occurring, or to profit from allowing defragmentation trades. This would make it more likely that winners of large blocks of spectrum are allocated adjacent blocks of spectrum, which would facilitate trades between them.

3.131 We also note that the small winner restriction would impose costs on bidders in the 3.6-3.8 GHz band assignment stage. Small winners would be restricted to bidding for the

⁶⁵ We note that we are not proposing to include any restrictions during the negotiation period on winners of 3.6-3.8 GHz spectrum negotiating with other parties, regardless of whether they have won spectrum in the band.

⁶⁶ ‘Notice of Ofcom’s proposal to make regulations for the award of 700 MHz and 3.6-3.8 GHz spectrum’, 28 October 2019, paragraphs 2.75-2.101

⁶⁷ BT/EE non-confidential response to the June 2019 consultation, page 4.

⁶⁸ O2 non-confidential response to the June 2019 consultation, paragraph 16, page 6.

⁶⁹ Vodafone non-confidential response to the June 2019 consultation, page 2.

⁷⁰ H3G non-confidential response to the June 2019 consultation, page 7 and 8.

⁷¹ BT/EE non-confidential response to the June 2019 consultation, page 4.

bottom and top of the band only, while large winners would be less likely to win the bottom or top of the band if they wish to be placed there.

- 3.132 Increasing the small winner restriction by 5 MHz to '20 MHz or less' would have the benefit of increasing the probability of the 3.4-3.8 GHz band being defragmented through post auction trades. This is because a winner of 20 MHz in the principal stage would not be able to strategically bid in the assignment stage to insert themselves in the middle of the band to frustrate trades that would aid defragmentation.
- 3.133 However, increasing the small winner restriction by 5 MHz to '20 MHz or less' would extend the disadvantage to winners that have won 20 MHz, as they would then be restricted in their band placement to the top or bottom of the band. Winners of other amounts that favour the top or bottom of the band may also be less likely to win their preferred placement, given the additional restriction that a 20 MHz winner must be placed at the top or bottom of the band.
- 3.134 On balance, we consider the benefits outweigh the disadvantages, due to the increased probability of post auction trades leading to defragmentation. We therefore now propose to allow winners that have won **20 MHz or less** to only bid for the top and bottom of the 3.6-3.8 GHz band.

Negotiation Phase

- 3.135 Our June 2019 consultation proposed to additionally include a negotiation phase, within the assignment stage of the auction, during which winners of 3.6-3.8 GHz spectrum would have the opportunity to agree the assignment of frequencies in the 3.6-3.8 GHz band between themselves.
- 3.136 We set out two possible sub-options of the negotiation phase. One sub-option would require unanimous agreement among the winning bidders of 3.6-3.8 GHz spectrum. The other sub-option would allow for partial agreement in the absence of unanimous agreement. We said that, as a minimum, we were minded to adopt the unanimous agreement negotiation phase.
- 3.137 All respondents supported the inclusion of a negotiation phase in the auction. However, respondents were split on what type of negotiations should be allowed. BT/EE, the IET and O2 favoured including the partial agreement option; while H3G and Vodafone favoured allowing only unanimous agreement.^{72 73 74 75 76}
- 3.138 O2 agreed with our proposal that the unanimous negotiation phase should last ten working days, with a further five working days for bidders to agree partial deals.⁷⁷ It said

⁷² BT/EE non-confidential response to the June 2019 consultation, page 5 and 6.

⁷³ The IET 5GFF non-confidential response to the June 2019 consultation, page 1.

⁷⁴ O2 non-confidential response to the June 2019 consultation, paragraph 14, page 5.

⁷⁵ H3G non-confidential response to the June 2019 consultation, paragraph 3.5, page 5.

⁷⁶ Vodafone non-confidential response to the June 2019 consultation, page 2.

⁷⁷ O2 non-confidential response to the June 2019 consultation, paragraph 51, page 16.

that this was sufficient time for parties to secure agreement without a single party being able to draw out the process unnecessarily.

- 3.139 However, BT/EE said that it would be challenging to complete negotiations within a two to three week timescale, due to complex arrangements that may need to be agreed between parties, which could require contracts and introduce internal governance issues. BT/EE therefore proposed that we increase the timescale for unanimous agreement to three weeks, and the maximum overall negotiation period (including partial agreement, were it adopted) to four weeks.⁷⁸
- 3.140 Having considered this, we propose to extend the unanimous negotiation period to three weeks, which would result in a maximum overall negotiation period of four weeks. We think this is appropriate, given the limited downside of a one-week delay. If bidders reach unanimous agreement before this time, Ofcom would close the negotiation period early.

Publishing 3.6-3.8 GHz assignment stage bid data

- 3.141 Our usual approach is to publish all auction bid data alongside the results of the auction, primarily in the interests of transparency and fairness between bidders. We consider it may be appropriate to take a different approach to the 3.6-3.8 GHz assignment stage bid data in the circumstances of this auction, given the potential for post-auction trades to achieve defragmentation of holdings in the 3.4-3.8 GHz band.
- 3.142 Along with our updated proposals, we have considered the following three approaches to publishing 3.6-3.8 GHz assignment stage bid data:
- a) to publish all 3.6-3.8 GHz assignment stage bids with the results of the auction, in line with our usual approach;
 - b) to publish all 3.6-3.8 GHz assignment stage bids with a delay after the auction, once there is reduced risk of the bid data impacting on post-auction trades to achieve defragmentation; or
 - c) not to publish the 3.6-3.8 GHz assignment stage bids.
- 3.143 There may be the possibility that the publication of any assignment stage bid data for 3.6-3.8 GHz could affect post-auction trades, for example by revealing further information about bidders' valuations for specific frequency locations. We would be concerned if publishing this information had the potential to adversely affect or undermine future commercial trading negotiations, and thereby reduce the likelihood of successful trades within the 3.4-3.8 GHz band. This could be relevant regardless of whether bidders reach a partial, unanimous or no agreement during the proposed negotiation period. We therefore do not consider it appropriate to publish the 3.6-3.8 GHz assignment stage bid data immediately.
- 3.144 We consider that delaying the publication may have some merit, but also presents some potential issues. We would want to write the timing of any such delay into the Auction

⁷⁸ BT/EE non-confidential response to the June 2019 consultation, page 6.

Regulations in order to provide certainty, but the length of the delay is not obvious given that there is no time limit to post-auction trades. One approach might be to pre-specify the delay before publication, such as twelve months (with the potential for earlier publication if all winning bidders were to agree). However, there is also the potential that the delay in publication may influence the timing of any post-auction trades. For example, bidders may feel pressured to complete the trades before the publication of bid data, or to wait until after publication so that their commercial negotiations can be informed by the bids.

- 3.145 We therefore propose to adopt option (iii), which is not to publish the 3.6-3.8 GHz assignment stage data. This approach would apply regardless of whether bidders take up our proposals for the negotiation period.⁷⁹ We do however intend to publish which bidders (if any) have entered into agreements with each other during the negotiation period. We welcome stakeholders' views on our proposal not to publish the 3.6-3.8 GHz assignment stage bid data.

Reserve prices

- 3.146 We are proposing to maintain the ranges of reserve prices from the December 2018 consultation:
- a) for 700 MHz FDD spectrum, within the range of £100m-£240m per 2x5 MHz lot;
 - b) for 700 MHz SDL spectrum, £1m per 5 MHz lot;
 - c) for 3.6-3.8 GHz spectrum, within the range of £15m-£25m per 5 MHz lot.
- 3.147 We generally adopt a conservative approach to setting reserve prices. We proposed to set reserve prices that are materially lower than our benchmarks for possible market value (where meaningful benchmarks are available).⁸⁰ This would provide room for relevant price discovery, while still mitigating concerns about tacit collusion and strategic demand reduction.
- 3.148 We set out a full explanation of our approach to setting spectrum reserve prices in the December 2018 consultation at paragraphs 7.233-7.238, which we adopt similarly here.
- 3.149 We received comments from O2 and BT/EE on our reserve price proposals.
- 3.150 O2 agreed with the range of reserve prices that we proposed.⁸¹ O2 would prefer prices at the lower end of the range for more opportunities for price discovery. O2 said that it would accept higher reserve price if we considered this necessary to underpin revenues in the

⁷⁹ This is a change to our proposal in the June 2019 consultation, which was to only not publish bid data if bidders reached unanimous agreement during the negotiation period

⁸⁰ This is different from the approach Ofcom uses for setting Annual Licence Fees (where we also use evidence on benchmarks for market value). In setting Annual Licence Fees, Ofcom takes a conservative interpretation of the evidence to determine market value, whereas in this auction we wish to set reserve prices below market value to avoid unsold spectrum, encourage participation and allow a margin for price discovery.

⁸¹ O2 non-confidential response to the December 2018 consultation, page 46.

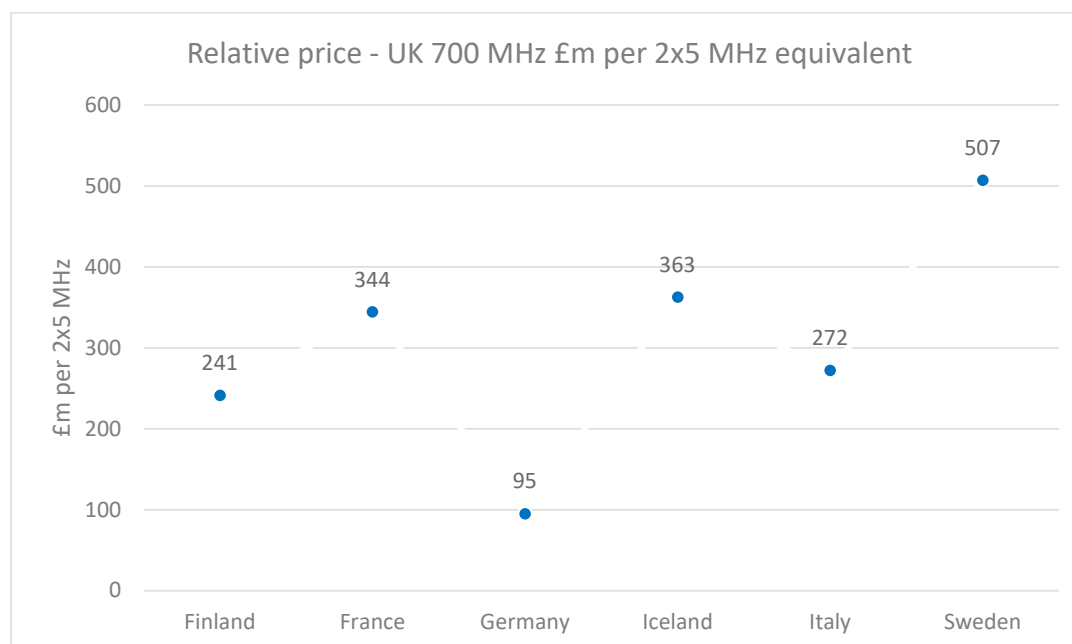
event of a low competition scenario.⁸² O2 also supported our proposal for setting a low but non-trivial reserve price for 700 MHz SDL, as the value of this is uncertain.

3.151 BT/EE agreed with the 700 MHz SDL reserve price.⁸³ BT/EE considered the reserve prices for 700 MHz FDD and 3.6-3.8 GHz spectrum need to be significantly lower. BT/EE did not consider the range that we proposed for 700 MHz FDD to be materially lower than the benchmarks for market value considering the auction outcomes in Germany. BT/EE proposed that we set the reserve price for 3.6-3.8 GHz much closer to that used in the auction of the 3.4-3.6 GHz band, i.e. £1m per 5 MHz, for greater price discovery and prevent unsold spectrum.

700 MHz FDD

3.152 We have updated our analysis to take into account the recent awards for 700 MHz FDD which occurred in Sweden, Denmark, Norway and Switzerland. Of these recent awards, Sweden was the only award which published price information on 700 MHz FDD.

Figure 3.3: 700 MHz FDD relative benchmarks in £m per 2x5 MHz based on September 2019 prices



Source: benchmarks for 700 MHz FDD derived from: auction results from the respective European countries, Ofcom adjustments to control for cross-country variations, price ratio of 700 MHz to 800 MHz spectrum for each country, PPP, and inflation. The benchmark methodology follows the one described in the December 2018 consultation for determining reserve prices. The relative prices have been updated to account for inflation to September 2019 levels.⁸⁴⁸⁵

⁸² We note revenue generation is not one of our duties and has never been an objective of our spectrum auctions. We therefore do not set reserve prices to underpin revenues.

⁸³ BT/EE non-confidential response to the December 2018 consultation, page 74, paragraph 5.65.

⁸⁴ December 2018 consultation, paragraphs 7.233-7.238.

⁸⁵ The relative prices have also changed because the auction data of Italy and Germany were discovered to be incorrect for the December 2018 consultation and have now been corrected. For the Italian auction, the reserve prices were updated to reflect a correction on the number of instalments in which the bidders could pay their auction fees. After adjusting for

- 3.153 Sweden has the highest relative price of our benchmark countries at £507m for 2x5 MHz, while Germany has the lowest relative value at £95m for 2x5 MHz.⁸⁶ These two values are materially outside the range of our other benchmark prices, which are more closely clustered together between £241m and £363m. Finland's relative value of £241m for 2x5 MHz is at the lower end of this group. We also note that our reserve price for 800 MHz spectrum in the UK was £225m, which adjusted to September 2019 prices is £251m.
- 3.154 Taking account of these factors, we propose to set a reserve price for 2x5 MHz of 700 MHz spectrum within the range of £100m-£240m.
- 3.155 In response to BT/EE, we are taking into account that the lowest benchmark, which is for Germany, is at risk of understating market value. As we stated in the December 2018 consultation, in our view, bidding in the 700 MHz band in the German 2015 auction may have been affected by strategic demand reduction and bid signalling.⁸⁷ We noted there were some similarities to the 900 MHz band in the same auction and that we had concluded in the 2015 statement on annual licence fees for 900 MHz and 1800 MHz that there was a risk that the price of 900 MHz understated market value in Germany.⁸⁸
- 3.156 We will update our analysis of benchmarks for reserve prices, based on upcoming auctions for 700 MHz taking place between now and the publication of our statement.

700 MHz SDL

- 3.157 There have been recent auctions in Switzerland and Denmark in which 700 MHz SDL spectrum was awarded. We note the reserve prices of both awards were above our proposed reserve price.⁸⁹ However the final price of the spectrum band was not published in either auction. We also note that 5 MHz of SDL spectrum went unsold in Switzerland.

3.6-3.8 GHz

- 3.158 We propose to set a reserve price of between £15m and £25m per 5 MHz of spectrum in the 3.6-3.8 GHz band. This aligns with our proposal to set reserve prices that are closer to, but materially lower than, possible market value.

inflation, this decreased the relative price by £17m. For the German auction, the reserve prices were updated to reflect a correction on the date the spectrum was available for use. After adjusting for inflation, this increased the relative price by £2m.

⁸⁶ We note just 2x20 MHz of 700 MHz FDD spectrum was auctioned in Sweden. In addition, unlike the other countries in this comparison, the price of 700 MHz FDD in Sweden was higher than the price of 800 MHz.⁸⁷ December 2018 consultation, footnote 218 to paragraph 7.241.

⁸⁷ December 2018 consultation, footnote 218 to paragraph 7.241.

⁸⁸ See paragraphs A8.422-A8.431 and A8.446-A8.448 of [the 2015 ALF for 900 MHz and 1800 MHz statement](#). In addition, we also concluded in that statement there was a risk of overstatement in the 800 MHz auction price in the 2010 auction in Germany (relative to the forward-looking UK value of 800 MHz – see paragraph A8.476b) – since the 800 MHz price is the denominator in the relative value benchmark for 700 MHz, this risk of overstatement in 800 MHz reinforces the risk of understatement in the 700 MHz relative value benchmark.

⁸⁹ Reserve prices for 5 MHz of 700 MHz SDL was 4.2 million CHF in Switzerland, and 25 million DKK in Denmark. Adjusted for cross-country variations such as PPP, inflation, population, licence duration and auction date; the UK equivalent reserve price for 5 MHz of unpaired 700 MHz is approximately £10M in Switzerland and £6M in Denmark.

- 3.159 We use the market prices in the UK's 3.4-3.6 GHz band as a benchmark. We consider this to be the most reliable benchmark, as the bands are very similar and using a UK benchmark instead of international benchmarks for this band allows us to accommodate UK-specific market characteristics, meaning that fewer adjustments are necessary.
- 3.160 We consider it appropriate to set a higher reserve price for this band than we did for the 3.4-3.6 GHz band in the 2018 auction, when market values were less clear. Stakeholders face less uncertainty over the value of the spectrum compared to the previous auction, as market evidence from the previous auction is now available. We also consider there to be a low risk of unsold lots with our proposed range of reserve prices, given the UK market price of 3.4-3.6 GHz.
- 3.161 The reserve price range helps mitigate our concerns around tacit collusion, which we consider to be a particular risk in this auction (see 2.41). Therefore, in our view, it is not appropriate to use the same reserve price for this award as in the 2.3 GHz and 3.4-3.6 GHz auction, for which BT/EE has argued.
- 3.162 We will set out our final decision on reserve prices in our statement, taking into account any responses to this consultation and any relevant upcoming auctions that happen before we publish our statement.⁹⁰

Consultation questions

Question 1: Do you agree with our proposal to use an SMRA design for this award?

Question 2: Do you have any comments on the proposed detailed rules for our SMRA design?

Question 3: Do you have any other comments you wish to make on our proposals for this award?

⁹⁰ We note the 700 MHz auctions that have occurred in Switzerland, Denmark and Norway. However, we are unable to take the results of these auctions into account in the determination of spectrum reserve prices for 700 MHz FDD. In each of these auctions, the price for 700 MHz FDD was not available or not published. In Switzerland, prices were published in aggregate for each bidder but not for individual lot categories. In Denmark, the auction was a package auction and therefore there are no prices for individual bands. In Norway, price information for each band in 700 MHz FDD was published. However, the 800 MHz auction in Norway was a package auction. We are therefore unable to derive a relative UK equivalent price for 700 MHz using the 800 MHz prices as a comparison. Where applicable, we will take into account the reserve prices for 700 MHz SDL.

A1. Responding to this consultation

How to respond

A1.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 9 December 2019.

A1.2 You can download a response form from <https://www.ofcom.org.uk/consultations-and-statements/category-2/award-700-mhz-3.6-3.8-ghz-spectrum-revised-proposals>. You can return this by email or post to the address provided in the response form.

A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to RadioSpectrum.Award@ofcom.org.uk, as an attachment in Microsoft Word format, together with the [cover sheet](#).

Responses may alternatively be posted to the address below, marked with the title of the consultation:

The Auction Team,
Spectrum Group
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.4 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:

- Send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files. Or
- Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.

A1.5 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)

A1.6 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.

A1.7 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A1.8 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 4. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

- A1.9 If you want to discuss the issues and questions raised in this consultation, please contact John Glover on 020 7981 3000, or by email to RadioSpectrum.Award@ofcom.org.uk.

Confidentiality

- A1.10 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on our website, www.ofcom.org.uk, as soon as we receive them.
- A1.11 If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.
- A1.12 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.13 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our [Terms of Use](#).

Next steps

- A1.14 Following this consultation period, Ofcom plans to publish a statement.
- A1.15 If you wish, you can [register to receive mail updates](#) alerting you to new Ofcom publications.

Ofcom's consultation processes

- A1.16 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 2.
- A1.17 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.18 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Email: corporationsecretary@ofcom.org.uk

A2. Ofcom's consultation principles

Ofcom has seven principles that it follows for every public written consultation:

Before the consultation

- A2.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

- A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.
- A2.3 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.
- A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.
- A2.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.
- A2.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

- A2.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A3. Consultation coversheet

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing

Name/contact details/job title

Whole response

Organisation

Part of the response

If there is no separate annex, which parts? _____

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

DECLARATION

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

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

Name

Signed (if hard copy)

A4. Consultation questions

Question 1: Do you agree with our proposal to use an SMRA design for this award?

Question 2: Do you have any comments on the proposed detailed rules for our SMRA design?

Question 3: Do you have any other comments you wish to make on our proposals for this award?

A5. Illustrative auction procedures

- A5.1 The illustrative procedures set out in this annex are intended to provide a description of how the spectrum award auction process would work for the proposed Simultaneous Multiple Round Ascending auction design. In the event of any discrepancy or inconsistency between this description and the rules set out in the draft Regulations, it is intended that the proposed rules in the draft Regulations take precedence. Once the draft Regulations have been finally enacted by Ofcom and entered into legal force, they would constitute enacted UK legislation and as such would also, in the event of any discrepancy or inconsistency, take precedence to anything in this description or in the Information Memorandum.
- A5.2 The language we use throughout this annex is close to the one we expect to use in the draft Regulations, for ease of reference.

Lot structure

Use of frequency generic lots

- A5.3 The award mechanism would consist of two distinct bidding stages. In the first stage (the 'principal stage'), the spectrum available would be offered as 'frequency-generic' lots grouped into three 'lot types'; one for each of the paired 700 MHz, unpaired 700 MHz and 3.6-3.8 GHz. Each lot would be frequency generic and would correspond (respectively) to a 2x5 MHz, 5 MHz and 5 MHz block of spectrum in the relevant frequency band. During this stage, bids would relate to a number of lots in each lot type, but not to specific frequencies within the lot type's frequency range. This first stage would allow Ofcom to determine the number of lots (i.e. the total bandwidth) to be assigned to each bidder in each band.
- A5.4 The specific frequencies assigned to each winner of frequency-generic lots would then be determined in a follow-up 'assignment stage'. Ofcom would determine, for each frequency band, the potential assignment options that guarantee all winning principal stage bidders receive contiguous assignments. In the 3.6-3.8 GHz band, bidders that have won 20 MHz or less would be restricted to bidding for assignments at either the top or bottom of the band. Winning principal stage bidders in the 3.6-3.8 GHz band would also have an opportunity to negotiate their assignments, as an alternative to assignment stage bidding determining the outcome.
- A5.5 In the event there are several assignment band plans in which some bidders would be assigned different frequencies, such bidders would be invited to bid for their preferred option. Winners of 3.6-3.8 GHz spectrum would also have the opportunity to negotiate their assignments, as an alternative to assignment stage bidding determining their location. Further details on the selection of assignment stage outcomes are provided in the subsection on the assignment stage below.

Lot types and spectrum packaging

- A5.6 The spectrum available would be offered in three generic lot types:
- a) 700 MHz paired frequency lots: This lot type would contain six 2x5 MHz lots of FDD spectrum in the frequency ranges 703-733 MHz and 758-788 MHz (700 MHz FDD);
 - b) 700 MHz individual frequency lots: This lot type would contain four 5 MHz lots of unpaired spectrum, suitable for providing supplemental downlink, in the frequency range 738-758 MHz (700 MHz SDL); and
 - c) 3.6-3.8 GHz lots: This lot type would contain twenty-four 5 MHz lots of TDD spectrum within the frequency range 3680–3800 MHz.

Eligibility points

- A5.7 As explained in more detail below, the principal stage would include a rule that the number of eligibility points used by a bidder in a round cannot exceed the bidder's eligibility limit for that round.
- A5.8 For this purpose, each 700 MHz FDD lot would be assigned four eligibility points, while each 700 MHz SDL and 3.6-3.8 GHz lot would be assigned one eligibility point.
- A5.9 The number of eligibility points used by a bidder in a round is equal to the sum of the eligibility points associated with all the lots for which the bidder submits or maintains a bid in the round. As 700 MHz FDD lots have double the eligibility points of 700 MHz SDL and 3.6-3.8 GHz lots on a per MHz basis, bidders may increase their demand in MHz when switching from 700 MHz FDD to 700 MHz SDL or 3.6-3.8 GHz lots. If they do not increase their demand in MHz when switching from 700 MHz FDD to 700 MHz SDL or 3.6-3.8 GHz, then they would lose eligibility. Conversely, bidders switching from 700 MHz SDL or 3.6-3.8 GHz to 700 MHz FDD may have to reduce their overall demand in MHz.
- A5.10 Information on how to determine a bidder's eligibility limit, and the number of eligibility points used by a bidder, is provided from paragraph A5.55 below.

Applications, initial deposit, overall bid constraint and qualification

- A5.11 Applicants would be required to provide Ofcom with a range of information, by a deadline specified by Ofcom, in order to apply to participate in the auction. Amongst other things, applicants would be required to specify their existing spectrum holdings in their application, as this information would be required for the implementation of the overall spectrum cap (leading to an "overall bid constraint" for each bidder).
- A5.12 Along with their application, applicants would be required to submit an initial monetary deposit of £100,000, which might be forfeited in whole or in part if the applicant

subsequently breaches the Regulations.⁹¹ Any interest on deposits would be retained by Ofcom and passed to HM Treasury.

- A5.13 After the deadline for applications, Ofcom would notify each applicant of the name of every other applicant and its associates. Applicants would then need to ensure they meet bidder association rules, which would not allow for two or more associated applicants to participate in the auction. They would need to do so by a deadline specified by Ofcom, and it may be the case that some applicants have to withdraw their application to prevent another applicant from failing to qualify in the auction. Other qualification criteria to ensure that applicants are suitable to hold a licence would also apply. The provisions for qualification are similar to those used in recent awards by Ofcom, and are specified in the Regulations.
- A5.14 After the deadline for complying with the bidder association rules (referred to above), Ofcom would determine which applicants qualify to participate in the auction.
- A5.15 To do so, Ofcom may require additional information from specific applicants, which would need to be provided before a deadline specified by Ofcom.
- A5.16 Following the last day for withdrawals from the award, Ofcom would determine the list of qualified applicants (i.e. bidders), and return the initial deposit to any applicants who fail to qualify. Only qualified applicants would be allowed to participate in the auction.
- A5.17 Before the first round of the auction takes place, each bidder would need to provide an additional deposit to Ofcom of at least £900,000, which would determine the bidder's initial eligibility limit. This is in addition to the initial monetary deposit of £100,000 referred to above. The initial eligibility limit would determine the maximum number of bids that the bidder may submit in the first round of the auction.

The Electronic Auction System

- A5.18 The auction would be run over the internet using an Electronic Auction System (EAS). No specialist hardware or software would be required on bidder's terminals, as the EAS interface would run on a standard web browser. However, bidders would need to install authentication credentials, provided by Ofcom only to qualified applicants who are confirmed as bidders, on any computer they wish to use to access the system. As in previous auctions, Ofcom would allow bidders to submit bids by alternative means in the event that they experience technical difficulties with the EAS, subject to Ofcom granting permission to the bidder to do so and provided that the bids by alternative means are authenticated in accordance with the Regulations for the auction.
- A5.19 Ofcom also expects to make a stand-alone version of the software available to applicants, a few days after application. Applicants would be able to login both as bidders and as the auctioneer, allowing them to run internal mock auctions as part of their training.

⁹¹ If the applicant simply chooses to withdraw its application by the last day for withdrawal, or fails to qualify in the auction, then that bidder's initial deposit of £100,000 would not be forfeited for that reason.

The principal stage

- A5.20 The purpose of the principal stage is to determine the number of lots to be assigned to each bidder in each band, and the 'base price' that each winner of spectrum would be required to pay for the lots it has won.
- A5.21 Bidding in the principal stage would proceed in rounds, which consist of time windows scheduled by the auctioneer during which bidders are invited to submit 'bid decisions'. We refer in this document to 'bid decisions' in order to reflect the fact that bidders are entitled, on their principal stage form(s), to do more than submit a new bid. In particular, bidders may indicate that they wish to request that their eligibility limit be carried forward to the next round.
- A5.22 The submission of bid decisions is only accepted while a round is in progress, and is only processed once the round has finished. At the end of each round, bidders would be notified whether the auction would proceed to the next stage or a further bidding round is needed, and given certain information about the results of the completed round (as detailed below).

Overview of the bidding process

- A5.23 During the principal stage, bidders may submit bids for the (generic) lots available at prices announced by the auctioneer. These prices are known as the 'round price'. At the end of each round, Ofcom determines provisional winning bids for each lot. We refer to these provisional winning bids as 'bids with standing high bid status', or 'standing high bids' in this document.⁹² These are bids which would become the winning principal stage bids unless they are replaced in subsequent rounds.
- A5.24 The principal stage would end when there are no 'round events' in a round. This means that, in a round, no bidders have submitted any new bids and no waivers have occurred (explained below beginning at paragraph A5.72).
- A5.25 When the principal stage ends, standing high bids would ordinarily become winning principal stage bids. Standing high bidders would be required to pay the round price of their winning principal stage bids for the lots they have won (plus, following the assignment stage, any additional price incurred).

Bids

- A5.26 The bid submission process requires bidders to select the number of lots they wish to bid for at the price specified by the auctioneer (i.e. at the round price). However, this is not a package bid. Formally, where a bidder opts to bid for a number of lots this would be treated as separate bids for individual lots from that bidder. However, the principal stage is structured so that new bids would be subject to a common round price applying to all

⁹² In the draft Regulations we refer to these as "bids with standing high bid status".

lots in a frequency band; this facilitates the making of bids through the EAS, as bidders would simply need to specify the number of lots sought in each category.

- A5.27 Each bid must specify:
- the frequency band to which the bid applies; and
 - the price that the bidder would pay for the lot if the bid is selected as a winning bid by virtue of being a standing high bid. We note that this price is the round price, as determined by the auctioneer for the round in which the bid was submitted.
- A5.28 Submitting a bid establishes a commitment to acquire, in the event that the bid is selected as a winning bid, a lot in the specified frequency band at a price equal to the round price.
- A5.29 Bidders may bid for several lots simultaneously. However, it is possible that only some of these bids may be selected as winning bids. Notwithstanding this, the process for selecting standing high bids has been designed with the intention of minimising the number of potential bidders who win some, but not all, of the bids they made simultaneously for lots in a lot category. We refer to such bidders in this document as ‘partial standing high bidders’.
- A5.30 A bid is only valid if it is submitted during a round in accordance with the Regulations.

The overall bid constraint

- A5.31 On the basis of a bidder’s recorded spectrum holdings (which are determined shortly after the deadline for payment of the additional deposit, but before the start of the principal stage), Ofcom would determine the overall bid constraint that would apply to each bidder.
- A5.32 The overall bid constraint would establish a limitation on the combination of the number of new bids made in the round and standing high bids assigned at the end of the most recent round⁹³ that the bidder can submit for lots of the three lot types (700 MHz FDD, 700 MHz SDL and 3.6-3/8 GHz).
- A5.33 A bidder’s overall bid constraint is irreversible and would apply throughout the auction. This means that, if a bidder subsequently divests all or part of its recorded spectrum holdings, its overall bid constraint would not be increased. Further, where a bidder’s existing spectrum holdings are changed after they have been recorded (other than as a result of a divestment), this may be grounds for Ofcom to exclude that bidder from the award process and to forfeit its deposit if that change would affect that bidder’s overall bid constraint.

The bidding process

- A5.34 The bidding process in the principal stage would require one or more rounds, each round consisting of a fixed time window during which bidders may submit bid decisions in accordance with prices announced by the auctioneer.

⁹³ In the bands where the bidder does not submit new bids.

A5.35 As explained above, a bid decision is only valid if it is submitted during a round in accordance with the Regulations.

Scheduling of rounds

A5.36 When a round is scheduled, the following information would be made available to each bidder:

- the start and the end time of the round;
- the round price for each lot type for that round;
- the bidder's own eligibility limit;
- the number of waivers the bidder has left (explained below);

A5.37 Ofcom expects rounds to last 30 minutes, but we may choose different durations. We intend to provide bidders with at least 15 minutes notice before the start of a round.

Bid submission during a round

A5.38 In each round, bidders can make a single submission of bid decisions using the EAS. Therefore, bidders should submit all of the bids they wish to submit in a given round simultaneously in the same submission, or alternatively request to carry forward their eligibility limit. When a round is in progress, each bidder's EAS interface would provide a bid form.

A5.39 To make a submission, a bidder would need to:

- a) specify, using the principal stage form provided by the EAS:
 - i) the number of lots in each lot type for which they wish to submit a bid at the round price for that lot type. We note that:
 - bidders may not specify a bid amount for a lot that differs from the round price for that lot type;
 - in the first round, each bidder must submit a bid for at least one lot. Any bidders who do not do so would be excluded from the auction and would not receive a refund of any of their deposit. In subsequent rounds, however, bidders may decide to not place any bids for any lots;
 - any bid submitted by a bidder must not breach the overall bid constraint set for that bidder.
 - ii) if it wishes to request to carry forward its eligibility limit (this is only possible if a waiver has not occurred on three occasions, if the bidder is using a number of eligibility points which is smaller than the bidder's eligibility limit in the round and if it is not submitting any bids). This would also not be available for bidders in the first principal stage round;
- b) send the completed bid form to the auction server, so that the bid can be checked for validity against the Regulations;

- c) provided that the submission is valid according to the Regulations, confirm the submission using the confirmation form provided in the bidder interface of the EAS.

- A5.40 The submission process is only completed when the bidder confirms its submission. Submissions sent to the server to check validity but not confirmed would be discarded by the EAS.
- A5.41 Upon receipt of a valid submission, the EAS interface would provide a confirmation page. Conversely, if the submission process fails, the EAS interface would revert to the bid form. It is the responsibility of the bidder to check (through its bidder interface) that its submission has been successfully received by the auction server, and to alert Ofcom if it suspects any problems have occurred.
- A5.42 Once the auction server has received a confirmation of a valid submission in a round, the bidder would not be able to revise or withdraw this submission, or submit any further bid decisions in respect of that round.

Round prices

- A5.43 For each round, Ofcom would specify the round price per lot for each lot type.
- A5.44 In the first round, the round price for each lot type would be the respective reserve price. We have consulted on reserve prices in the ranges of £100-240m per 700 MHz FDD lot, £1m per 700 MHz SDL lot, and £15-25m per 3.6 GHz lot.
- A5.45 In subsequent rounds:
 - a) the round price for a lot type would increase if the number of standing high bids for that lot type at the most recent round price is equal to the total number of lots available in that lot type;
 - b) otherwise, the round price for the lot type would remain unchanged.
- A5.46 Therefore, round prices would not decrease over the course of the rounds.
- A5.47 The amount of the increase in round prices, when applicable, would be determined at Ofcom's discretion and may vary across lot types and across rounds.
- A5.48 Round prices would be specified in whole thousands of pounds.

Determination of standing high bids

- A5.49 At the end of each round, the EAS would determine which bids for each lot type have standing high bid status. Standing high bids are determined for each lot category independently.
- A5.50 To do so, the EAS would firstly consider the following bids:
 - a) the standing high bids in the lot type at the beginning of the round that have not been replaced by a standing high bidder submitting new bids in respect of that lot type; and
 - b) the new bids in respect of that lot type submitted during the round.
- A5.51 Secondly, the EAS would order the bidders who made those bids as follows:

- a) first, take in random order those bidders whose bids are at the current round price (regardless of whether they maintained previous standing high bids or submitted new bids in the current round);
- b) next, take in random order those bidders who (i) maintained standing high bids with a bid amount lower than the current round price and (ii) are standing high bidder on the number of lots they bid for in that lot type when they submitted these bids;
- c) finally, if there is a bidder who (i) maintained its standing high bids with a bid amount lower than the current price and (ii) is a partial standing high bidder, that bidder is placed last.

A5.52 The EAS would then select the standing high bids by taking the bids submitted by each of these bidders in the order established in the previous step, until there are no more lots available.

A5.53 This approach ensures that:

- a) there can be at most one partial standing high bidder in each lot type; and
- b) bids at the same price level are treated equally (regardless of whether they have been submitted in an earlier or later round), except for standing high bids from a partial standing high bidder, which is outbid first.

Bidding for lots when the bidder holds standing high bids

A5.54 After the first round, a bidder holding standing high bids in a lot type may submit further bids for that lot type. However:

- a) If the round price for that lot type has increased relative to the round price of the bidder's standing high bids, that bidder may only submit bids at the new round price if it is bidding for at least as many lots as it holds standing high bids on. If a bidder submits bids at the new price level, then the bidder's standing high bids at the earlier price level would be discarded (regardless of whether the new bids become standing high bids, and independently of the bids submitted by other bidders); or
- b) Conversely, if the round price for that lot type has not increased relative to the round price of the bidder's standing high bids, that bidder may only submit bids for strictly more lots than the number of lots on which it holds standing high bid status. If a bidder submits new bids for that lot type, any standing high bids held by the bidder would be cancelled. Therefore:
 - the bidder must specify the total number of lots it wishes to bid for at the prevailing round price; and
 - as previous standing high bids are cancelled, there is no guarantee that the bidder would hold any standing high bids after bids for the round have been processed.

Box 1: Example of the determination of standing high bids

The example below illustrates how standing high bidders and partial standing high bidders are determined at the end of each round. Consider the 700 MHz lot category, with six lots available and four bidders (Bidders A, B, C and D). Prices and bids are purely illustrative.

Round	Price	Number of lots bid for				Order	Standing high bids at the end of the round [price]			
		A	B	C	D		A	B	C	D
1	150	4	2	3	1	BACD	4[150]	2[150]	-	-
2	160	-	-	3	1	DCAB	2[150]	-	3[160]	1[160]
3	160	waiver	2			CBDA	-	2[160]	3[160]	1[160]
4	170	3	-	-	-	ADCB	3[170]	-	2[160]	1[160]
5	170	-	2	-	-	BADC	3[170]	2[170]	-	1[160]

In round 1, all bidders submit bids at the current round price. The EAS generates a random order for this group of bidders (BACD). There are no other bidders to consider. The first bidder in the order, Bidder B, bid for 2 lots and becomes standing high bidder on its full bid of 2 lots. We refer to this as being a “full standing high bidder”. The next-ranked bidder, Bidder A, bid for 4 lots and also becomes full standing high bidder on 4 lots. There are no residual lots available, so Bidders C and D do not become standing high bidders.

In round 2, the price increases to 160, as all standing high bids at the end of round 1 were at the previous round price of 150. Bidders C and D submit new bids at the higher current round price. Bidders A and B do not need to submit new bids as they are full standing high bidders at the previous round price (although they may do so if they want). Bidders A and B therefore “maintain” their standing high bids from the previous round.

First, the EAS will consider the bids at the current round price and generates a random order for the corresponding group of bidders (DC). Second, the EAS will consider the full standing high bidders that have maintained their standing high bids at a price lower than the current round price, and randomly order these bidders (AB).

Therefore, the overall order of bidders is DCAB. Bidders D and C become full standing high bidders on 1 and 3 lots respectively at the current round price. There are only 2 residual lots available, so the next-ranked bidder, Bidder A, becomes standing high bidder on 2 lots at the previous round price of 150. This is fewer than the 4 lots it originally bid for in round 1. We refer to bidders that are standing high bidder on strictly fewer lots than it bid on as “partial standing high bidders”. Bidder B has no standing high bids at the end of round 2.

In round 3, the price does not increase as Ofcom was unable to assign all standing high bids at the round 2 price of 160. Bidder B bids for 2 lots at 160. Bidder A submits a waiver, which maintains bidder A's current eligibility limit to the next round and prevents the bidder from submitting a bid in this round (we explain how waivers work in more detail in paragraphs A5.59).

The EAS first ranks and randomly orders bidders that have submitted bids at the current round price of 160, which includes Bidder B, C and D (CBD). The EAS then considers any full standing high bidders that have maintained their standing high bids at a previous round price. There are no bidders in this category. The EAS lastly considers any bidders that maintained standing high bids at a previous round price and were partial standing high bidders – this applies to Bidder A.

Therefore, the overall order of bidders is CBDA. Bidders B, C and D become full standing high bidders at the current round price of 160. Bidder A has no standing high bids.

In round 4, the price increases to 170 as all standing high bids at the end of the previous round were allocated at the round price of 160. Bidder A submits a bid for 3 lots at 170.

The EAS first considers the bids submitted at the current round price, from Bidder A. The EAS then randomly orders full standing high bidders at a lower round price (DCB).

Therefore, the overall order of bidders is ADCB. Bidders A and D become full standing high bidder on 3 lots at the price of 170, while Bidder D becomes full standing high bidder on 2 lots at the lower round price of 160. Bidder C becomes partial standing high bidder on 1 lot at 160. Bidder B does not have standing high bids.

In round 5, the price does not increase, as there are still standing high bids left at a lower round price. Bidder B makes a bid for 2 lots at the current round price of 170.

The EAS first considers and randomly ranks the bids at the current price (BA). Then the EAS considers full standing high bidders from previous rounds at a price lower than the current round price, which applies only to D. Lastly, EAS considers the partial standing high bids from the previous round with a price lower than the current round price, which applies only to C.

Therefore, the overall order is BADC. Bidders B and A become full standing high bidders on 3 lots and 2 lots respectively at 170. Bidder D also becomes full standing high bidder on 1 lot, but at the previous round price of 160. Bidder C has no standing high bids.

In the next round, there are no new bids or waivers submitted. Let us suppose there are also no bids either in 700 MHz SDL or 3.6-3.8 GHz. As will be explained later in the annex, this means the principal stage ends. Any standing high bids become winning bids. The base price for the lots won by bidders A and B is 170, and for Bidder D is 160.

Eligibility rule

- A5.55 The number of eligibility points used by a bidder in a round cannot exceed the bidder's eligibility limit for that round. To assess a bidder's compliance with the eligibility rule, we need to firstly calculate that bidder's eligibility limit in the relevant round.
- A5.56 Each bidder would start each round with a given eligibility limit. In the first round, this would be determined by the amount of the bidder's 'additional deposit'. In subsequent

rounds, the bidder's eligibility limit would be equal to the number of eligibility points used by the bidder in the most recent round provided that a waiver did not occur in that round.

- A5.57 The number of eligibility points used by a bidder in a round is calculated as:
- a) the sum of the eligibility points assigned to all lots for which the bidder submits bids in the round; plus
 - b) where the bidder does not submit bids for a particular lot type in that round, the sum of eligibility points assigned to all lots in that lot type for which the bidder held a standing high bid at the end of the most recent round.
- A5.58 As explained at paragraph A5.8 above, each 700 MHz FDD lot would be assigned four eligibility points, while each 700 MHz SDL and 3.6-3.8 GHz lot would be assigned one eligibility point. Accordingly, where a bidder submits three bids in a round for 3.6-3.8 GHz lots and does not submit any bids for 700 MHz FDD lots (but has standing high bids for two 700 MHz FDD lots from the previous round), then that bidder would have used 11 eligibility points in that round (i.e. $(3 \times 1) + (2 \times 4)$).

Waivers

- A5.59 Bidders can preserve their eligibility limit from one round to the next by using a waiver, even though they used a number of eligibility points which is smaller than their eligibility limit. Waivers are referred to in the draft regulations and the EAS as 'eligibility events'. There is a limit of three waivers per bidder in the course of the principal stage.
- A5.60 A waiver may occur as a result of either:
- a) A bidder submitting a valid request to carry forward its eligibility limit in its principal stage form; or
 - b) The EAS automatically carrying forward the bidder's eligibility limit when a bidder:
 - i) does not submit a valid principal stage form within a round; and
 - ii) the number of eligibility points used by the bidder from standing high bids is less than its eligibility limit for the round; and
 - iii) the limit of three waivers is not met.
- A5.61 The EAS would not make any other default submissions.
- A5.62 In turn, a bidder's request to carry forward its eligibility limit would be valid only if:
- a) the number of eligibility points used by the bidder from standing high bids is less than its eligibility limit for the round;
 - b) the bidder does not submit any new bids in the same round;
 - c) the limit of three waivers is not met.
- A5.63 A waiver cannot happen in the first round.
- A5.64 To prevent the EAS from carrying forward the bidder's eligibility limit automatically, bidders may submit a decision not to place any new bids in the round. When they check

the selection containing no new bids, the EAS would inform that they would lose eligibility if they submit it.

Information released at the end of each principal stage round

- A5.65 At the end of each round, the EAS would process the submissions in the round and determine whether a further round is needed. In the event that a further round is needed, the EAS would determine which lot types require a price increase. Information about a completed round would be made available to bidders only after the auctioneer approves the results for the round.
- A5.66 The 'active bids' in each lot type in a given round are defined to be, for the purposes of the description in this document:
- a) the standing high bids in that category at the beginning of the round that have not been replaced by the standing high bidder submitting new bids in that category; and
 - b) the new bids for lots in that category submitted in the round.
- A5.67 'Excess demand' is a concept defined in the Regulations. Excess demand for lots in a lot type in a given round is the total bandwidth corresponding to all active bids in that category minus the total bandwidth corresponding to all the lots available in that category.
- A5.68 If a further round is needed, the following information would be made available to each bidder on the EAS interface:
- a) the number of bids submitted by the bidder in the most recent round;
 - b) the number of bids with standing high bid status currently held by the bidder and the respective round prices;
 - c) the number of times a waiver can occur in respect of that bidder;
 - d) the bidder's eligibility limit for the next principal stage round;
 - e) the bidder's financial exposure⁹⁴ after the end of the most recent round;
 - f) for each lot type, after the first round, the following information about excess demand
 - i) For 700 MHz FDD and 3.6-3.8 GHz, the smallest positive multiple of 20 MHz that is strictly greater than excess demand in that lot type in the most recent round (i.e. whether excess demand for that lot type in the round was less than 20 MHz, 40 MHz, 60 MHz, 80 MHz, etc.).
 - ii) For 700 MHz SDL, the smallest positive multiple of 10 MHz that is strictly greater than excess demand in that lot type in the most recent round (i.e. whether excess demand for that lot type in the round was less than 10 MHz, 20 MHz, 30 MHz, 40 MHz, etc.).

⁹⁴ A bidder's financial exposure is the sum of the number of standing high bids held by the bidder in each lot type at the end of the round, multiplied by the round price at which the bids were made.

Revised proposals on auction design

- A5.69 At this stage, no further information would be released about the bids submitted by other bidders.
- A5.70 If the principal stage has ended, the following information would be made available to each bidder on the EAS interface:
- b) a message informing the bidder that the principal stage has ended; and
 - c) the names of the winning principal stage bidders and, in respect of each of them, the number of lots won in each lot type and the associated round price for those winning bids.
- A5.71 The EAS would allow bidders to view and download the information provided after each completed round, once approved by the auctioneer.

End of the bidding process

- A5.72 The bidding process ends after the first round in which no bids are submitted, and where no waiver occurs.

Determination of winning principal stage bids

- A5.73 At the end of the bidding process, bids with standing high bid status would become winning principal stage bids.

Determination of base prices

- A5.74 The Regulations introduce the concept of the 'base price' for winning principal stage bids. This is intended to reflect a bidder's total liability for those bids, as at the end of the principal stage. For each standing high bid that became a winning principal stage bid, the base price would be equal to the round price at which the winning bid was submitted. A bidder's total base price for a lot type would be the number of winning principal stage bids multiplied by the base price for that lot type.

Box 2: Worked up example of principal stage

The example below illustrates how eligibility points, switching lot categories and waivers work in the principal stage. For simplicity we use only two lot categories in this example, instead of the three lot categories in the auction. This example takes the point of view of a particular bidder and assumes: the same lot structure of the award for the 3.6-3.8 GHz and 700 MHz FDD bands (24 lots available in 3.6-3.8 GHz and 6 lots in 700 MHz FDD), price increases in all rounds and the principal stage progressing as shown. The bids and prices are purely illustrative.

Round	700 MHz FDD			3.6-3.8 GHz			Financial exposure	Eligibility points used
	Price	Decision	Outcome	Price	Decision	Outcome		
1	150	Bid, 4 lots	PSHB, 1 lot	30	No bid	No SHB	150	16

2	160	No bid (maintain SHB)	No SHB	32	Bid, 8 lots	SHB, 8 lots	256	12
3	170	waiver	No SHB	34	waiver	PSHB, 2 lots	64	12
4	180	No bid	No SHB	36	Bid, 10 lots	SHB, 10 lots	360	10

In **round 1**, the bidder bids for 4 lots of 700 MHz FDD and becomes standing high bidder on 1 lot. It does not bid for any lots of 3.6-3.8 GHz. In total, the bidder used 16 eligibility points, and so its eligibility limit for round 2 will be 16. The bidder's financial exposure is given by the number of standing high bids multiplied by the round price when those bids were submitted. With 1 standing high bid at the price of 150, the financial exposure is therefore 150 (i.e. 1×150).

In **round 2**, the bidder does not submit new bids for 700 MHz, as it wishes to switch its demand to 3.6-3.8 GHz. It therefore maintains its partial standing high bid from the previous round, and bids for 8 lots of 3.6-3.8 GHz. At the end of the round, it no longer has any standing high bids for 700 MHz FDD, and becomes standing high bidder on 8 lots of 3.6-3.8 GHz. Its financial exposure is 256 (8×32). In total, the bidder has used 12 eligibility points (8 points for the 8 bids on 3.6-3.8 GHz and 4 points for maintaining its standing high bid on 1 lot in 700 MHz FDD). Its eligibility limit for the next round is 12.

In **round 3**, the bidder submits a waiver, which maintains its eligibility limit (12) to the next round and prevents the bidder from submitting a bid in this round. We explain how this request works in paragraphs A5.59 above. The bidder's eligibility limit for round 4 will therefore be equal to its eligibility limit in this round, 12. The bidder ends the round as partial standing high bidder on 2 lots of 3.6-3.8 GHz. Its financial exposure is 64 (2×32).

In **round 4**, the bidder bids for 10 lots of 3.6-3.8 GHz and becomes standing high bidder on 10 lots. The bidder does not submit new bids for lots in 700 MHz FDD. It used 10 eligibility points and so its eligibility limit for round 5 will be 10. The bidder's financial exposure is 360 (10×36).

In the next round, the bidder does not submit any new bids or a waiver. Let us suppose there are also no bids or waivers from the other bidders. As will be explained later in the annex, this means the principal stage ends. Any standing high bids become winning bids. The bidder has won 10 lots of 3.6-3.8 GHz at a price of 360.

The assignment stage

- A5.75 The specific frequencies assigned to bidders who have won lots in the principal stage would be determined in the assignment stage.
- A5.76 The assignment of specific frequencies would be determined independently for each band.
- A5.77 Winning bidders in the 3.6-3.8 GHz band would also have the opportunity to negotiate the outcome of the assignment stage, as an alternative to the outcome being determined solely by assignment stage bidding.

Possible combinations of assignment stage options

- A5.78 For each of the three bands, Ofcom would only consider combinations of assignment stage options in which each bidder is assigned a contiguous frequency block that corresponds to the bandwidth it won in the principal stage, and in which any unallocated spectrum forms a contiguous frequency block.
- A5.79 For the 3.6-3.8 GHz band, bidders that have won 20 MHz or less of 3.6-3.8 GHz spectrum would have the additional restriction of only bidding for the top or bottom of the 3.6 GHz. Subject to the outcome of any negotiation phase (set out in paragraph A5.101 below), Ofcom would only consider combinations of the assignment stage options in which a bidder that has won 20 MHz or less is either assigned the top or bottom of the band, or the adjacent frequencies where more than one bidder has 20 MHz or less. This is set out in more detail below.
- A5.80 If there is only one assignment that meets these requirements, then bidders would be assigned the frequencies corresponding to the spectrum they won in the relevant lot type in accordance with this assignment. If there are multiple assignments that meet these requirements, then bidders who would be assigned alternative frequencies in different assignments would be invited to submit bids for these alternative options.
- A5.81 If a bidding process for the assignment stage is needed, Ofcom would schedule a single round of bidding (the 'assignment round') in which the relevant bidders may submit bids (the 'assignment stage bids') for their preferred assignment stage options.
- A5.82 After bidders have submitted their assignment stage bids, if at least two winning bidders of 3.6-3.8 GHz spectrum agree to participate in a negotiation phase, they would have the opportunity to negotiate assignments on the 3.6-3.8 GHz band following submission of bids. If negotiations are successful, this would be reflected in the assignment stage outcome in 3.6-3.8 GHz.
- A5.83 Ofcom would then determine the assignment that would maximise the value of accepted bids for the 700 MHz FDD, 700 MHz SDL, and (subject to the outcome of the negotiation phase) 3.6-3.8 GHz bands. Bidders may then be required to pay a price (the 'additional price'), on top of their prices from the principal stage, for the frequencies they are assigned (if they submitted a winning bid for this option and other bidders had expressed a preference for an option that was not compatible). Bidders do not have to submit assignment stage bids to be assigned spectrum they won in the principal stage. Participation in the bidding process of the assignment stage is optional.

Restriction of assignment stage options for bidders that have won 20 MHz or less of 3.6-3.8 GHz spectrum

- A5.84 Any bidder that has won 20 MHz or less of 3.6-3.8 GHz spectrum ('small 3.6-3.8 GHz winners') in the principal stage would be restricted to bidding for the top or bottom of the 3.6-3.8 GHz band. Subject to the placement of any unsold spectrum, the assignments stage options for any small 3.6-3.8 GHz winners must satisfy one of the following conditions:

- a) the assignment is at the top of the band;
- b) the assignment is immediately below only other winners of 20 MHz or less (provided that one of the winners in this series is assigned the top of the band);
- c) the assignment is at the bottom of the band; or
- d) the assignment is immediately above only other winners of 20 MHz or less (provided that one of the winners in this series is assigned the bottom of the band).⁹⁵

A5.85 Any bidder that has won 20 MHz or less and that is party to a successful negotiation agreement would no longer be restricted to being placed at the bottom or top of the band (see 'Negotiation phase and determination of winning assignments in 3.6-3.8 GHz' below).

Assignment stage bids

- A5.86 The 'assignment stage options' for each bidder are determined by Ofcom in accordance with our determination of possible combinations of assignment stage options.
- A5.87 If there are several possible assignment stage options for a band, then at least two bidders would have multiple assignment stage options in that band. Any such bidders would have the opportunity to express their preferences within those options in the form of assignment bids.
- A5.88 An assignment stage bid consists of:
- a) an assignment stage option; and
 - b) a bid amount, specified in pounds, and which must be in whole thousands of pounds and at least zero.
- A5.89 Submitting an assignment stage bid establishes a commitment to pay an additional price that would not exceed the bid amount in the event that the bidder is assigned the frequencies specified in the corresponding option.

Scheduling of the assignment stage round

- A5.90 When the assignment stage round is scheduled, the following information would be made available to each bidder:
- a) the start and the end time for the round;
 - b) the assignment stage options that the bidder may bid for.

Bid submission

A5.91 When the assignment stage round is in progress, participating bidders may submit a single list of assignment stage bids using the EAS.

⁹⁵ These conditions apply where there is no unsold spectrum following the principal stage. Where there is unsold spectrum, the unsold spectrum can be placed in any location in the band, provided it is assigned in a contiguous block. This includes being placed at the bottom or top of the band, and next to or between small 3.6 GHz winners.

- A5.92 The interface of the EAS would provide an assignment stage form that lists all assignment stage options available to the bidder.
- A5.93 To submit its list of assignment stage bids, a bidder would need to:
- a) enter the bid amount for each one of the assignment stage options it wishes to bid for in its assignment stage form (the bid amount for any options left blank would be set to zero);
 - b) send the bid form to the auction server, so that it can be checked for validity against the Regulations;
 - c) provided that all bids in the list are valid according to the Regulations, confirm submission of its assignment stage bids using the confirmation form provided by the bidder interface of the EAS.
- A5.94 The submission process for a bidder would be blocked if any of the assignment stage bids in the list are invalid. In such a case, none of the assignment stage bids made by that bidder would be accepted, unless the bidder amends its list and completes the submission process of a valid list of assignment stage bids.
- A5.95 The process of submitting a list of assignment stage bids is only completed when the bidder confirms the submission. A list sent to the server to check for validity but not confirmed would be discarded by the EAS.
- A5.96 Upon receipt of a valid submission of a list of assignment stage bids, the EAS interface would display a confirmation page, listing the assignment stage bids received by the EAS. Conversely, if the assignment stage bids submission process fails, the EAS interface would revert to the assignment stage form. It is the responsibility of the bidder to check (through its bidder interface) that its list of assignment stage bids has been successfully received by the auction server, and to alert Ofcom if it suspects any problems have occurred.
- A5.97 Once the auction server has received a confirmation of a valid submission of a list of assignment stage bids in the assignment round, the bidder would not be able to revise or withdraw this submission, or submit any further assignment stage bids.
- A5.98 Any bidder who fails to submit a list of assignment stage bids before the end of the assignment stage round would lose the opportunity to submit assignment stage bids. In this case, the bid for all of its assignment stage options would be set to zero by default.

Determination of winning assignments in 700 MHz FDD and 700 MHz SDL

- A5.99 The determination of winning assignments stage bids would be calculated independently for each frequency band of 700 MHz spectrum.
- A5.100 For each of the 700 MHz FDD and 700 MHz SDL frequency bands, the EAS would sum the bid amounts of the bids that can be accepted in each alternative possible assignment plan. The winning assignment plan would be the one that yields the greatest value of accepted bids. If there are multiple assignment plans that yield the greatest value, one of these would be selected as the winning assignment plan at random.

Negotiation phase and determination of winning assignments in 3.6-3.8 GHz

- A5.101 For the 3.6-3.8 GHz band, bidders that have won spectrum in the 3.6-3.8 GHz band would have an opportunity to negotiate an alternative outcome to the assignment stage. If at least two winning principal stage winners of 3.6-3.8 GHz spectrum consent to a negotiation phase, Ofcom would pause the auction after assignment stage bidding for a period of up to 28 calendar days. Ofcom would not process or reveal the assignment stage bids during this period.
- A5.102 If all bidders unanimously agree the assignments in the 3.6-3.8 GHz band during this period, they must notify Ofcom of this agreement within this 28-day period.⁹⁶ Ofcom would then proceed to assign the 3.6-3.8 GHz spectrum in accordance with this agreement. Under these circumstances, bidders would not pay any 'additional prices' for their 3.6-3.8 GHz assignments.
- A5.103 If all bidders are unable to come to a unanimous agreement, but a subset of bidders successfully agree to be assigned adjacent frequency locations in the 3.6-3.8 GHz band, Ofcom would reflect this in the outcome as set out below.
- A5.104 This subset of bidders must notify Ofcom by the specified deadline of:
- a) which bidders have agreed to be part of the subset; and
 - b) the order of the bidders' assignments in the subset.
- A5.105 Ofcom will only accept notifications of any agreement between subsets of bidders in the last 7 days of this 28-day negotiation period.
- A5.106 Ofcom would treat the 3.6-3.8 GHz spectrum won by these bidders as a single contiguous block for the purpose of determining the assignment stage outcome, and would invalidate any bids submitted by these bidders during the assignment stage bidding. This single contiguous block would have a bid value of zero. Ofcom would then determine the assignment that would allow us to maximise the value of accepted bids as set out above, subject to the bidders in the subset receiving adjacent assignments. Bidders that are included in the subset would not pay additional prices for its assignments. Bidders that are not included in the subset may pay an additional price, calculated as set out in the following section.
- A5.107 Any bidder that has won 20 MHz or less and that is part of a successful negotiation agreement would no longer be restricted to being placed at the bottom or top of the band.
- A5.108 If no agreements are reached in the negotiation phase or the negotiation phase is not activated (i.e. less than two bidders agree to participate), Ofcom would determine the assignment in 3.6-3.8 GHz in the same way as for 700 MHz FDD and 700 MHz SDL. That is, Ofcom would determine the assignment that maximises the value of accepted bids, and bidders may be required to pay an additional price for their 3.6-3.8 GHz assignment.

⁹⁶ The draft Regulations refer to a unanimous agreement among all winning bidders in 3.6-3.8 GHz as a 'full adjacency agreement'.

Determination of additional prices

- A5.109 The determination of additional prices is calculated independently for each frequency band. The total additional price to be paid by a bidder would be equal to the sum of its 700 MHz FDD, 700 MHz SDL, and 3.6-3.8 GHz additional prices (if any) it has to pay. If bidders have successfully unanimously agreed assignments or have agreed to be part of a subset receiving adjacent assignments in the 3.6-3.8 GHz band, these bidders would not have to pay additional prices for their 3.6-3.8 GHz assignments.
- A5.110 Additional prices to be paid by winning bidders for the specific frequencies awarded to them in the assignment stage are based on the concept of opportunity cost.
- A5.111 For each band, the opportunity cost of assigning a subset of bidders their frequencies in the winning assignment plan is calculated as the difference between:
- a) the highest value of bids that could be achieved across all alternative assignment plans (subject to the outcome of any partial agreement in 3.6 -3.8GHz) if all the bids from the bidders in the subset were set to zero; and
 - b) the sum of bid amounts of bids that are accepted from bidders that are not included in the subset in the winning assignment plan.
- A5.112 The standalone opportunity cost of a bidder is the opportunity cost of the subset of bidders that includes only this bidder.
- A5.113 For a given frequency range, the additional prices must satisfy the following conditions:
- a) the additional price for each bidder cannot be negative;
 - b) the additional price for each bidder cannot exceed the bid amount specified by the bidder for the assignment option it is assigned in the winning assignment plan;
 - c) the sum of additional prices for each subset of bidders (including subsets containing a single bidder, and the subset containing all bidders) must be at least the joint opportunity cost for that subset of bidders;
 - d) the total sum of additional prices must be the smallest across all possible sets of prices that meet the three conditions above.
- A5.114 If there are multiple combinations of prices (one for each winning bidder) that satisfy the conditions above, then the additional prices would be the unique combination of prices that minimises the sum of squares of the differences between each bidder's additional price and their standalone opportunity cost across all sets of prices that satisfy all four the conditions above.

Deposits

Top up deposits during principal stage

- A5.115 At any point during the principal stage, Ofcom may require a bidder to increase its deposit up to an amount equal to the highest financial exposure of the bidder from previous rounds.
- A5.116 In the event of a deposit call, Ofcom would specify a deadline for bidders to make any additional deposits, and provide details of how to make the additional deposit.
- A5.117 If the bidder does not provide Ofcom with the top up deposit as required, it would not be allowed to submit a principal stage form in the next principal stage round nor in any subsequent principal stage round. In addition, the bidder would also be unable to submit an assignment stage form in the assignment stage and shall be deemed to have made a valid bid for a value of zero pounds for each of its assignment stage options.
- A5.118 The bidder would not be excluded from the award process for not having provided the sufficient top up deposit, and it would still win any bids that become winning bids. However, the bidder would not be granted a licence for its winning bids unless it provides Ofcom with the total auction sum payable, following the end of the assignment stage.

Required final principal stage deposit

- A5.119 At the end of the principal stage, by a deadline to be specified by Ofcom, bidders need to have on deposit at least the sum of the total base price in 700 MHz FDD, 700 MHz SDL, and 3.6 GHz.
- A5.120 If the bidder does not provide Ofcom with the required final principal stage deposit, it would not be excluded from the award process. However, it would not be allowed to submit assignment stage bids and would be deemed to have made valid assignment stage bids with a value of zero pounds for all of its assignment stage options.

Required assignment stage deposit

- A5.121 During the assignment stage, by a deadline to be specified by Ofcom, bidders need to have on deposit at least the sum of the required final principal stage deposit (see above) and the amount which is the sum of the bidder's highest assignment stage bid for its 700 MHz FDD, 700 MHz SDL, and 3.6-3.8 GHz assignment stage options.
- A5.122 If the bidder does not provide Ofcom with the assignment stage deposit, all the assignment stage bids submitted by the bidder (if any) would be deemed to be invalid.
- A5.123 As a result, the bidder would be deemed to have made a valid assignment stage bid with a value of zero pounds for all available assignment stage options.

Total auction sum

- A5.124 After the end of the assignment stage, Ofcom shall notify bidders of their total auction sum payable.
- A5.125 Where a bidder's total auction sum is less than the amount it has on deposit, Ofcom would specify a deadline by which it must pay the difference between the two amounts.
- A5.126 A bidder that does not provide the total auction sum payable by the deadline shall not be entitled to the grant of any licences, nor a refund of its deposit. It shall also remain liable to pay the difference between its deposit and its total auction sum payable.

Extraordinary events

- A5.127 Ofcom retains powers to address extraordinary events that might otherwise compromise the auction, including:
- a) rescheduling a round that has been scheduled and has not yet started;
 - b) rescheduling the end of a round in progress;
 - c) cancelling a round in progress;
 - d) cancelling one or more completed rounds and rolling back to a previous round;
 - e) suspending the auction;
 - f) cancelling the auction;
 - g) cancelling some or all bids submitted by one or more bidders in earlier rounds; and
 - h) excluding one or more bidders from the auction.
- A5.128 Bidders who breach the Regulations may forfeit part or all of their deposit.

Information released at the end of the auction

- A5.129 The auction ends with the completion of the grant stage. At this point, the following information would be released to all bidders:
- a) the frequencies assigned to each bidder that has been awarded spectrum; and
 - b) the price paid by each bidder that has been awarded spectrum, including a breakdown of that bidder's base price and any additional prices.
- A5.130 Ofcom would also publish a range of information on its website, including:
- a) the names of the winning bidders and the frequencies won by those bidders (and licence fees paid);
 - b) the names of those winning bidders (if any) that failed to pay their total auction sum on time and who therefore failed to obtain licences under the auction, despite making winning bids; and

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- c) details of all valid principal stage bids, valid assignment stage bids for the 700 MHz frequencies, and occurrences of a waiver during the auction.