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# Three's response to Ofcom's consultation on the Award of the 700MHz and 3.6-3.8GHz spectrum bands

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## Non-Confidential

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12 March 2019

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# Executive Summary

The problem of mobile coverage is one of the most difficult policy problems facing Ofcom. Good 4G services from all four MNOs are only available in 66% of the UK landmass ('areas of full coverage'). The final 9% is a Total Not Spot (TNS), where no MNO provides good coverage.

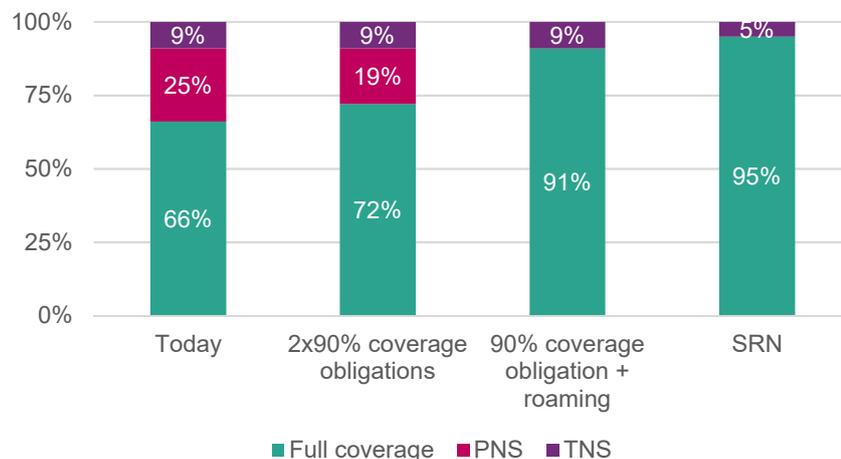
Partial Not Spots (PNS, or areas with good coverage from some but not all, MNOs) cover 25% of the landmass. They comprise the majority of homes and business without good quality coverage. Hundreds of thousands of consumers living in PNS do not have a good choice of provider, and visitors often lose connectivity in these areas.

Ofcom proposes two 90% geographic coverage obligations, offering discounts on spectrum to the winners of the obligations. Ofcom recognises that most of the coverage extension will be in PNS and that, on their own, the obligations will not deliver comprehensive coverage across the UK.

Three's view is that the problem of mobile coverage can be resolved at once. All four MNOs can cover 91% of the landmass by sharing existing infrastructure, or by roaming onto each other's networks. We just need a policy which aligns MNOs' incentives towards the goal of extending coverage, not one which creates diverging interests between them.

Figure 1 compares the geographic coverage delivered by the three options under consideration by Ofcom, DCMS and the industry: 90% coverage obligations; a Rural Roaming obligation attached to a single 90% obligation; and a Single Rural Network (SRN).

**Figure 1: The Single Rural Network and Rural Roaming are much better options to improve coverage.**



Source: Three

## Executive Summary continued

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In summary, the 90% obligations would reduce PNS in around 6% of the country, with no significant impact on TNS. This outcome would not be a good use of taxpayer's money or meet Ofcom's objectives for the auction:

- Based on Ofcom's figures, the required subsidy would be £400-800m. A third of that (£120-£280m) would be taxpayers' money going straight into the pockets of BT/EE (the likely lowest cost provider), with no corresponding benefit. It should be no surprise that BT/EE is the only MNO keen to have the obligations;
- The reason is that the subsidy would reflect the cost to the highest losing bidder for the obligations (✗), not the actual cost of meeting the obligation to BT/EE (which would be £120-£280m lower). The inflated subsidy would need to be paid upfront in Spring 2020 (i.e. through lower auction revenues), even though the winners would take four years to deliver 90% coverage;
- The coverage improvement would focus on PNS, or areas where an existing network is already serving customers. Instead of sharing the network that's already there, the obligations incentivise building duplicate networks in areas where there is scarcely enough traffic to justify having a single network. This inefficiency increases the size of the subsidy needed at the taxpayer's expense. Moreover, this effectively subsidises two MNOs to overbuild rival networks, which Ofcom has previously advised can distort competition;
- The obligations can bias the auction in favour of the MNOs that can meet them most cheaply. Those MNOs may be expected to win more spectrum than otherwise, because ✗, against Ofcom duty to ensure optimal use. The auction can award the obligations even when the social cost (i.e. the subsidy and the cost of an inefficient allocation) is twice the social benefit of extending coverage to 90%.

If Ofcom is using coverage obligations as a 'stick' to have the industry cooperate on solving the problem, it has achieved the desired effect: the industry is talking. But the obligations are now getting in the way of the solution. An MNO who expects to win an obligation has no incentive to cooperate or share the coverage advantage provided by the subsidy. The obligations would re-create large coverage advantages between MNOs and ruin any chance of future cooperation to solve the problem of mobile coverage.

Having four MNOs at or close to 95% coverage is well within reach through a concerted effort between Government, Ofcom and industry. The SRN remains the best solution. It promises to eliminate PNS in 25% of the landmass, for the industry to leapfrog to 91% coverage. The SRN could then build new sites in TNS to deliver up to 95% coverage, without the need for future initiatives or complementary measures.

We expect the costs of the SRN to be a fraction of the cost of the coverage obligations. Few (if any) new sites would be required to get to 91%. Public funding could be directed towards building new sites (to

move the industry towards 95%), and funding would only be granted once coverage is delivered. The SRN would improve competition and service to all customers (not just those of two MNOs) without distorting the auction.

The other option is to have a single 90% coverage obligation and to attach a Rural Roaming obligation to it. Ofcom proposes a second coverage obligation in order to extend coverage to the customers of a second MNO. By the same logic, roaming can be used instead to extend coverage to the customers of all four MNOs, at half the cost to the taxpayer, and with less risk of distorting the auction.

A single coverage obligation and an attached Rural Roaming obligation would eliminate PNS in 25% of the UK at half the cost (i.e. a public subsidy of £200-400m). The subsidy would need to be paid upfront in Spring 2020. This would avoid inefficient build of duplicate networks and promote competition, consistent with Ofcom's objectives for the auction.

For the reasons set out above, our position is that no coverage obligations should be offered in the auction. Three anticipates that this would re-align MNOs' incentive towards the common goal of improving coverage. The SRN can be designed to preserve BT/EE's 4G coverage advantage (by improving all MNOs' coverage by the same absolute amount). A four-way SRN will be straightforward to agree upon. Discussions have progressed to the point where an agreement could be reached in a matter of weeks, not months.

If Ofcom insists on bringing coverage into the auction, it should include no more than one coverage lot to halve the risk of inefficiency in the auction. Ofcom should also attach a mandatory roaming obligation to this coverage lot for the reasons set out above, and set a maximum discount at no greater than one-half of the lowest estimate of social benefit (to assure that procurement of coverage passes the cost-benefit analysis).

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# 1. Ofcom's obligations are undermining the solution to the problem of mobile coverage (the Single Rural Network).

## Executive Summary

DCMS' recent consultation on its Strategic Priorities for telecommunications reaffirms Government's commitment to 95% geographic coverage. Ofcom shares Government's objective of expanding the availability of mobile services across the UK.

DCMS sees the 700MHz auction as a vital opportunity to extend coverage, but invites Ofcom to consider the option of Rural Roaming as a complementary solution. In the auction consultation, Ofcom similarly finds that the 700MHz auction will not fully resolve the problem of mobile coverage. Ofcom commits to work with Government and the mobile industry on complementary initiatives to improve coverage.

Three's view is that the problem of mobile coverage can be resolved at once. We have come to hold this view following recent, detailed discussions with other MNOs. All that is needed is a policy that aligns MNOs' incentives towards the common goal of jointly extending mobile coverage, not one that creates diverging interests between MNOs.

Ofcom's coverage obligations are now the main obstacle standing in the way of the solution. Coverage differences between MNOs are at an all-time low. This provides a unique opportunity for MNOs to collaborate and share networks in rural areas. All four MNOs can cover 91% of the UK landmass with 4G by simply sharing their existing infrastructure, without deploying a single site. MNOs have every incentive to do so, provided coverage obligations do not get in the way.

By contrast, Ofcom's obligations would re-create large coverage advantages between MNOs. This would effectively scupper any chance of MNOs cooperating towards solving the problem of mobile coverage in the future. This section discusses Three's view on the appropriate solution:

- The problem of mobile coverage requires sharing networks in rural areas;
- MNOs can cover 91% of the UK's landmass by simply sharing existing sites;
- MNOs now have an incentive to share to solve the problem of mobile coverage, provided coverage obligations do not get in the way;
- Ofcom's proposed coverage obligations are undermining the single rural network.

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## **1.1 The problem of mobile coverage requires sharing networks in rural areas**

The problem of mobile coverage is one of the most difficult policy problems facing Ofcom. It has defied all previous attempts at a solution. It is only four years since UK MNOs (reluctantly) agreed to extend mobile coverage to 90% of the UK's landmass. Having delivered on that commitment, the industry now faces fresh demands from Government and Ofcom to deliver universal mobile coverage.

The problem of coverage has one simple issue at its heart: economic forces set a limit beyond which further coverage becomes uneconomic.<sup>1</sup> As Ofcom has found, commercial investment driven by competition is reaching the limits of profitable coverage at approximately 80% of the UK landmass.

The costs of deploying a network in more remote areas are typically higher (owing to the longer distances to mobile backhaul and more difficult topography) while the incremental revenues are generally lower (owing to lower population densities). MNOs are unlikely to win many new customers by extending coverage into rural areas, and the increases in network traffic are insufficient to drive significant revenue increases.

Due to low traffic levels and significant fixed costs, the economics of coverage in rural areas are analogous to those of a natural monopoly. The (average) cost of extending coverage into remote areas declines over the entire addressable market. A single network can serve these areas at lower cost than two or more competing networks.

Hence, solving the problem of mobile coverage requires sharing of infrastructure. It is neither feasible nor efficient for MNOs to deploy competing networks in areas where there is scarcely enough traffic to justify deployment of a single network. The solution is to have a single shared MNO network providing coverage in rural areas.

## **1.2 MNOs can cover 91% of the UK landmass by simply sharing existing sites**

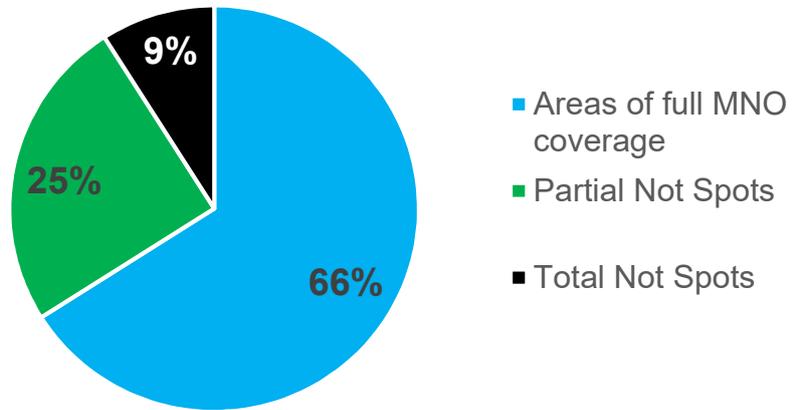
The latest coverage statistics from Ofcom show that good 4G services from all four MNOs are available to 66% of the UK landmass. Partial Not Spots ('PNS', where there is good quality coverage from at least one, but not all, MNOs) cover 25% of the UK geography. Total Not Spots ('TNS', where no MNO provides good quality coverage) consist of the final 9% of the landmass.<sup>2</sup>

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<sup>1</sup> On this, see Ofcom's Economic Geography report [https://www.ofcom.org.uk/data/assets/pdf\\_file/0019/130681/Economic-Geography-2018.pdf](https://www.ofcom.org.uk/data/assets/pdf_file/0019/130681/Economic-Geography-2018.pdf)

<sup>2</sup> <https://www.ofcom.org.uk/research-and-data/multi-sector-research/infrastructure-research/connected-nations-2018/interactive-report>

**Figure 2: MNOs can cover 91% of the UK landmass by sharing existing sites**



Source: Three

Hence, the mobile industry already covers 91% of the UK landmass, although 25% is only covered by some but not all MNOs. As Ofcom has found, “more than 90% of the UK is served with good outdoors coverage by the combined coverage footprint of all operators”.<sup>3</sup>

Therefore, it is possible, in principle, for all MNOs to cover 91% of the landmass by simply sharing existing infrastructure. This would take the industry a long way towards meeting the Government’s 95% target. Even though some sites may not be shareable in practice (so there may be a need to deploy a limited number of new sites to reach 91%), sharing is the most effective solution.

Today, the two network sharing agreements in the UK (MBNL and CTIL) operate largely separate site portfolios. As Ofcom has noted, “there is relatively little sharing between the two established infrastructure sharing joint ventures, MBNL and CTIL”.<sup>4</sup> A framework agreement to share sites between MBNL and CTIL exists, but it is largely unused.

As shown in Figure 2, CTIL only contributes [X] of Three’s [X] sites. Most our sites are provided by [X]

<sup>3</sup> Consultation, paragraph A11.14, found at <https://www.ofcom.org.uk/consultations-and-statements/category-1/award-700mhz-3.6-3.8ghz-spectrum>

<sup>4</sup> Consultation, paragraph A17.33

**Figure 3: [X]**

Source: Three

This provides a key opportunity to solve the problem of mobile coverage through large-scale sharing between MBNL and CTIL, enabled by the provisions of the new Electronic Communications Code (which provides an automatic right for MNOs to share apparatus without prior agreement from landowners, provided there is no adverse visual impact).

### 1.3 MNOs now have an incentive to share to solve the problem of mobile coverage (if coverage obligations do not get in the way)

The 90% geographic coverage obligation has reduced differences in good coverage between MNOs to an all-time low. Ofcom has reported that good quality 4G coverage levels in the UK (as of September 2018) are as presented in Table 1, below.

**Table 1: UK 4G data coverage by operator**

MNO	Landmass	Outdoor premises	Indoor premises
BT/EE	84.4%	99.1%	88.4%
O2	74.4%	98.9%	94.8%
Three	78.4%	98.6%	89.4%
Vodafone	78.6%	99.0%	93.7%

Source: Ofcom Connected Nations 2018, Figure 4.1

This illustrates that MNOs' good quality 4G landmass coverage is much closer than in the past, with only a difference of four percentage points between Vodafone, O2 and Three. Ofcom also estimates that, by the time of the spectrum award, coverage differences will have converged further [X]

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This has incentivised MNOs to discuss the prospect of a shared network in rural areas (a Single Rural Network, 'SRN'), as discussed below. The incentive to collaborate exists because no MNO has a significant competitive advantage to lose from sharing their coverage with others, while all MNOs save money by sharing networks in rural areas.

However, Ofcom's proposed obligations are getting in the way of improved mobile coverage. An MNO which expects to win a coverage obligation in the 700MHz auction will effectively receive public funding (in the form of a discount on the auction fees) to increase its coverage unilaterally to 90% of the UK's landmass. The MNO will have no incentive to participate in the SRN, since this would share the coverage advantage the MNO expects to receive from the public subsidy.

Critically, coverage obligations would undo any prospect of future collaboration to solve the problem of mobile coverage. They would recreate large coverage advantages between MNOs, so the incentive to cooperate by sharing infrastructure will no longer be there.

Two MNOs, the obligation winners, would reach 90% geographic coverage within four years of the 2020 auction. Naturally, they would only want to share infrastructure to address TNS which remain after that, in order to protect their new coverage advantage while also reducing the cost of extending coverage into TNS.

By contrast, the two MNOs left behind by the obligations would have similar coverage to today. They would have no incentive to expand coverage into the 90<sup>th</sup> to 95<sup>th</sup> percentiles of the country. If they seek to expand coverage, their priority would be to target the difference between their current level and 90%, since that is where their competitive disadvantage lies and where there are comparatively more customers and traffic.

#### **1.4 Ofcom's proposed coverage obligations are undermining the Single Rural Network**

Our experience on the SRN supports the view above. Since the summer of 2018, the four MNOs have discussed how best to meet Government's ambition of comprehensive coverage by sharing infrastructure in rural areas. MNOs have engaged with both DCMS and Ofcom throughout the process.

The scope of the SRN would be based on both Government and Ofcom's ambitions for good quality coverage, including both PNS and TNS. This would result in the elimination of PNS and, with public funding, the expansion of coverage into TNS for up to 95% of the country.

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[X] As Ofcom has found, PNS contain the majority of homes and businesses without good coverage, so addressing them would create the greatest consumer benefit.<sup>5</sup> [X]

However, discussions have been derailed by the prospect of the 90% coverage obligations. BT/EE was initially engaged in the discussions around a four-way share between MNOs in rural areas of the UK, and contributed analysis to the proposal for discussions with DCMS and Ofcom on 8<sup>th</sup> February 2019.

BT/EE has recently withdrawn its support. We suspect that this may be motivated by its assessment that it is likely to win one of the 90% coverage obligations in the 2020 auction. BT/EE has the highest 4G geographic coverage level at 84%, so the incremental cost of meeting Ofcom's 90% obligation will be lower than for other MNOs.

[X]

An industry-agreed shared network is not possible while BT/EE's interest and the public interest remain misaligned. Three's proposed solution is to do away with coverage obligations altogether. This would help align the incentives of all four MNOs and bring BT/EE back into the SRN discussions, as BT/EE would no longer expect a public subsidy to reach 90% coverage and would, therefore, be incentivised to participate.

Three knows from cross-industry discussions to date that, if incentives are aligned, a four-way network share will be straightforward to agree upon. The industry has progressed discussions to the point where an agreement could be reached in a matter of weeks, not months.

The first best solution to solving the coverage problem is, therefore, for Ofcom not to impose coverage obligations so that incentives are aligned for agreement on a SRN. If, instead, Ofcom insists with coverage obligations, then the next best solution is for it to impose a single coverage obligation with an attached roaming obligation. We discuss the reasons for this in Section 2.

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<sup>5</sup> Consultation, paragraph 4.11

## 2. The next best solution is Rural Roaming and a single coverage obligation to limit inefficiency in the auction.

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### Executive Summary

Ofcom proposes two free-standing 90% geographic coverage obligations in the auction. These give the winners of the obligations a discount on the spectrum they buy. As Ofcom has recognised, if Ofcom cannot pay bidders or accept negative bids, MNOs may bid for more spectrum than they want in order to benefit from a greater discount.

Hence, Ofcom's obligations can bias the auction in favour of the MNOs who can meet them at lower (net) cost, who are likely to be those with the largest networks and with the most subscribers. Those MNOs may be expected to win more spectrum than they would otherwise in an efficient allocation, contrary to Ofcom's efficiency and competition duties.

Ofcom tolerates this risk because it believes that the maximum discount would limit the potential inefficiency and ensure the coverage lots are only awarded if the social benefits exceed the resource costs of meeting the obligations and the opportunity cost of any changed allocation.

However, this is incorrect. Firstly, Government would have to pay more than the resource cost of extending coverage to 90%. The loss in auction revenues would reflect the cost of extending coverage to the highest losing bidder for the obligations, not to the winners of those obligations (or the maximum discount, if lower).

Secondly, the positive price constraint makes it possible to allocate both coverage obligations when the social cost of extending coverage is twice as large as the social benefit. This introduces an unacceptably large risk of inefficiency in the auction. This risk is needlessly exacerbated by procuring two coverage lots, when Ofcom's objectives are better served by procuring a single coverage lot with a mandatory roaming obligation.

We conclude that no coverage lots should be offered unless Ofcom can accept negative bids and pay bidders in the auction. If a coverage objective must remain in the auction, having a single coverage obligation would at least limit the potential inefficiency.

Attaching a Rural Roaming obligation to the single coverage lot would extend coverage more widely and do away with the need for a second obligation anyway. This is consistent with Ofcom's advice to Government and with Government's own view that Ofcom should maintain the roaming option by including appropriate provisions in spectrum licences.

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## **2.1 Ofcom's obligations can award coverage obligations when the social cost of extended coverage is twice the social benefit**

Ofcom proposes to unbundle two coverage obligations into separate lot categories unattached to any spectrum. The coverage lots would operate in the same way as spectrum lots, but with negative reserve prices (i.e. a discount on the spectrum purchased).

The discount would be bid down if demand for a coverage lot exceeds supply. The reserve prices effectively set the maximum discount that bidders can receive on the spectrum packages bought in the auction if they want to take on a coverage obligation.

Unbundled coverage obligations have significant advantages over obligations which are pre-attached to specific lots of spectrum. They give additional flexibility to bidders and eliminate the risk of unsold spectrum if the obligations turn out to be too costly.

But there is a serious problem with the way these coverage lots are included in the auction. Ofcom considers that it has no legal powers to accept negative bids or pay bidders, so it proposes to constrain the minimum bid in the auction to £1,000 (a 'positive price constraint'). This introduces a key inefficiency into the auction, one which is not limited by the maximum discount, for the reasons set out in the Power Auctions report at Annex 1.

### 2.1.1 Ofcom has to promote efficient use and ensure that coverage obligations are not awarded unless the benefits exceed the costs

Ofcom's main spectrum duty is to allocate spectrum efficiently. Efficiency is best served by allocating spectrum to the highest bidders (as long as they are willing to pay the reserve price). It is to ensure such an efficient allocation that Ofcom and other regulators have moved to using auctions instead of administrative hearings or lotteries.

The role of the auctioneer in a procurement auction for a public good (such as mobile coverage) is not limited to ensuring efficiency. Ofcom must ensure not only that the lowest cost MNOs extend coverage to 90%, but also that the coverage extension is socially desirable in the first place.

This reasoning has led Ofcom to identify two roles for the maximum discount set on the coverage obligations:

- The first role is to provide an incentive for bidders to bid for the obligations;
- The second role is to ensure the obligations are only awarded if the social benefits of awarding them exceed the opportunity cost. Ofcom considers that the opportunity cost of the obligations would be reflected in the loss in total bid value in the auction (i.e. the difference in the value of bids with and without the obligations), and includes both the resource cost to a bidder of meeting the obligations and any

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change in the allocation of spectrum that could result from awarding them.<sup>6</sup>

In Ofcom's view, the winner determination algorithm would determine whether a higher total auction value is achieved by selling the coverage obligation(s) or not, with the maximum discount reflecting the social benefits of extending coverage and the auction bids reflecting the social costs.

In that way, Ofcom considers that the obligations would only be awarded if the social benefits exceed the opportunity costs. The maximum discount would limit the extent of any inefficiency that may be needed to award the coverage obligations, reflecting the balance between social costs and benefits. This conclusion, however, is incorrect.

### 2.1.2 The opportunity cost of the obligations is only bounded by the maximum discount absent a positive price constraint

To understand the auction distortion introduced by the positive price constraint, it helps to analyse the auction outcome absent that constraint. Assume that Ofcom could award free-standing coverage obligations, allow negative bids and pay bidders if the price of their preferred package is less than the discount. In that scenario:

- The auction outcome would be fully efficient. The highest value bidders would win the spectrum and the lowest cost MNOs would win the coverage lots to extend coverage to 90% (funded by lower auction revenues going to Government);
- An obligation would only be awarded if the resource cost to an MNO of meeting it (as reflected in the MNO's bids) is lower than the maximum discount (that is, if the loss in total bid value compared to an auction without obligations is less than the maximum discount);
- However, Government would have to pay more than the resource cost of extending coverage to the winners of the obligations. The loss in bid value would reflect the resource costs to the winners of the coverage lots. But the reduction in auction revenues (i.e. the subsidy) would be higher, because it would instead reflect the cost of meeting the obligation to the highest losing bidder for the obligations (or the maximum discount, if lower);
- Because the obligations would not change the spectrum allocation, there would only be one opportunity cost. This reflects not only the resource costs of meeting the obligations, but the opportunity cost of the public subsidy needed to extend coverage, which is higher. The subsidy represents an opportunity cost to society because it displaces Government's provision of other public good and services.

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<sup>6</sup> Consultation, paragraph 7.113 and A13.19-A13.20

### 2.1.3 The positive price constraint makes it possible for the social cost of the coverage lots to greatly exceed the social benefits

The Power Auctions report explains that the positive price constraint can introduce a greater distortion and inefficiency into the award than Ofcom may have appreciated.

As Ofcom has acknowledged, bidders who run up against the positive price constraint will have an incentive to bid for more spectrum than they want, in order to benefit from a greater discount. In effect, [X].

In comparison with the auction outcome above:

- As Ofcom recognises, the auction outcome could be inefficient, and the auction tilted in favour of MNOs who can meet the coverage obligations most cheaply. Spectrum could end up in the hands of lower value users;
- As Ofcom says, there are now two opportunity costs – the first, however, is not the resource cost of meeting the obligations but rather the loss in auction revenue due to the inclusion of the obligations (which is higher). As above, this reflects the subsidy which must be paid to the winners of the coverage lots to extend their coverage. This can exceed the resource cost of doing so and add up to the maximum discount for each coverage lot;
- There is also the separate opportunity cost of an inefficient spectrum allocation, which can also add up to the maximum discount for each coverage lot. [X].

Hence, contrary to Ofcom's view, the maximum discount does not limit the opportunity cost of the coverage lots, nor ensure that each obligation is only awarded if an MNO can meet it at lower cost than the maximum discount. It is possible that the social cost of the coverage lots will greatly exceed the social benefits.

The extent of the distortion and associated inefficiency is directly related to the number of coverage lots and to the maximum discount per lot. The greater the number of coverage obligations, and the larger the maximum discount proposed by Ofcom, the greater the risk that spectrum may end up with lower value users.

Assuming a maximum discount of £350m per coverage lot, with two coverage obligations Ofcom's proposals can generate both a reduction in auction revenue of up to £700m and a distortion in the allocation of spectrum of up to another £700m. This creates a total opportunity cost of up to £1.4bn, or four times the maximum discount.

Ofcom should not suggest that this inefficiency could be resolved through trading between the coverage bidders and the bidders with the highest

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intrinsic value after the auction.<sup>7</sup> The 700MHz and 3.6GHz spectrum to be awarded will not be subject to an ALF during the initial 20-year period. Ofcom has taken the view (in the context of 900/1800MHz and UKB's 3.4-3.6GHz Annual Licence Fees) that the trading market for mobile licences is unlikely to be sufficiently effective to promote optimal use without the additional signal provided by an ALF.<sup>8</sup>

#### 2.1.4 The risk of inefficiency in the auction is very real

Three is concerned about the risk of distortion in the auction if a low-cost provider of a coverage obligation runs against the positive price constraint. We want to compete on a level-playing field in the auction, not one where the odds are tilted in favour of MNOs with larger coverage and a greater subscriber base to monetise investment in coverage.

For instance, [X]

This is a very real risk. Ofcom has estimated the cost to MNOs of fulfilling the proposed obligations.<sup>9</sup> Ofcom considers that, absent coverage obligations:

- Vodafone, O2 and Three's geographic coverage will go from current levels to around 82% in the long run (over a 20-year period). They would each need an extra 100 sites to go from current coverage to 82%, and a further 500-1,000 sites to get from 82% to 90%;
- BT/EE will stay at its current 84% geo 4G coverage. Ofcom knows that BT/EE's coverage will increase but assumes that it will go back down to 84% (because it may not use all ESN sites after its contract expires in 2023).<sup>10</sup> Ofcom notes that BT/EE might require around 300-700 fewer sites than the other MNOs to reach 90%.<sup>11</sup>

Hence, BT/EE could have a minimum cost advantage over rivals of between 300 and 700 sites. Ofcom estimates average site costs of £395,000 in present value terms (taking initial and ongoing costs cost of a site).<sup>12</sup> This gives BT/EE a minimum cost advantage of between £119m and £277m in the auction.

There is good reason to believe that these estimates are wrong at both the top and lower end in any event:

- [X];
- BT/EE already covers 84% and has publicly announced plans to extend coverage further. It is not prudent to assume that BT/EE's coverage will go back down to 84%. BT/EE has withdrawn from the SRN, suggesting it expects to build a sizable coverage

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<sup>7</sup> Consultation, paragraph A13.39

<sup>8</sup> [https://www.ofcom.org.uk/data/assets/pdf\\_file/0013/130540/Annual-Licence-Fees-for-UK-Broadbands-3.4-GHz-and-3.6-GHz-spectrum.pdf](https://www.ofcom.org.uk/data/assets/pdf_file/0013/130540/Annual-Licence-Fees-for-UK-Broadbands-3.4-GHz-and-3.6-GHz-spectrum.pdf)

<sup>9</sup> Consultation, paragraph A14.58, A11.114

<sup>10</sup> Consultation, paragraph 4.79

<sup>11</sup> Consultation, paragraph A14.58

<sup>12</sup> Consultation, paragraph A14.90

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advantage which it does not want to share with other MNOs. If BT/EE expected its coverage to converge with that of other MNOs over time, it would not have left the table.

In summary, the positive price constraint can bias the auction in favour of the MNO(s) that can provide the coverage obligation most cheaply. These MNOs could win more spectrum than they would in an efficient allocation. This goes against Ofcom's duties of ensuring optimal use and promoting competition. In consequence, Power Auctions recommends that:

- No coverage lots should be offered in the auction unless the positive price constraint can be eliminated;
- If coverage lots remain in the auction, the number of coverage lots should be reduced to one. This will immediately reduce the potential inefficiency induced by the coverage lots by 50%.
- The coverage lot should be subject to a roaming obligation to maximise the value to consumers of the coverage lot. The maximum discount would be set conservatively, so that in the event that the social cost of the coverage obligation exceeds the maximum discount, it is still likely to be less than its social benefit.

## **2.2. A single coverage lot and Rural Roaming obligation would limit auction inefficiency and extend coverage in PNS**

Our view is that, absent a SRN, Rural Roaming would be the next best option for improving coverage. If Ofcom insists in having coverage obligations in the auction, it should include a single free-standing coverage lot and attach a Rural Roaming obligation to it. This would remove the need for a second coverage obligation and serve to increase the coverage of all operators to 90% of the UK.

Since the potential auction inefficiency is directly related to the number of coverage lots on offer, having a single coverage lot would reduce the inefficiency by 50%. A Rural Roaming obligation can then be attached to that lot to extend the benefits of 90% coverage beyond the customers of the winner of the coverage obligation.

### **2.2.1 Rural Roaming can play a key role in improving mobile coverage in PNS**

In its recent consultation on Strategic Priorities in Telecoms, Government asks Ofcom to consider Rural Roaming in PNS and maintain the roaming option by including appropriate provisions in spectrum licences.<sup>13</sup> As the

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/779226/SSP\\_Consultation\\_-\\_Publication\\_Version\\_2\\_.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779226/SSP_Consultation_-_Publication_Version_2_.pdf)

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consultation recognises, PNS contain the majority of homes and businesses without good coverage.<sup>14</sup>

As recently as June 2018, Ofcom advised Government that Rural Roaming “*has the potential to be a credible solution in Partial not spots*”.<sup>15</sup> Ofcom estimated that any-to-any Rural Roaming can deliver 90% geographic coverage to customers of all four MNOs at modest cost (£5-15m upfront and annual opex of £2-3m per MNO). Ofcom said that implementing roaming agreements could take between 9 and 18 months.

Six months later, Ofcom has discarded Rural Roaming as an option in the consultation. The Rural Roaming option is consigned to one of the Annexes and dismissed summarily in a couple of pages. This sudden change in policy is difficult to understand, particularly given the obvious shortcomings with Ofcom’s obligations.

Rural Roaming deserves a fair hearing. We ask Ofcom to consider all options (not just coverage obligations), comparing the advantages and disadvantages objectively side by side, as we propose in Section 3.

Our proposed Rural Roaming obligation is sketched in the box below.

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<sup>14</sup> Consultation, paragraph 4.11

<sup>15</sup> [https://www.ofcom.org.uk/\\_data/assets/pdf\\_file/0017/120455/advice-government-improving-mobile-coverage.pdf](https://www.ofcom.org.uk/_data/assets/pdf_file/0017/120455/advice-government-improving-mobile-coverage.pdf)

### **A single coverage and 4G Rural Roaming obligation**

A 4G wholesale roaming obligation can be attached to a single coverage lot in the auction. Like the coverage obligation, the roaming obligation would also be included in any spectrum licences won in the award.

The combined obligation would require the winner of the coverage lot to meet the geographic coverage target and offer 4G wholesale roaming to all other MNOs. Roaming would be constrained to rural areas specified by Ofcom, to mitigate investment concerns and maintain an acceptable customer experience.

#### Extending coverage to other customers

The winner of the obligation would make 4G coverage in areas within scope of the obligation available to all other MNOs. Consumers of other MNOs could make or receive voice calls, send or receive text messages and receive 4G data services on their mobile phone in an area where their home network has no coverage.

#### Scale of the coverage obligation

Ultimately, the scale of the coverage obligation would depend on both Ofcom's policy objectives and the incentives it offers for MNOs to bid for it. Ofcom could choose a more ambitious target than 90% to help meet Government objectives. Ofcom would be able to retain any sub-requirements (i.e. to cover a certain number of new premises and build a certain number of new sites) in the combined obligation.

#### Technical requirements

The Rural Roaming requirement would have to meet Ofcom's definition of good quality 4G coverage (i.e. at least -105dBm for outdoor 4G coverage). This requires reliable voice calls and a high probability of access to at least 2Mbps. Like the coverage obligation, the Rural Roaming obligation could be delivered with any spectrum (e.g. 800MHz).

Ofcom considers that roaming could be used to comply with its proposed coverage obligations so long as 'the service onto which the obligated operator roams meets the requirements of our proposed obligations' [paragraph 4.43]. Ofcom could use the same principle to determine the technical requirements of a Rural Roaming obligation.

#### Wholesale pricing

The wholesale Rural Roaming rate would be set on fair, reasonable and non-discriminatory (FRAND) terms. Ofcom would produce guidance for what constitutes 'fair and reasonable' terms, to ensure that the winning bidder prices wholesale roaming efficiently. Ofcom would act as arbitrator in any disputes about the pricing of roaming services by the winner of the obligation.

### 2.2.2 If Ofcom intends to pursue roaming as a solution to mobile coverage, it should do so through the auction

In October 2018, Ofcom's Chairman and CEO appeared in front of the House of Commons Digital, Culture, Media and Sport Committee on Disinformation and 'fake news'. Ofcom suggested that imposing a

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roaming obligation in the auction could run into legal difficulties, but roaming can be taken forward with industry outside of the auction.<sup>16</sup>

Absent a Single Rural Network, we consider that Rural Roaming should be imposed in the auction through a wholesale roaming obligation. Ofcom has legal powers to impose roaming as a condition in one of the new licences.

The discount on the auction price for the winner of the coverage and roaming obligations would provide a strong incentive for MNOs to buy them. After the licences have been issued, it will be very difficult for Ofcom to impose roaming. The ‘carrot’ of an auction discount would no longer be available for an MNO to voluntarily acquire the obligation.

If Ofcom intends to pursue a Rural Roaming solution outside of the auction, it should set out exactly how it intends to do so now. Retaining the option to impose roaming later would add uncertainty into the auction. When bidding for coverage obligations, MNOs would not know whether they would subsequently be required to offer roaming. The value of the coverage lot would be uncertain, because bidders would not know if they would receive a competitive advantage from the extended coverage or gain revenues from other MNOs purchasing roaming services.

### **2.3 There are no detrimental effects on the auction or investment from a 4G Rural Roaming obligation**

#### 2.3.1 Benefit of a Rural Roaming obligation

Ofcom considers that a roaming obligation may not provide a significant benefit if there is limited appetite to acquire it in the auction, and that MNOs may not be interested in buying wholesale roaming services from the winner of a roaming obligation anyway. Ofcom also finds that, since roaming would be limited to 700MHz spectrum, the obligated MNO may deploy its 700MHz spectrum in areas of limited roaming and use other spectrum elsewhere to avoid the obligation.<sup>17</sup>

As described above, our proposed roaming obligation would not be limited to 700MHz spectrum and could be delivered with any spectrum (e.g. 800 MHz) to satisfy Ofcom’s definition of good quality 4G coverage. This means that operators which do not win the Rural Roaming obligation will have the option of roaming much more widely than Ofcom suggests.

#### *Operators bidding for the roaming obligation in the auction*

All else being equal, operators are likely to prefer to bid for the roaming-encumbered coverage obligation rather than rely on purchasing a roaming solution from other operators. This is because they value the control over where to extend their network and the simplicity involved in

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<sup>16</sup> <https://parliamentlive.tv/Event/Index/69cdc8e4-6894-451b-ba23-de6344a822b0>

<sup>17</sup> Consultation, paragraphs A17.20-A17.21

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keeping their customers on their own network rather than having to manage arrangements where they roam onto others.

Notwithstanding this, there are two mechanisms by which Ofcom can further incentivise operators to bid for the roaming-encumbered coverage obligation in the auction rather than wait and purchase a roaming service from the obligation winner.

Firstly, Ofcom should set the maximum discount on the coverage obligation to incentivise operators to bid for it. Any operator which estimates that the net cost to it of improving its coverage to 90% of the UK geography is below the maximum discount will be incentivised to bid for it. The addition of a Rural Roaming obligation to the coverage lot should also provide additional revenues to the obligation winner.

Secondly, it could structure the regulation of the wholesale Rural Roaming charge so that it is relatively more attractive for an operator to provide the roaming service than it is to purchase it. It could do this by allowing the obligation winner to include a specified mark-up over the incremental costs of providing a roaming service in its wholesale charge.

We agree with Ofcom<sup>18</sup> that commercial negotiation is the most proportionate approach to setting regulated prices and would expect it to set out ex ante guidance on how the roaming charge should be commercially set, including in relation to any mark-up.

We further note that, by increasing the wholesale roaming charge, this mark-up should also reduce operators' incentives to decommission their existing sites and roam onto the obligation winner's network. We discuss this below.

#### *Operators purchasing roaming from the obligation winner*

We also expect that MNOs who do not win the obligation would want to receive wholesale roaming on regulated terms, to avoid being left behind on coverage. We agree with Ofcom that MNOs are reaching the limits of coverage that can be commercially reached through competition.

However, this does not mean that an MNO will not achieve a competitive advantage from improving coverage beyond current levels. It is simply that the gain from improving coverage is outweighed by the cost of unilaterally extending coverage into more remote areas.

MNOs require cheaper solutions, such as Rural Roaming at regulated prices (or more extensive network sharing). This is supported by our experience in the SRN. The reason MNOs have been engaged in discussions is because none want to be left at a competitive disadvantage by the coverage obligations, but there is no commercial case for unilaterally expanding coverage into rural areas either.

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<sup>18</sup> Ofcom's Advice to Government, paragraph 1.33.

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### 2.3.2 Effect on the auction

Ofcom considers that including a roaming obligation would introduce uncertainty into the auction, as a holder of a non-coverage lot could use roaming to achieve the same level of coverage as the holder of the coverage lot. Ofcom is concerned that MNOs may not bid for coverage lots, as they could increase coverage by roaming onto the network of whoever wins those lots.<sup>19</sup>

We note that this should not be a concern in the medium term as the most valuable 700MHz spectrum (the FDD bands) will be used to deploy a 5G coverage layer and increase 5G coverage whereas the roaming solution we propose is a 4G-only solution. Similarly the primary use case for the 3.6 band that is included in the auction is also for 5G. The only band for which this may be a concern is 700MHz SDL which may be used for 4G in the short term. However this marginal concern could be addressed by the wholesale pricing structure of the Rural Roaming service as explained above.

This means that MNOs bidding in the auction would not have the conflict that Ofcom presents for the majority of the spectrum included in the auction since MNOs would still need to bid aggressively on 700MHz spectrum to increase their medium-term 5G coverage, regardless of whether they have the option to purchase 4G roaming after the auction.

### 2.3.3 Effect on investment

The consultation considers that a roaming requirement could affect investment in three ways:

- Non-roaming operators might decommission existing masts in rural areas if roaming was cheaper and more efficient, which could lead to a reduction in coverage in some areas;
- Operators may stop building new masts to expand coverage into rural areas if doing so no longer gave them a competitive advantage;
- Operators might be deterred from upgrading masts to new technologies in existing PNS in rural areas if other operators could piggy-back of their networks. i.e. roaming could have an adverse effect on incentives to invest in 5G.

These are the exact same concerns that Ofcom considered in its advice to Government.<sup>20</sup> It is puzzling that the consultation should present them as insoluble, when the advice to Government found a ready answer for them. The advice concluded that *“if the wholesale price which operators offered to their competitors were set at the right level then we would expect investment incentives to be largely preserved”*.

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<sup>19</sup> Consultation, paragraph A17.26

<sup>20</sup> [https://www.ofcom.org.uk/data/assets/pdf\\_file/0017/120455/advice-government-improving-mobile-coverage.pdf](https://www.ofcom.org.uk/data/assets/pdf_file/0017/120455/advice-government-improving-mobile-coverage.pdf)

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All that is required is setting the wholesale price at a level which ensures that MNOs retain incentives to invest and are compensated for any loss of commercial advantage. Nevertheless, we address each of Ofcom's concerns in turn.

### *Decommissioning existing masts*

We do not expect any operator to decommission existing masts. The holder of the roaming obligation would have to maintain existing masts (and build new sites) because it would be required to do so to meet the accompanying 90% coverage obligation.

MNOs which do not hold the roaming obligation would also be incentivised to retain existing masts in areas where rural roaming provides an alternative, so long as the wholesale price is appropriately constructed.

The most substantive cost associated with deploying mobile networks in rural areas is the fixed cost of building a site. Once the site is built and the fixed costs paid, a mobile operator will be left to pay the operational costs of maintaining the site (for example, power and transmission).

An operator will only decommission a site and roam onto another network in an area where the wholesale roaming charge plus the costs of decommissioning the site<sup>21</sup> are less than the operational costs of continuing to run its existing site.

The wholesale roaming charge could be set to reflect the incremental costs of carrying additional wholesale traffic to provide non-roaming MNOs the right build or buy incentives. Depending on the traffic levels on sites, these costs will be similar to the operational costs that an operator bears from running a mobile site. The operator will, therefore, have no incentive to decommission its existing site since doing so will not reduce its ongoing costs and it would also have to bear the additional costs of decommissioning the site.

If the incremental costs of carrying wholesale traffic are, instead, significantly lower than the operational costs of running a site, incentives to retain existing infrastructure would be retained by allowing for an uplift in the wholesale roaming charge which reflects a share of any operational costs which are non-incremental to traffic.

### *Stop building new masts*

There is no prospect that the availability of wholesale roaming would displace MNOs own investment in coverage, because the roaming obligation would only apply in specified rural areas where the commercial case for expanding coverage is weak in the first place. As a result,

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<sup>21</sup> These can be significant and include the cost of removing equipment from a site and the MNO being released from long-term contracts with landowners.

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competition is unlikely to drive operators to increase their coverage in any case.

As Ofcom has recognised in its consultation, the expansion of coverage into rural areas is reaching the limits of that which can be driven by competition. It is for this reason that Ofcom is exploring alternative ways to expand coverage in these areas, such as its proposed coverage obligations.

Throughout the rest of the UK, MNOs would continue to have the ability and incentive to invest in upgrades to differentiate their service offering and compete on the quality of their networks

#### *Incentives to invest in 5G*

We do not consider that our proposed roaming solution would affect the incentives for any operator to invest in upgrading masts to 5G because the proposed roaming solution is a 4G solution. An MNO which won the roaming obligation and upgraded its masts to provide a 5G service would not be required to allow other operators to roam on its 5G service.

# 3. The Single Rural Network and Rural Roaming lead to better consumer outcomes than Ofcom's obligations.

## Executive Summary

In this section, we compare the Single Rural Network and Rural Roaming solutions against Ofcom's proposed 90% coverage obligations. We assess each option against Ofcom's objectives for the auction, namely: i) improving mobile coverage; ii) efficient use of the public subsidy; iii) promoting competition; iv) ensuring optimal use of spectrum and auction efficiency; v) promoting economic efficiency.

The table below uses a simple traffic light system comparing the two alternative options with Ofcom's proposed coverage obligations.

	Ofcom's proposed 90% obligations		Single Rural Roaming obligation		Single rural network	
<b>Improving mobile coverage</b>	Two MNOs serve 90% of UK. No MNO alignment to push coverage to 95%.	●	All MNOs serve 91% of the UK. Aligned incentives to get to 95%.	●	All MNOs serve up to 95% of the UK.	●
<b>Efficient use of public funds</b>	Second price auction inflates public subsidy.	●	Single coverage obligation lowers inflated subsidy.	●	Government contributes to resource cost of coverage only.	●
<b>Promoting competition</b>	Improved coverage for two MNOs and biases auction in favour of larger MNOs.	●	Improved coverage for all MNOs. Reduced auction bias.	●	Improved coverage for all MNOs. No auction bias.	●
<b>Promoting economic efficiency</b>	Duplicate networks in PNS.	●	Single network in uneconomic areas.	●	Single network in uneconomic areas.	●
<b>Optimal use of spectrum</b>	Risk of large inefficiency in the auction.	●	Reduced risk of inefficiency in auction.	●	No auction inefficiency.	●

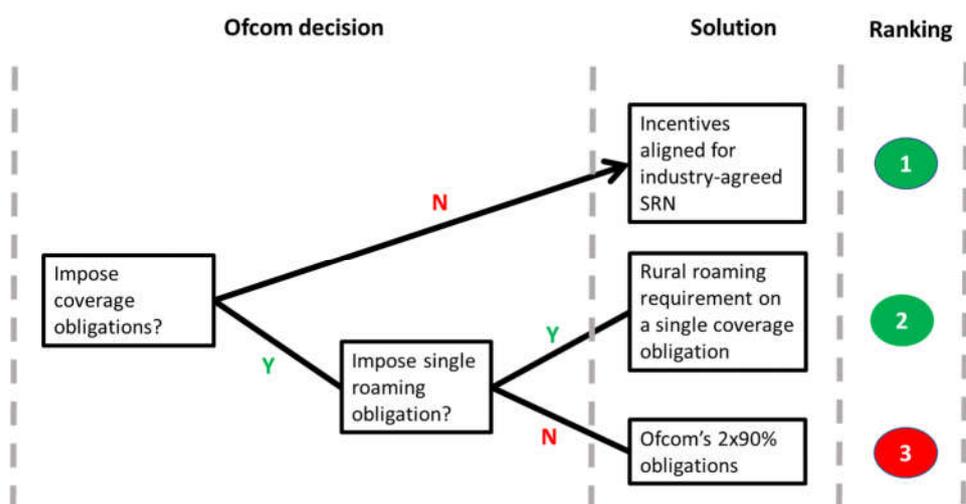
This comparison clearly illustrates that both the SRN and the inclusion of a single coverage lot with a Rural Roaming obligation are better at promoting Ofcom's objectives than the 90% obligations.

The SRN remains the best solution to improve mobile coverage in the UK. It can eliminate PNS in rural areas and make significant inroads in TNS, providing consumers with good quality mobile services in up to

95% of the country. The SRN ensures service competition from all MNOs and minimises the public subsidy without distorting the auction or incentivising duplication of networks in harder to reach areas.

Likewise, Ofcom can generate a much better outcome than the 90% obligations through a single obligation and Rural Roaming. Only one network would be built (rather than duplicate networks in low population density areas). The improvement in coverage would be much greater, and the customers of all four MNOs (not just two) would benefit from it. All four MNOs (not just two) would provide competition in rural areas. The public subsidy required would be halved, as would be the risk of distortion and inefficiency in the auction.

Based on this analysis, the figure below sets out Ofcom’s key decisions and a high-level assessment of the rankings of each of the three solutions.



We urge Ofcom to use its policy levers in the auction to provide the correct incentives for operators to engage in four-way shared single rural network. This means removing the proposed coverage obligations so that incentives are aligned for a voluntary agreement. If Ofcom persists with the strategy of imposing coverage obligations, it should only include one unbundled coverage lot and attach a roaming requirement to it.

### 3.1 The SRN and Rural Roaming can solve the problem of mobile coverage now, unlike coverage obligations

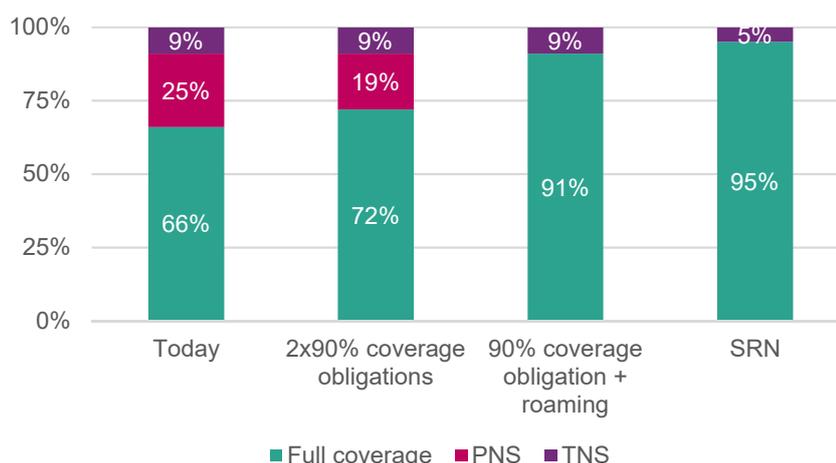
Ofcom estimates that 25% of the UK landmass is a PNS where some but not all MNOs provide good quality 4G coverage. PNS contain most homes and businesses without good coverage in the UK.<sup>22</sup> 9% of the landmass is a TNS while 66% has good coverage from all four MNOs ('area of total coverage').

<sup>22</sup> Consultation, paragraphs 4.11 and A11.76-A11.77

The consultation does not estimate the impact of the 90% coverage obligations on PNS and TNS. It simply says that Ofcom expects the coverage improvement to occur mainly in PNS areas, and that Vodafone, O2 and Three could potentially meet the premises requirement by rolling out solely to premises in PNS.<sup>23</sup>

Ofcom did estimate the impact of two 92% coverage obligations in its 2018 advice to Government. Those estimates can be used to assess the likely coverage improvement from the current obligations. Figure 3 compares our estimates of good quality 4G geographic coverage, today and for each of the three options: Ofcom’s 90% coverage obligations;<sup>24</sup> a 90% coverage plus Rural Roaming obligation;<sup>25</sup> and the four-way Single Rural Network deployed in all areas up to 95% of the country.

**Figure 4: The Single Rural Network and Rural Roaming options can significantly improve coverage.**



Source: Three

This illustrates the lack of ambition of Ofcom’s obligations. We estimate that the obligations could reduce PNS by approximately six percentage points, with no noticeable impact in TNS. Even then, only the customers of two MNOs would benefit in those areas. It is no surprise that Ofcom emphasises that the obligations will not address all coverage issues, and commit to work with the industry on complementary initiatives.<sup>26</sup>

The obligations improve coverage compared to today, not compared to the SRN or a single 90% obligation together with Rural Roaming. Critically, as discussed in Section 1, coverage obligations would

<sup>23</sup> Consultation, paragraphs A11.112-A11.120

<sup>24</sup> We have approximated these values based on today’s levels, Ofcom’s estimates of the impact of its proposed 92% coverage obligations on UK coverage in its Advice to Government and Ofcom’s view that the majority of coverage improvements from its coverage obligations will be realised in PNS.

<sup>25</sup> As we discuss above, this can provide a basis for agreement to extend coverage further towards Government’s 95% ambition, but we have taken a conservative approach and not assumed that here. We have also taken a conservative approach in assuming that the roaming obligation will not eliminate any TNS.

<sup>26</sup> Consultation, paragraph 1.9

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perpetuate PNS and TNS. They would recreate large coverage advantages that would scupper any chance of future cooperation.

The outcome is entirely predictable. MNOs' incentives would be misaligned, and the industry would resist any further initiative to improve coverage. The winners of the 90% obligations would not want to share their coverage to tackle PNS. The MNOs left behind would not want to address TNS (since their priority would be to tackle their disadvantage in PNS, if they could see an economic case for doing so unilaterally).

By contrast, as discussed in Section 1, all four MNOs can cover 91% of the UK landmass by sharing existing infrastructure through MBNL and CTIL, or by roaming onto each other's networks. With both the SRN and roaming, the industry would eliminate PNS and leapfrog to 91%. Under both options, consumers of all four MNOs would be able to receive a good quality 4G service in those areas.

The SRN could then build new sites in TNS to deliver up to 95% coverage, without the need for future initiatives or complementary measures. This would be a concerted effort where the interest of all MNOs would be aligned. The SRN would have a site owner responsible for building and operating the new sites in outlying areas, allowing customers of all MNOs to access the coverage provided by those masts.

A roaming requirement attached to a coverage obligation would also allow coverage to be extended beyond 91%. 4G coverage from all MNOs would be broadly similar by the end of deployment to meet the coverage obligation (i.e. Spring 2024). This would align the incentives to share their networks to further expand coverage into TNS. Four-way discussions on the SRN have confirmed that expanding coverage into TNS where MNOs begin at a similar coverage level is straightforward to agree upon.

### **3.2 The 90% obligations deliver a small improvement in coverage at a very high cost to the taxpayer**

In the 2020 award, Ofcom will offer a discount on spectrum receipts to the winners of the 90% obligations. The discount is effectively a public subsidy because Government will forego some of the revenue that it would have received for the spectrum absent the obligation. There are three main subsidy options to improve coverage:

- An indirect subsidy granted to two MNOs through the coverage obligations in the 700MHz and 3.6-3.8GHz licences to be awarded, as Ofcom proposes;
- A direct subsidy through public procurement – i.e. the SRN would require participating MNOs to share costs equitably, with PNS and TNS addressed in a cost-optimal way through an industry consortium of 4 MNOs, and with supporting Government funding where network-sharing is commercially infeasible; and
- A mixture of the two – i.e. a single coverage obligation with a Rural Roaming obligation attached to it in the auction (to address PNS

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and extend coverage to 91%), plus an SRN-like consortium to push coverage towards 95%, with supporting Government funding.

Ofcom's coverage obligations will not deliver value for money to the taxpayer. In Figure 3, we estimate that coverage obligations would reduce PNS in around 6% of the country, with no significant impact on TNS. The public subsidy required to secure such a modest improvement would be very high:

- Government would not pay the actual cost of hitting 90% incurred by the winners of the obligations, but rather the cost to the highest losing bidder for them. Ofcom has estimated that Vodafone, Three and O2 would each spend £200-400m on 500-1,000 new sites.<sup>27</sup> With two obligations, the subsidy needed would be £400-800m;
- A third of the subsidy (£120-£280m) would be taxpayers funding excess profits of the lowest cost provider, likely BT/EE. Ofcom has estimated that BT/EE might require around 300-700 fewer sites than other MNOs to hit 90%, but Government would pay BT/EE as if it incurred the same costs as the other MNOs;<sup>28</sup>
- The subsidy would need to be paid upfront in Spring 2020 (i.e. through reduced auction revenues), even though it would take four years for the winners of the obligations to deliver the coverage extension.

A single 90% coverage obligation and an attached Rural Roaming obligation would eliminate PNS in 25% of the UK at half the cost of the obligations (i.e. with a public subsidy of £200-400m). Over half of the subsidy (£120-£280m) would represent taxpayer's money funding excess profits of the lowest cost provider. The subsidy would need to be paid upfront in Spring 2020. The cost of implementing Rural Roaming to the industry would be comparatively modest (£5-15m upfront per MNO and annual Opex of £2-3m per MNOs according to Ofcom).<sup>29</sup>

The SRN would deliver the greatest coverage extension, eliminating PNS in 25% of the country and further extending coverage in TNS towards 95%. We expect the costs of the SRN to be far below those of the coverage obligations. No new sites would be required to expand coverage to 91%. All that would be required is the installation of active equipment on existing masts. Funding would be more gradual as it would only be granted once coverage is delivered.

Quite apart from the size of the subsidy, there is the separate question as to whether a subsidy would be appropriate in the first place. We have seen in Section 2 that Ofcom's proposals could award the two coverage obligations when the social cost (in terms of the required subsidy and any allocation of spectrum to lower value users) is twice the social benefit.

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<sup>27</sup> Consultation, paragraph A14.92

<sup>28</sup> Ofcom estimates average site costs of £340,000 in present value terms (taking initial and ongoing costs cost of a site).

<sup>29</sup> [https://www.ofcom.org.uk/\\_data/assets/pdf\\_file/0017/120455/advice-government-improving-mobile-coverage.pdf](https://www.ofcom.org.uk/_data/assets/pdf_file/0017/120455/advice-government-improving-mobile-coverage.pdf)

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### 3.3 The 90% obligations do not promote competition

Ofcom has advised Government that a public subsidy to pay for new coverage roll-out would be appropriate in TNS, but not in PNS. The reason, per Ofcom itself, is that funding operators to overbuild their competitors' networks in PNS could create distortions to competition.<sup>30</sup>

Yet this is exactly what Ofcom is proposing with the 90% obligations. As discussed above, Ofcom considers that most of the coverage improvement secured by the 90% obligations would be in PNS. These are areas where an existing network is already serving customers.

More generally, Ofcom's obligations would subsidise the two incumbents with the largest networks to extend their coverage to 90%. That BT/EE will be one of them is almost certain. BT/EE certainly expects that outcome, as evidenced by its withdrawal from the SRN. We have discussed in Section 2 that it is highly unlikely that BT/EE's 4G coverage would go backwards to 84% in the future (as Ofcom has assumed).

[REDACTED].

Moreover, as discussed in Section 2 Ofcom's obligations can bias the spectrum side of the auction in favour of the bidders that can provide the coverage obligation most cheaply. It should be expected that these MNOs will win more spectrum than they would in an efficient allocation.

[REDACTED]

### 3.4 A concerted effort between MNOs (through a Single Rural Network) will deliver a much more efficient solution

As Ofcom has found, industry is reaching towards the upper bounds of the coverage that commercial investment driven by competition will deliver.

The areas targeted by Ofcom's coverage obligations are uneconomic to serve. For example, some of the sites that Three upgraded in 2017 to comply with Ofcom's 90% geographic voice coverage obligation carry on average only [REDACTED] calls per month.

As discussed in Section 1, these low levels of traffic indicate that the economics of providing coverage in these areas are analogous to those of a natural monopoly. One network can supply the market more cheaply than two or more networks.

PNS are areas which can only support one network shared between two MNOs (i.e. MBNL or CTIL). TNS are areas which do not support one network shared two-ways. Even four-way sharing of a single network may not prove economic, depending on traffic volumes.

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<sup>30</sup> [https://www.ofcom.org.uk/\\_data/assets/pdf\\_file/0017/120455/advice-government-improving-mobile-coverage.pdf](https://www.ofcom.org.uk/_data/assets/pdf_file/0017/120455/advice-government-improving-mobile-coverage.pdf)

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Ofcom considers that most of the coverage improvement with its two obligations will occur in PNS, or areas where there is already one network. This means that Ofcom's obligations would incentivise building two duplicate networks in areas that are so scarcely populated that they require a subsidy even to build out just one network.

Ofcom's obligations proposals would divide traffic that is most efficiently served by one network between two competing networks running in parallel to each other. This foregoes economies of scale and would lead to an increase in the average cost faced by MNOs, relative to where only one network is deployed.

By contrast, all MNOs can cover 91% of the landmass and eradicate PNS by simply sharing existing infrastructure, either through the SRN or via roaming. If all existing sites are shareable, no new sites would be needed. A concerted effort by all four MNOs is likely to be a much more efficient solution to the problem of mobile coverage than encouraging duplication of parallel networks in areas where there is scarcely enough traffic to justify having a single network.

### **3.5 The Single Rural Network would ensure optimal use of spectrum without distorting the auction**

Ofcom's main statutory duty in relation to spectrum is to ensure optimal use. Ofcom awards spectrum by auction because it considers that doing so will secure optimal use. Ofcom expects the operator which ascribes the highest value to the spectrum to be most likely to use it efficiently to deliver the services consumers most want.

In Three's view, the best option to ensure optimal use and preserve the efficiency of the auction is undoubtedly the SRN initiative. This would resolve the problem of mobile coverage outside of the auction, and there would be no coverage lots in the auction. The auction would run its course without all the distortions and complications created by Ofcom's proposed coverage obligations.

As discussed in Section 2, due to the positive price constraint, Ofcom's proposed 90% obligations could bias the auction in favour of the bidders that can provide the coverage obligation most cheaply. [§<] They may be expected to win more spectrum than they would in an efficient allocation, contrary to Ofcom's statutory duty of ensuring optimal use.

The risk of a distortion in the auction is needlessly exacerbated by procuring two coverage lots, since the size of the distortion is proportional to the number of obligations in the auction. Our second-best option, a coverage and Rural Roaming obligation, would halve the risk of sub-optimal use of spectrum and inefficiency in the auction.

# 4. Ofcom's competition measures do not address the consequences of further asymmetric distribution of sub-1GHz spectrum.

## Executive Summary

Three's view is that MNOs' shares of mobile spectrum must be kept between a 20% floor and a 30% ceiling to maintain a four-player market structure. Following Three's acquisition of UKB and the result of the 2018 PSSR auction, spectrum shares have converged towards those ranges.

As Ofcom has found, BT/EE, Three, Vodafone and O2 now have 32%, 25%, 25% and 18% respectively of currently allocated spectrum (including 3.4-3.6GHz), with further spectrum to be awarded at the auction. Hence, we agree with Ofcom that the auction poses no risk to the credibility of any MNO.

We also support the imposition of an overall spectrum cap of 416MHz (37%), to address the risk of weaker competition due to asymmetry in overall spectrum. In our view, Ofcom is right to find no competition concerns in relation to '5G spectrum', as there is no prospect of unmatchable advantages arising from the distribution of that spectrum.

However, Ofcom understates the impact on competition of a situation in which neither BT/EE nor Three win 700MHz spectrum. This situation does pose a material risk to competition because:

- There are two concerns (not one as Ofcom claims) that arise if neither BT/EE nor Three win 700MHz spectrum – capacity in harder to serve areas and the ability to rollout a nationwide 5G network.
  - First, contrary to what Ofcom suggests, [redacted]. The alternatives to low frequency spectrum such as site densification or other technological solutions proposed by Ofcom are either not commercially practicable or will only have a marginal impact.
  - Another concern not considered by Ofcom is that [redacted].
- Contrary to what Ofcom claims the ability to provide good quality indoor service (with sufficient capacity) is a competitive differentiator. [redacted].
- All of the above mean that a scenario in which neither Three nor BT/EE win any 700MHz will lead to a substantial lessening of

competition in retail markets (contrary to what Ofcom claims) and additionally to a reduction in competition in wholesale markets which is not considered at all by Ofcom.

The substantial lessening of competition in retail and wholesale mobile markets [X]. This would be an effective competitive strategy, contrary to what Ofcom claims.

Ofcom should address the risk of further concentration of sub-1GHz spectrum in the hands of Vodafone and O2 by the imposition of an 80MHz (37%) sub-1GHz cap, in addition to the overall spectrum cap.

The proposed cap would avoid extreme asymmetry in sub-1GHz spectrum, by constraining Vodafone and O2 to acquire a maximum of 2x10MHz of 700MHz FDD and 5MHz of 700MHz SDL spectrum. This would preclude Vodafone and O2 from bidding strategically, and leave a minimum of 2x10MHz FDD and 1x10MHz of 700MHz SDL for Three and BT/EE to expand their low frequency holdings.

As we note in section 4.7, the risks of imposing a sub-1GHz cap are asymmetric – with significant upside for consumers in terms of ensuring continued effective competition in mobile services and limited if any loss in efficiency in terms of spectrum allocation.

#### 4.1 [X]

As Ofcom acknowledges there is a difference in ‘good’ indoor 4G coverage of 4-6% points between Three and BT/EE on the one hand and Vodafone and O2 on the other as shown in Table 2.<sup>31</sup> This data shows that with their larger existing holdings of sub-1GHz spectrum, Vodafone and O2 have a capacity advantage in harder to serve areas.

**Table 2: Three and BT/EE have inferior coverage in harder to serve areas due to their smaller sub-1GHz holding**

MNO (total sub-1GHz holding)	Indoor – 4G (2Mbit/s download)
BT/EE (10 MHz)	88.4%
Three (10 MHz)	89.4%
O2 (54.8 MHz)	94.8%
Vodafone (54.8 MHz)	93.7%

Source: Ofcom, Award of the 700 MHz and 3.6-3.8 GHz spectrum bands, Figure 5.10 and Figure 5.12

In addition, contrary to what Ofcom suggests, [X].<sup>32</sup>

<sup>31</sup> Consultation, paragraph 5.310.

<sup>32</sup> Consultation, paragraph 5.315.

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Moreover, as Ofcom's own analysis in Annex 10 of its Consultation shows deploying more low frequency spectrum substantially increase its ability to propagate. This is shown in comparisons of the propagation characteristics between 2x5MHz and 2x10MHz of 700MHz spectrum. This would be an additional advantage of 700 MHz spectrum for Three given that we currently only hold 2x5 MHz of 800MHz spectrum.

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<sup>33</sup> [REDACTED]

<sup>34</sup> [REDACTED]

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**Figure 5:** [✂]

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Source: Three

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**Figure 6:** [✂]

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Source: Three

As can be seen from Figures 5 and 6 while an average user speed of 2Mbps, may be sufficient to meet demand today, this will not be sufficient to meet demand in the future i.e. it will take longer to meet (indoor

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coverage) demand currently served by the 800MHz layer if average users speeds remain at 2Mbps.

These trends in demand reflect Ofcom's own research which finds that:<sup>35</sup>

*Given its portability and penetration, the smartphone is the preferred device, regardless of where people are accessing the internet, even at home (37% of the time spent online at home is on a smartphone)...*

*...Use of the smartphone to go online when not at home or work is even more pronounced, accounting for 72% of time spent online.*

*The convenience of using the internet through a smartphone, and the availability of high speed mobile networks, are key enablers of out-of-home internet use.*

Video streaming already represents around [X] of Three's network traffic, and we expect this grow over time. We also note that while file downloading and web browsing (some of the most common smartphone uses) do not have a hard minimum speed requirement, the quality of experience increases with speed.<sup>36</sup>

- *Web pages* are getting larger and more content-rich, so data speeds need to increase commensurately to provide a good consumer experience. The size of the average web page has roughly trebled from around 700kB in 2010 to over 2100kB in 2015. To load a web page of this size in around 3 seconds, which is what customers consider to be a good experience, a data speed of around 8-10Mbit/s is necessary;
- *File downloads* are increasingly common. Speeds determine how quickly large files will download and how many files can be downloaded per second.

These market and demand developments mean that in the absence of measures to constrain the ability of both Vodafone and O2 to further expand their holdings of sub-1GHz spectrum, there is the risk that the competitive advantage that O2 and Vodafone currently hold in serving harder to reach areas will be increased and reduce effective competition from BT/EE and Three.

### **4.3 Other solutions proposed by Ofcom are either not commercially practicable or will only have a marginal impact**

We note that Ofcom suggests that:<sup>37</sup>

*...There are means other than by deploying more low frequency spectrum by which MNOs can, in principle, improve their quality of*

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<sup>35</sup> Page 15, Op. Cit.

<sup>36</sup> Three's PSSR response, Annex 11

<sup>37</sup> Consultation paragraph 5.295

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*coverage. These include building more sites and upgrading existing sites, using Wi-Fi offload and voice-over-Wi-Fi, or using sites with different characteristics such as small outdoor and indoor cells*

We disagree with this assessment. While it may be technically possible to deploy the alternatives that Ofcom suggests, it is either not commercially practicable to deploy these alternatives and/or any improvement will be marginal and localised, so these alternatives are not a substitute for the addition of a 700MHz coverage layer.

#### 4.3.1 Adding sites while theoretically possible will not be a commercially feasible substitute for additional 700MHz

In Annex 10 of its consultation, Ofcom provides technical analysis of the relative propagation characteristics of 700MHz and 1800MHz spectrum. The intention of this analysis is to demonstrate that network densification and deployment of higher frequency spectrum can be a substitute for a less heavily-densified 700MHz network in the provision of indoor mobile services.

Ofcom's analysis compares three network configurations:

- 1) 2x20MHz of 1800MHz spectrum deployed on 18,000 sites nationally;
- 2) 2x10MHz of 700MHz spectrum deployed on 16,000 sites nationally; and
- 3) 2x5MHz of 700MHz spectrum deployed on 16,000 sites nationally.

Its results indicate that a mobile network based on 2x20MHz of 1800MHz spectrum will require approximately 2,000 additional mobile sites to provide an indoor service which is still inferior to one based on 2x10MHz of 700MHz spectrum but superior to one with 2x5MHz of 700MHz spectrum.

This analysis supports Three's view that operators require low frequency spectrum to provide widespread indoor mobile coverage at the quality expected by consumers as the deployment of an additional 2,000 mobile sites to improve indoor coverage is commercially infeasible and impractical.

*Costs of deploying an additional 2,000 mobile sites are prohibitive*

Ofcom estimates that the cost of deploying a new mobile site is, on average, £340,000 over 20 years.<sup>38</sup>

Our indicative estimate of the 20-year cost (in NPV terms) of deploying a further 2,000 mobile sites is [X] This is clearly not financially-viable as a means of improving indoor mobile coverage and illustrates that an MNO

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<sup>38</sup> Consultation, paragraph A14.10

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with sufficient sub-1GHz spectrum can provide better service in harder to serve areas which cannot be commercially served with spectrum in other bands.

*It is impractical to assume that an additional 2,000 mobile sites could be deployed in a time frame comparable to deploying 700MHz spectrum*

Deploying a new macro site is not straightforward. In doing so, mobile operators must, for example, identify and negotiate access to the location, construct the site in accordance with planning laws and organise power and transmission to the site. This can be costly and time-consuming even if the process runs smoothly. The practicalities of deploying 2,000 new mobile sites would, therefore, clearly be prohibitive.

Deploying low frequency spectrum on existing sites is a far simpler and timelier means by which to improve coverage in harder to serve areas, and equipment currently being deployed to roll-out 5G in the 3.6GHz band could also be used to deploy 700MHz.

#### 4.3.2 Small cells, femto cells and repeaters may help improve indoor coverage marginally

We have considered the various technological solutions mentioned by Ofcom and find that while these are theoretical substitutes and may help improve indoor coverage marginally in some cases, these are not substitutes to deploying 700MHz spectrum.

For example, *small cells* could be used to add some capacity to the network in capacity hot spots but this would only be incremental and these small cells are generally deployed in urban (not rural) areas. As Ofcom also acknowledges the necessary access to high capacity backhaul may not be available. So while in theory small cells could be used to provide additional capacity or in limited cases incremental indoor coverage, deploying small cells in great numbers is not a commercially practicable option – Three estimates that using small cells to provide equivalent capacity to deploying 10 MHz of 700MHz spectrum would be [X]times more expensive.

*Repeaters* work as a passive element to rebroadcast the network's present air-interface capacity. This will depend on the existing levels and quality of outdoor coverage. Hence repeaters are not an effective solution to increasing the level of service (for example higher speeds and/or capacity) indoors – it is just an extension of coverage from a donor macro cell.

*Femto cells may be a substitute* theoretically but it is hard to define use cases for Femto cells in less densely populated areas as these are expensive to deploy and subscribers will not be willing to bear these additional costs when they can get good indoor coverage without a Femto cell from competitors that have deployed 700MHz.

*Ofcom also suggests making use of more efficient technologies, such as 4G and 5G and/or using more efficient antenna technologies such as*

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*beamforming and massive MIMO.* We note that 4G will already be deployed and high-frequency spectrum for 5G would be ineffective for wide coverage and deep indoor coverage even if using massive MIMO.

Finally we note that *increasing the number of sectors per site (sector densification)* is effective only where demand is evenly spread as is usually the case in urban areas not in less densely populated areas. This would likely also require site strengthening or rebuild (requiring further planning permissions) alongside additional radio equipment costs resulting in higher site Opex. Again this is not a commercially practical option that would scale to provide the same benefits as deploying 700MHz.

#### 4.3.3 Wi-Fi offload will not be an effective solution for all deep indoor traffic on Three's cellular network

As mentioned above Three currently uses 800MHz to provides deep indoor coverage. Traffic on Three's 800MHz layer (where deployed) as a proportion of overall traffic is not insignificant and is estimated to be around [X] of the overall traffic today. We expect the volume of this traffic to grow with overall traffic volume.

As Ofcom mentions there are limitations to the use of Wi-Fi off load such as good availability of fixed broadband, no guaranteed quality of service over unlicensed spectrum and poorer user experience in areas where there is congestion or interference from multiple devices.<sup>39</sup>

This is reflected in a recent report by OpenSignal which finds that in many countries (though not as yet in the UK) smartphone users now experience faster average download speeds using a mobile network than using Wi-Fi. This is likely to change in the UK as well with the launch of 5G. Furthermore the OpenSignal report finds that:<sup>40</sup>

*Relying only on Wifi for indoor experience will not be viable. Consumers will increasingly override their smartphone's automatic Wifi choice, and instead select cellular, to find the fastest download speed. If when they switch off Wifi they find the mobile experience to be poor, it will reduce satisfaction levels. Operators need to deliver good in-building mobile network coverage to be successful.*

A recent report by harriX also finds that in the US frequent Wi-Fi off loaders have lower carrier satisfaction rate as compared to those who don't off-load to Wi-Fi.<sup>41</sup>

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<sup>39</sup> Consultation, paragraph A8.68-69

<sup>40</sup> Page 16, 'The State of Wifi vs Mobile Network Experience as 5G Arrives', OpenSignal, November 2018.

<sup>41</sup> Q42018, HarrisX Mobile Insights

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### 4.3 Deep indoor coverage is valued by customers and 700MHz spectrum will allow Three to improve capacity in harder to serve areas in large parts of the UK

Contrary to what Ofcom claims,<sup>42</sup> network quality in harder to serve areas is an important factor considered by customers and poor network quality is a competitive disadvantage.

For example, Three has worked to address these concerns by launching new services like its 4G-supervoice service which uses our existing 800MHz spectrum to allow customers to make calls, send texts and use the internet deep indoors.<sup>43</sup>

Also as we discuss above, two recent reports by OpenSignal<sup>44</sup> and harriX<sup>45</sup> find that mobile subscribers (worldwide and in the US) who have to off-load traffic to Wi-Fi report poorer customer satisfaction with their mobile service. Hence there is an expectation of in-building cellular coverage among Three's subscribers – for example [X]

700MHz will provide this capacity in harder to reach areas and allow for load balancing between the 800/1400MHz layer and the 700MHz layer helping to relieve congestion and provide a better experience for customers in harder to reach areas.

We serve large parts of the UK primarily based on our 800MHz layer as shown in Figure 7 – the grey areas (where covered). It is commercially feasible to serve the green areas with our high frequency spectrum in addition to low frequency spectrum. It is in all the grey areas (where covered) that additional 700MHz will be useful in load rebalancing and relieving congestion in Three's 800MHz layer as traffic demand grows. This is because 700MHz will have great coverage potential and its in-building penetration will be comparable to 800MHz (4G). Outside urban areas it will offer wide-area 4G/5G mobile coverage.

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<sup>42</sup> Consultation, paragraphs 5.276 and 5.312

<sup>43</sup> <http://www.three.co.uk/Discover/network/4G-Supervoice>

<sup>44</sup> Page 16, 'The State of Wifi vs Mobile Network Experience as 5G Arrives', OpenSignal, November 2018.

<sup>45</sup> Q42018, HarrisX Mobile Insights

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## Figure 7: [REDACTED]

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Source: Three

### 4.4 [REDACTED]

An additional concern that Ofcom does not fully consider is that [REDACTED]

[REDACTED] 700MHz FDD is fully standardised and harmonised for 5G use, and is widely adopted as the preferred 'pioneer' low-frequency band for 5G.

Paired 700MHz spectrum will be critical in that decision. [REDACTED]

[REDACTED] As a result, Three expects that its 800MHz spectrum will continue to be required for 4G for at least another [REDACTED] years.

[REDACTED]

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## Figure 8: [REDACTED]

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Source: Three

### **4.5 A scenario where neither BT/EE nor Three win 700MHz will lead to a reduction in retail and wholesale competition**

#### 4.5.1 The retail market

As discussed above, there are two concerns (not one as Ofcom claims) that arise if neither BT/EE nor Three win 700MHz spectrum – capacity in harder to serve areas and [REDACTED]. The alternatives to low frequency spectrum such as site densification or other technological solutions proposed by Ofcom are either not commercially practicable or will only have a marginal impact.

Furthermore, the ability to provide good quality indoor service (with sufficient capacity) and [REDACTED] is a competitive differentiator. Three serves large parts of the UK primarily based on our 800MHz layer, and Three's ability to improve network capacity in these harder to serve areas will depend on the availability of 700MHz [REDACTED].

This means that a scenario in which neither Three nor BT/EE win any 700 MHz will lead to a substantial lessening of competition in retail markets as [REDACTED].

#### 4.5.2 The wholesale market

, [REDACTED].

*Wholesale MVNO*

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In wholesale, there is generally a trade-off between coverage and price, [X]

We note that Ofcom has previously expressed serious concerns about the intensity of competition in the wholesale market. Ofcom told the European Commission (EC) that MVNOs are becoming increasingly less relevant because they are unable to compete for customers with high data use due to the pricing structures offered by MNOs.

Specifically, Ofcom told the EC that “MVNOs are increasingly becoming less relevant as consumers become more data orientated,<sup>46</sup> and that MVNOs now “make a limited contribution to retail competition compared to MNOs” and are unable to compete for high value customers with high data tariffs due to per unit usage pricing structures offered by MNOs (such as per minute, per text and per GB).<sup>47</sup>

Ofcom also indicated that MVNOs have limited market power “as evidenced by the difficulty that some MVNOs have had in negotiating the supply of 4G”, noting that MVNOs are not given access to the latest technologies or only years after they are launched by MNOs.

The EC largely relied on Ofcom’s submissions in relation to the wholesale market in its decision to prohibit Three’s acquisition of O2. The EC found that the ability of UK MVNOs to compete has decreased since 2009 to the point that they “are unable to meaningfully constrain the competitive behaviour of MNOs on the retail market for mobile telecommunications services today”.<sup>48</sup>

Three did not agree with these submissions but [X]

A crucial failing of Ofcom’s current auction award Consultation is the complete absence of any analysis of the impact of further asymmetry in sub-1GHz spectrum on the wholesale market. In effect [X]

### *IoT*

Three’s presence in IoT has been limited because [X]. Most IoT applications are ‘low data’, low cost, and high availability. [X]

However, 700MHz will always be better for IoT customers to access the network given its use as a 5G coverage layer. There are also many IoT use-cases that require deep in-building and underground access, which 700MHz can help Three achieve. For example, [X]

## **4.6 Strategic investment by Vodafone and O2 would be an effective strategy**

[X]

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<sup>46</sup> Phase I submission to the EC in relation to Three’s proposed acquisition of O2, paragraph 3.7

<sup>47</sup> Phase I submission to the EC in relation to Three’s proposed acquisition of O2, paragraph 1.5

<sup>48</sup> EC Decision, paragraph 969 and 971.

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#### 4.6.1 [X]

#### 4.6.2

[X]

### **4.7 The risks of imposing a sub-1GHz cap are asymmetric – with significant upside for consumers and citizens and limited if any loss in efficiency**

Three believes that the case for decisive intervention in the form of a sub-1GHz spectrum cap is clear. This because any loss of efficiency associated with Three's proposals of a 37% sub-1GHz cap is likely to be small (or non-existent) compared to the substantial benefits for consumer and citizens from greater competition in both the retail and wholesale markets.

#### 4.7.1 Minimal effect on Vodafone and O2 given their substantial existing sub-1GHz spectrum holdings

We consider that a 37% sub-1GHz cap (excluding 1400MHz) i.e. 80MHz would be the minimum needed to address concerns about asymmetric distributions of that spectrum. The 80MHz cap would limit each of Vodafone and O2 to a maximum of 25MHz in the 700MHz band, across both FDD and SDL.

In relation to 700MHz FDD spectrum Vodafone and O2 would be limited to a maximum of 2x10MHz each, consistent with the sub-1GHz cap Ofcom applied in the 4G auction and with precluding the ability of Vodafone and O2 to bid strategically. This would leave a minimum of 2x10MHz FDD and 1x10MHz of 700MHz SDL for Three and BT/EE to expand their low frequency holdings.

#### 4.7.2 Clear competitive benefits from more effective competition in the retail and wholesale markets

The result of the proposed cap will simply be to avoid a situation of extreme asymmetry in sub-1GHz spectrum by constraining Vodafone and O2 to acquire a maximum of two lots (instead of three lots) of 700MHz FDD and one lot of 700MHz SDL spectrum.

By addressing the risk of a very asymmetric distribution of sub-1GHz spectrum, the safeguard cap will allow Three and BT/EE to compete effectively with Vodafone and O2 in retail and wholesale mobile markets nationally.

From the perspective of consumers, further concentration of sub-1GHz spectrum will also perpetuate 5G 'partial not spots'. These coverage gaps will make it difficult for consumers to have access to the competition and choice that would be possible if that spectrum was more evenly distributed, particularly those customers who value 5G services in areas

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that can only be profitably reached with 700MHz, or those who value a good quality of service indoors.

#### 4.7.3 Other regulators have tackled spectrum concentration decisively and Ofcom should do the same

Ofcom operates with a bias against intervention. This has historically resulted in a bias towards “under-intervention” in circumstances where decisive action was needed to protect the general interest.

In this context, it is useful to compare Ofcom’s approach to spectrum concentration to that taken by other regulators. For instance, when liberalizing 900MHz for 3G every Western European regulator except those in Portugal and the UK re-auctioned 900MHz or re-allocated some of it to a new 3G entrant.<sup>49</sup> The US Federal Communications Commission (FCC) when auctioning 600MHz in the US Incentive Auction also put rules in place to prevent excessive concentration of that spectrum, even though all four MNOs already held some spectrum.<sup>50</sup>

Similarly, the Australian Government recently decided, on advice from the Australian Competition and Consumer Commission (ACCC) to bar Telstra from the auction of 700MHz that was unsold in 2013.

Ofcom should also address the risk of further excessive concentration of sub-1GHz spectrum in the hands of Vodafone and O2 by the imposition of an 80MHz (37%) sub-1GHz cap, in addition to the overall spectrum cap as part of the auction rules.

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<sup>49</sup> Source: Three

<sup>50</sup> *Report and Order* at paragraph 4.

# 5. Spectrum trading can defragment the 3.4-3.8GHz band without the need for intervention.

## Executive Summary

Ofcom is under pressure to 'defragment' the 3.4-3.8GHz band, by requiring bidders to put their 3.4GHz into the assignment stage of the 2020 auction as a condition of participation ('mandatory reassignment'), or by allowing MNOs to do so voluntarily ('voluntary reassignment').

Ofcom thinks appropriate to leave defragmentation of the 3.4-3.8GHz band to the market. In Ofcom's view, a reconfiguration of the band could be delivered for all MNOs through simple bilateral trades after the auction, without the need for further intervention by Ofcom.

We agree. Indeed, we have previously indicated to Ofcom that Three is open to the idea of trading. In our view, however, there may be significant benefits for the industry if trades were concluded before the auction. All MNOs have now made public their 5G rollout plans. By the time of the auction, MNOs will have deployed frequency-specific equipment on thousands of sites while the final configuration of the band is still uncertain.

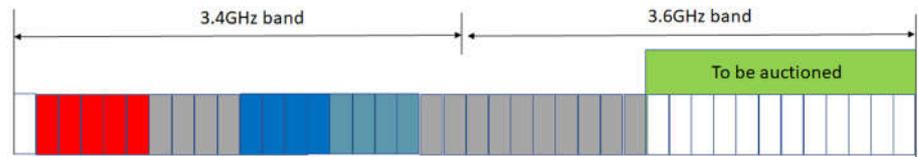
Three has engaged external advisors to support the design and implementation of a trading process before the auction, and to act as intermediary. Our advisors intend to share their proposed approach to trading with Ofcom and MNOs in the next few weeks, with a view to concluding the process as early as possible.

Although we obviously do not know the preferences of other MNOs, the optimal outcome for the industry may require multiple trades [X]. In order to help defragmentation of the band, [X], and remove the restriction that currently prevents partial transfers of UKB's licence.

### 5.1 Trading after the 3.6GHz auction can deliver defragmentation of the 3.4-3.8GHz band

Figure 9 shows the current configuration of the 3.4-3.8GHz band. Three holds two separate blocks in the band: a 40MHz block and a 100MHz block. If rivals win some 3.6GHz spectrum in the 2020 auction, their 3.6GHz would be separated from their 3.4GHz by our 100MHz block (and in the case of Vodafone, also Three's 40MHz block).

**Figure 9: current configuration of the 3.4-3.8GHz band**



Source: Three

We agree with Ofcom that the most effective approach is to allow the market to determine the best allocation of spectrum. Trading between MNOs after the 3.6GHz auction can deliver contiguity without the need for regulatory intervention. Figure 10 shows two highly plausible outcomes of the 3.6GHz auction where [REDACTED]

**Figure 9: [REDACTED]**

Source: Three

[REDACTED]

There are of course many other permutations. The reality, as Ofcom suggests, is that BT and O2 can both achieve contiguity after the auction without Three's involvement, and that all MNOs can achieve proximity without Three. [REDACTED]

## 5.2 The industry may prefer to trade to defragment the band before the auction

We have previously indicated to Ofcom that Three would be open to trading. In our view, however, there may be significant benefits if trades were concluded before the 3.6GHz auction.

All MNOs have publicly announced their 5G rollout plans. EE plans to upgrade 1,500 sites to 5G in 2019, and Vodafone has announced that it will enable 5G on 1,000 sites by 2020. Three intends to upgrade [REDACTED] sites itself by the end of 2020. Absent any trades, by the time of the auction MNOs will have upgraded thousands of sites with frequency-specific equipment while the final positions in the band are still uncertain.

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Three has engaged external advisors to support in the design and implementation of a trading process and to act as the intermediary. We are confident that the team will design a trading process that will work for all stakeholders involved.

The process will need to comply with the 700MHz and 3.6GHz auction rules and competition law. Ofcom will need to be comfortable that no MNO will receive information from another MNO that may affect its participation in the auction.

More generally, the process will need to avoid any multilateral discussions and minimise any transmission of information between persons who may wish to bid independently in the auction. We are optimistic that it will be possible to eliminate these risks through a carefully designed process.

### **5.3** [X]

### **5.4 The Wireless Telegraphy Regulations 2012 do not currently permit partial transfers of UKB's licence**

There is one other obstacle to trades involving UKB's licence. The Wireless Telegraphy Regulations 2012 do not permit partial transfers of those frequencies. Ofcom proposes to bring them within the Mobile Spectrum Trading Regulations to allow partial transfers. In practice, this means trades would have to wait until Ofcom decides on the auction regulations. We will liaise with Ofcom over the next few weeks to discuss our proposed approach to trading and explore ways of expediting this.

# 6. Ofcom should revise its proposed information policy and activity rule in the award.

## Executive Summary

Three commissioned Power Auctions to advise on Ofcom's proposed auction design. In addition to its findings described in section 2, the Power Auctions report at Annex 1 finds that:

- Masking of the aggregate demand for spectrum lots in ranges of 20MHz is unnecessary in a CCA and would provide some of the benefits of an open auction, but stops short of providing the full benefits associated with an information policy where aggregate demand is disclosed after each round;
- The proposed information policy on coverage lots is undesirably opaque, while the proposed activity rule (specifically, assigning zero eligibility points to the coverage lots) is highly nonstandard and falls short of its objective.

These critiques of the proposed design lead Power Auctions to recommend the following corresponding improvements:

- Adopt an information policy wherein the exact aggregate demand for each coverage lot is disclosed to bidders after every clock round, except for the final clock round, and adopt an activity rule that is proportionate to the auction. If Ofcom adopts the recommendation that no coverage lots should be offered in the auction unless the positive price constraint can be eliminated, then Ofcom is already aware of the appropriate activity rule.
- If Ofcom is adamant on including coverage obligations, notwithstanding the risks of substantial distortions and inefficiencies arising from the positive price constraint, then a revised activity rule should be adopted.
- All revealed preference constraints imposed by Ofcom should reflect the clock prices that bidders face under the positive price constraint, and the same approach should be taken for all revealed preference constraints, both for the purposes of relaxed bids and for deriving the bid limits in the supplementary round. This would eliminate the presence of lots with zero eligibility points, as well as make it possible for Ofcom to adopt a transparent information policy allowing bidders to bid truthfully and respecting one of the fundamental principles of auction design.

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## 6.1 Masking of the aggregate demand for spectrum lots in ranges of 20MHz is unnecessary in a CCA

Experience has shown that reporting aggregate demand information strikes the right balance between the extreme of reporting all individual bids and the opposite extreme of only reporting whether aggregate demand exceeds supply. This is not only the assessment of academic commentators but also the view of the US Federal Communications Commission, which has evolved from using a full disclosure information policy to reporting only aggregate demand in the context of a clock auction. This information policy has also been used in auctions conducted in other sectors, such as for the procurement of electricity.

Ofcom's proposed information policy to only reveal demand for spectrum lots in ranges of 20MHz adds a degree of uncertainty (compared to disclosing aggregate demand) about the actual aggregate demand for a spectrum category and about whether the clock rounds are nearing an end.

Ofcom offers two rather unpersuasive reasons why it should add this uncertainty.

The first rationale is that revealing precise levels of aggregate demand may open up opportunities for strategic bidding which, in the extreme, can facilitate tacit collusion as mentioned in paragraph 7.186 of Ofcom's consultation. However as Power Auctions points out the economics literature demonstrates that this rationale is incorrect. Specifically, in auctions along the lines of the Vickrey auction or CCA, winners are determined by calculating the allocation of items that maximises value in relation to the bidders' expressed bids, while the price paid by a winner is based on the opportunity cost of allocating the items to her as opposed to her competitors. Since the price paid is independent of the bidder's own bids, incentives for truthful bidding are created, and it is a weakly dominant strategy for a bidder to bid his true value.

Moreover, in dynamic versions of the Vickrey auction, there are no incentives for bidders to engage in market division. The economist's prediction in a dynamic Vickrey auction is an efficient allocation and pricing related to true opportunity cost.

Ofcom's second rationale for adding uncertainty in the information policy is that if bidders know that the clock rounds are not likely to end soon, they may bid for a larger package than they would otherwise, based on their valuations, in an attempt to relax their Relative Cap. A more relaxed Relative Cap, in turn, would allow bidders more room to place bids in the Supplementary Bid Round that impact the prices paid by their competitors. Power Auction finds that this is a rather tenuous justification for such a severe information policy. There is no evidence provided by Ofcom that this reflects real bidder behaviour in any auction; it is purely speculative. Moreover, even if true, it could be remedied by imposing a more constraining activity rule than the Relative Cap, such as the GARP-

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based activity rule that will be used in the upcoming Canadian 600MHz Auction.

Power Auctions concludes that the information policy proposed by Ofcom would provide some of the benefits of an open auction, but stops short of providing the full benefits associated with an information policy where aggregate demand is disclosed after each round. Specifically, a CCA with disclosure of aggregate demand after every round would allow valuation information to be aggregated across bidders, reducing common value uncertainty and making outcomes more predictable. Moreover, disclosure of aggregate demand after every round would allow bidders to switch their demand among different bands in light of other bidders' information and decisions, also reducing "substitution risk".

Following this, Power Auctions recommends an information policy wherein the exact aggregate demand for each coverage lot is disclosed to bidders after every clock round, except for the final clock round.

## **6.2 Non-disclosure of aggregate demand of coverage lots asymmetrically favours MNOs who can provide the coverage lot more cheaply**

Ofcom has proposed to reveal no aggregate demand information on the coverage obligations after each primary bid round. As Power Auctions explains, such an information policy would be a step back from dynamic auctions and would favour MNOs who can provide the coverage obligation more cheaply.

Withholding aggregate demand information for the coverage obligation lot also means that the auction process will provide little insight into opponents' information and decisions with respect to the coverage obligation category. This is problematic as there will be some common value uncertainty as to the value of the coverage lots. For example, one bidder may have better estimates of the costs associated with providing coverage in certain areas or of the revenue from currently underserved areas.

Moreover, this no disclosure policy favours MNOs who can provide the coverage lot more cheaply and are bidding for the coverage lots. If no aggregate demand information on the coverage obligations is revealed, bidders will observe whether the price of the coverage obligation category has increased from the previous round. Based on this information, a bidder that is bidding for the coverage obligation will have an information advantage and will be able to infer whether at most one other bidder was bidding for the coverage obligation.

The potential of this information advantage may motivate bidders to probe and to "play games". But, to the extent that bidders probe and play games, the price signals become less informative throughout the auction and bidders run the conscious risk of getting "stuck" on suboptimal combinations.

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Power Auctions recommends that Ofcom adopts an information policy wherein the exact aggregate demand for each coverage lot is disclosed to bidders after every clock round, except for the final clock round, and adopt an activity rule that is proportionate to the auction as described next.

### **6.3 The assignment of zero eligibility points to coverage lots is nonstandard and falls short of its objectives and invites strategic bidding**

Assigning zero eligibility points to the coverage obligation lot invites strategic bidding as recognised by Ofcom:<sup>51</sup>

*We propose revealing no information on aggregate demand for coverage lots. This is because there is more scope for bidders to bid on coverage strategically due to our proposal to associate no eligibility points with coverage. An example of strategic bidding would be a signalling strategy, whereby bidders bid on coverage lots in one clock round, and then do not bid on coverage in another. We consider that this risk is mitigated by revealing no demand information on coverage.*

As Power Auctions explains assigning no eligibility points to the coverage obligations is highly nonstandard and misguided. It is strictly detrimental for the proposed CCA design since it invites strategic bidding and forces Ofcom to withhold aggregate demand information for the coverage obligation lots which, as discussed above, asymmetrically favours MNOs who can provide the coverage lot more cheaply.

One reason Ofcom may have chosen to assign zero eligibility points to coverage lots is that the relaxed bids implementation as proposed by Ofcom is not appropriate for the proposed auction design which includes the positive price constraint.

The positive price constraint creates a conflict with a typical implementation of relaxed bids, such as the one proposed by Ofcom. Power Auctions provides a typical example for which Ofcom's "zero eligibility points" solution works, and then another in which a small change renders the solution completely useless and bidders are not able to bid truthfully even when zero eligibility points are assigned to coverage lots.

The misalignment between truthful bidding and the implementation of the relaxed primary bids in Ofcom's proposal (and more generally, the implementation of revealed preference constraints) is as follows:

- For the proper operation, relaxed bids require that the clock prices that are used for calculating revealed preference constraints are the same ones the bidder was facing when submitting its demand bid.

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<sup>51</sup> Consultation, paragraph 7.196

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- In contrast, Ofcom uses the unconstrained clock prices for imposing revealed preference constraints, while bidders face the constrained clock prices in primary rounds due to the positive price constraint.

Following this Power Auctions concludes and recommends that:

- In case Ofcom insists on using the positive price constraint in the auction then it should use an activity rule that is proportionate to the auction. All revealed preference constraints imposed by Ofcom should reflect the clock prices that bidders face under this constraint. This alternative general solution does not require assigning zero eligibility points to the coverage obligation lot and consequently, does not require withholding the aggregate demand information for the coverage obligation lot.
- Following this appropriate eligibility points should be assigned to the coverage lot and an information policy wherein the exact aggregate demand for each coverage lot is disclosed to bidders after every clock round, except for the final clock round.

# 7. Co-existence and non-technical licence conditions.

## Executive Summary

We recognise that the award of the 700MHz and 3.6-3.8GHz bands for the provision of mobile services will potentially cause limited interference issues with other registered users in the band and some in adjacent bands.

The approach taken to managing potential coexistence issues between mobile and DTT users in the 700MHz band should be the same as that taken in the 800MHz band. As Ofcom recognises, the approach to managing coexistence in the 800MHz band has been successful and operators should leverage the experience to provide a similarly successful approach to managing potential interference in the 700MHz band.

We agree with Ofcom that the approach to managing potential coexistence between mobile users and the existing registered users in the 3.6-3.8GHz band should replicate the solution currently used by UK Broadband when it is planning to deploy 3.6-3.8GHz spectrum on its mobile sites. However, Ofcom should be clearer about how it will intervene to solve any coexistence issues which do arise in this band.

At the end of this section, we consider Ofcom's proposed non-technical licence conditions. We briefly discuss those proposed conditions with which we do not agree and, where appropriate, provide Ofcom with references to areas where we consider them in greater detail.

### **7.1 The approach taken to managing potential interference between mobile users in the 700MHz band and DTT users should be the same as it is for the 800MHz band**

In Section 8 of the Consultation document, Ofcom presents the risk that a small number of digital terrestrial television (DTT) viewers will experience interference from mobile services operating in the 700MHz band following the auction. Its analysis found that the scale of the potential interference problem is likely to be relatively small, impacting a maximum of 36,000 DTT households.

It considers three options for how it might intervene to manage the risk of interference. These are:

- 1) Require 700MHz licensees to provide support, with broadcasters delivering the 'front line' of that support.
- 2) Require 700MHz licensees to provide viewer support with detailed requirements set by Ofcom.
- 3) Ofcom's preferred approach, which requires licensees to submit a joint plan setting out their approach to tackling interference, with

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an Ofcom imposed fall-back option should the joint plan prove to be unsatisfactory.

Ofcom's first option would require both broadcasters and licensees to take an active role in remedying interference issues. This over-complicates the solution and risks inconsistent outcomes for consumers if broadcasters and licensees are not sufficiently aligned. A more efficient approach would involve a single entity which manages all interference issues arising from use of the 700MHz band for mobile services.

Ofcom's second option is prescriptive and its proportionality relies on Ofcom's ability to successfully predict the scale of the interference ex ante. We have seen from our experience with 800MHz interference that this is a difficult task. Given their experience managing interference issues in the 800MHz band (through DMSL), it would be more efficient for operators to take the lead on doing the same for interference in the 700MHz band.

We agree with Ofcom's assessment that its preferred approach would be the best option for remedying potential interference issues in the 700MHz band since it provides a mechanism by which winners of 700MHz spectrum can work together to produce a flexible and scalable solution which will remedy coexistence issues in the most proportionate way.

This approach allows a similar solution to the one used for managing coexistence issues in the 800MHz band, if agreed on by all licensees. As Ofcom recognises in paragraph 8.16 of its Consultation, the industry-proposed solution for the 800MHz band (DMSL) has consistently delivered a high standard of service to viewers affected by interference problems. We would expect a comparable solution for 700MHz to be similarly successful since the approach has been previously tried and tested.

In paragraphs A19.33 and A19.34, Ofcom considers that any joint proposal would need to include provisions for its funding and management. Our view is that the funding, management, operation and oversight of a joint entity (such as DMSL) should be split equally between the licensees. This would ensure that the interference mitigation scheme operates in a way that was agreeable to all stakeholders.

We also consider it necessary that, consistent with the approach to 800MHz coexistence, Ofcom should impose an upper limit to the funding that licensees should provide to manage interference. Any shortfall in the required funding would be met by Government. This upper limit would give prospective bidders in the forthcoming auction certainty that their funding obligations would not exceed a certain amount were they to win 700MHz spectrum, allowing them to more accurately understand the value of the spectrum to them.

DMSL has provided a comprehensive response to Ofcom on its proposals for coexistence in the 700MHz band which we fully support.

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## **7.2 Three agrees with Ofcom's proposed approach to managing coexistence in the 3.6-3.8GHz band**

UK Broadband currently operates a fixed wireless access (FWA) service in the 3.6GHz band. Satellite earth stations and fixed links also operate within the band. As Ofcom recognises in paragraph 9.9 of the Consultation document, there is currently a process in place to manage coexistence between UK Broadband base station deployments and the other users in the 3.6-3.8GHz band.

Under the existing arrangements, we supply Ofcom with technical information about base stations on which we are planning to deploy our 3.6GHz spectrum. Ofcom then uses this propagation tools to identify any existing registered satellite earth stations that might be affected by a level of interference that exceeds the limits in the agreed coordination process. If such interference is predicted, then Ofcom initiates a detailed coordination process between UK Broadband and the affected FSS earth station licensees.

Ofcom is proposing to adopt a similar approach to managing new deployments by operators which deploy 3.6-3.8GHz spectrum won in the forthcoming auction, and has included a draft interim coordination notice in Annex 24 to the Consultation. We consider this to be an appropriate approach given our experience with deployments in the 3.6GHz band.

However, it is not clear why Ofcom is not prepared to offer more assistance to the affected satellite earth station and fixed links operators which fail Ofcom's coordination process.

In paragraph 9.11, Ofcom notes that it will not be able to "...enter into detailed discussions or offer additional services in relation to base station coordination" but fails to articulate what assistance it will offer.

The lack of apparent coordination assistance on offer from Ofcom doesn't seem to be reasonable nor fulfilling Ofcom's statutory duties for making efficient use of licenced spectrum. In its proposed state, it has the potential to repress deployment in this band.

## **7.3 Ofcom's proposed non-technical licence conditions**

Three is in broad agreement with Ofcom on its proposed non-technical licence conditions. We briefly consider notable exceptions in this section below and, where appropriate, refer Ofcom to places where we discuss the issues in greater detail.

### **7.3.1 Tradability of licences**

In paragraphs 10.13-10.15, Ofcom proposes that the licences awarded in the 700MHz and 3.6-3.8GHz bands will be tradable but not leasable.

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In its ‘Variation of UK Broadband’s spectrum access licence for 3.6GHz spectrum’<sup>52</sup>, Ofcom set out its position that it would continue to allow UK Broadband to grant leases to third parties for use of the spectrum, subject to the conditions set out in the licence because there is no evidence that these would be distortive to competition and/or harmful to consumers. We agree with this approach and expect that Ofcom’s decision on leasing in this consultation will have no effect on it.

Notwithstanding this, we consider that Ofcom should permit leasing in all spectrum bands subject to the Mobile Trading Regulations, including the new licences in the 700MHz and 3.6-3.8GHz spectrum bands. We set out our reasoning for this in the response we today provided to Ofcom’s ‘Enabling Opportunities for Innovation’ consultation.

### 7.3.2 Spectrum sharing

In paragraph 10.16, Ofcom notes that it may grant future authorisations to allow use of all, or part, of the spectrum, including the spectrum awarded in the forthcoming auction. We have provided a separate response to Ofcom’s ‘Enabling Opportunities for Innovation’ consultation in relation to Ofcom’s spectrum sharing proposals.

### 7.3.3 Roaming

In paragraphs 10.22 to 10.23, Ofcom considers that it will not rule out the possibility of imposing roaming conditions in 700MHz licences in the future.

We discuss above in sections 2 and 3 that Ofcom should include a single coverage obligation in the auction and attach to it a requirement for the winner to provide roaming services in rural areas. If, instead, Ofcom takes the position that it may impose roaming obligations in the future, the effect will be to increase uncertainty in the auction as operators will be unable to accurately estimate the value to them of Ofcom’s proposed coverage obligations.

### 7.3.4 Coverage obligations

Ofcom presents its proposed wording for its coverage obligations in Annexes 22 and 23. Ofcom should instead not impose obligations to align the incentives of operators to agree on an SRN. Failing that, it should impose a single coverage obligation with an attached roaming requirement. As we discuss in Section 3, both options better meet Ofcom’s objectives in the auction than its proposed coverage obligations.

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<sup>52</sup> [https://www.ofcom.org.uk/data/assets/pdf\\_file/0014/130253/Statement-UK-Broadbands-spectrum-access-licence-3.6-GHz.pdf](https://www.ofcom.org.uk/data/assets/pdf_file/0014/130253/Statement-UK-Broadbands-spectrum-access-licence-3.6-GHz.pdf)

# A1: Power Auctions Report for Three

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Provided as a separate attachment.