# Vodafone Response to Ofcom Consultation:

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

## Further consultation on modelling and technical matters

# Executive Summary

Vodafone believes there is a compelling case for a managed award of spectrum in preference to the conventional auction approach. Ofcom's analysis concluding that an auction will result in the most efficient usage of spectrum pre-dates the Covid-19 crisis and did not take account of the unprecedented turmoil to the global economy. We consider that given the level of stakeholder support, Ofcom has erred in failing to consult on the managed award approach.

On the narrow issues around which this consultation has been scoped:

- We cannot see any errors in Ofcom's Single User Throughput (SUT) analysis, but consider that Ofcom has placed undue emphasis on its output and conclusions about use cases that can theoretically be supported. It has failed to address the ramifications of what the SUT model results mean for network deployment, and in focusing on SUT has not adequately taken account of capacity issues.
- We acknowledge the benefits of Dynamic Spectrum Sharing (DSS), but raise a series of technical deployment issues, which mean that Ofcom may overstate the benefits it brings.

For both issues, the analysis fails to consider the implications of removing High Risk Vendors from UK networks and diversifying telecoms supply chains. Government aspirations to move away from the usage of High Risk Vendors are incompatible with fragmented spectrum, as new market entrants do not have the capability to accommodate this.

Ofcom considers that if there is a requirement for defragmented spectrum, then private trades will facilitate this. This may be the case, but the scenarios where this does not occur vastly outnumber the outcome where it does. ✂

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# 1. Introduction

Ofcom's conclusions on the proposed rules for the award of 3.6GHz spectrum drew heavily on conclusions reached from the Single User Throughput (SUT) model. Ofcom had not consulted on the usage of this model, or its conclusions, and so it was quite right that a stakeholder challenged this. We now know that the earlier SUT analysis contained errors, which doubtless would have been identified had Ofcom properly consulted. It is therefore correct that Ofcom now consults on the usage of the SUT model and inferences drawn from it.

We believe that the time that has been provided to respond to the consultation is incompatible with Ofcom's statutory duty to properly consult – just 19 working days, at a time when stakeholders are grappling with the effects of Covid-19 and other policy issues, not least the telecoms supply chain review that directly impinges upon the very equipment that is the focus of this consultation. This inevitably has an impact on the level of analysis that we have been able to undertake in response. Nevertheless, we have sought to provide a constructive input to the process, albeit not at the level of thinking that would normally be considered proper.

# 2. Managed Award of spectrum

Before turning to the SUT model, we must first reiterate Vodafone's belief that an auction is the wrong approach to awarding spectrum in the current climate.

The economic rationale for awarding spectrum via auctions in normal times is well established. Private values that mobile operators are prepared to bid for spectrum are a reasonable proxy for the social and economic value that will be derived from its usage, hence an auction that is determined by these private values should lead to a socially and economically efficient outcome.

However, if one thing is clear, it is that we are not living in normal times. We are almost certainly facing a global recession where the only reliable prediction is that nobody knows the precise impact of Covid-19. The British economy has shrunk by 25% between February and April, an unprecedented reduction[1]. Claims for unemployment benefit grew by 70% in April 2020, and this is only the start. Nobody can be clear whether there will be a second peak in the spread of the virus, or of the shape of the economy once we emerge from this crisis. The chancellor Rishi Sunak has warned that it is "*not obvious there will be an immediate bounceback*"[2] once lockdown restrictions are eased. More widely, president of the World Bank

[1] "UK economy shrinks record 20.4% in April due to lockdown", BBC News, 12th June 2020, https://www.bbc.co.uk/news/business-53019360

[2] "Coronavirus: No guarantee of quick economic bounceback, warns Sunak", BBC News, 19th May 2020 https://www.bbc.co.uk/news/business-52719230

David Malpass describes Covid-19 as a *"devastating blow"*[3] for the world economy. OECD chief economist Laurence Boone says the pandemic will have *"dire and long-lasting consequences for people, firms and governments"*, concluding that the UK would suffer the worst impact amongst major economies[4].

Whilst basic communications connectivity is increasingly seen as bearing utility characteristics, that cannot be said of enhanced services and leading-edge technologies such as 5G. In a cash-constrained environment, consumers could consider spend above basic connectivity to be discretionary, which inevitably has an effect on the value of the spectrum used to provide such services. Conversely, accessing the best communications service could become a priority spend item. Established operator models for forecasting future service demand, and hence spectrum valuation, cannot be relied upon at a time when the degree of economic uncertainty is greater than has ever been experienced.

The economic rationale for an auction is that the process leads to the spectrum ending up in the hands of those who value it most and will make the most efficient usage. In the current environment, an auction would actually result in the spectrum ending up in the hands of those who are most optimistic about Covid-19 and economic recovery. There is no reason to believe that there is any correlation between efficiency and optimism – the rationale for auctioning has simply broken down.

Compounding this, the principle of auctions relies on free flow of capital – that if a bidder believes an auction lot is worth a given amount, they will be able to secure capital to bid to that value from rational investors. Yet a glance at market prices illustrates that investors are spooked. The market capitalisation of BT, Telefonica and Vodafone have dropped by 43%, 29% and 17%[5] respectively since the beginning of the calendar year. We are not in a period of investor exuberance supporting large-scale investment in spectrum – instead there is a market expectation that companies batten down the hatches in preparation for difficult economic times. It follows that even if bidders were able to sing to the same hymn sheet in determining their value for the spectrum, it is highly questionable whether bidding would be driven by that, or instead by cash constraints.

There are practical constraints to running an auction while maintaining the social distancing requirements associated with Covid-19 that we will discuss privately with Ofcom. However, this is not the reason why we consider that an auction to be the wrong approach for this award – the practical issues will diminish in the relatively short-medium term, but the issues we outline around valuation and capital are likely to persist for a longer period than anyone would wish the spectrum to lay fallow. We cannot afford to wait for there to be a clear view of the depth of the forthcoming recession before getting the spectrum put to efficient use. An extraordinary approach is required for extraordinary times.

It is for this reason that Vodafone advocates a managed award of the spectrum. We consider that Ofcom can readily facilitate a negotiation process to allow the spectrum to be awarded to the mobile operators who

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[3] Coronavirus 'a devastating blow for world economy', BBC News, 7th June 2020, https://www.bbc.co.uk/news/business-52939846

[4] "Coronavirus: UK economy could be worst hit among leading nations, says OECD", BBC News, 10th June 2020, https://www.bbc.co.uk/news/business-52991913

[5] Vodafone having recovered from a low of losing 38% of market value

would make the most efficient usage of it. Combined with adjustments to annual licence fees on similar spectrum that has already been awarded, this can be achieved in a competitively neutral manner. This would not be any kind of "command and control" exercise; Ofcom's role would be to act as facilitator and mediator in a negotiated settlement. In effect, this represents an *ex-ante* trading process on the part of the operators in a managed environment. We believe that that this approach is more likely to result in the efficient utilisation of spectrum in the specific circumstances that we now face.

It is our understanding that of the four mobile network operators, three have written to Ofcom actively favouring a managed approach over an auction, and the fourth has said that it is a credible alternative that Ofcom should consult about. It is therefore astonishing that Ofcom has seen fit to dismiss the idea out of hand and not consult industry stakeholders.

Ofcom has put forward a series of reasons why it considers an auction[6] to be the only approach for awarding the spectrum:

- That the March statement concluded an auction was the best approach, promoted competition and secured the optimal usage of spectrum. However, the policy consideration that led Ofcom to default to the usage of an auction took place long before the impact of Covid-19 could have been reasonably foreseen. We have seen no evidence that Ofcom has revisited its analysis in light of Covid-19, which as we set out above has had a tumultuous impact on both the market valuation of telecoms providers (which in turn is determined by market views on future revenues) and on the wider economy. Our proposed approach promotes competition in that it would allow existing providers to carry out a rapid *ex ante* trade, then focus on deploying the spectrum to provide the compelling services that Britain's digital future demands, while facilitating market entrance so long as such entrants provide binding commitments to use the spectrum efficiently (i.e. at scale).
- That it would be lengthy and complicated exercise. We do not accept this. We have provided credible proposals[7] of how the process would work. The consultative exercise around agreeing this process could be rapid and there is already a broad consensus around the main stakeholders. The exercise has not proven to be lengthy and complicated in the case of countries such as New Zealand that have invoked this approach. In any case, it is abundantly clear that the practicalities of running an auction in the current environment mean that it must be delayed: Ofcom has itself admitted that the counterfactual auction approach means no bidding before November, meaning that the spectrum cannot be put into use until January or February 2021 at the very earliest.
- That the process could not be an open one and would conflict with Ofcom's statutory duties by not allowing market entrance. However, as we set out above, market entrance would very much be facilitated, subject to meeting a criterion of using the spectrum efficiently. This said, we do note that

[6] Letter from ✂
[7] Vodafone letter ✂

in the last auction of similar spectrum, the only potential market entrant dropped out of the bidding when pricing was at a fraction of the auction-reserve pricing that Vodafone proposes for a managed award[8]; there seems little evidence of new entrants willing to pay the price we suggest. We note that Ofcom does not intend making any special provision for new entrants in its proposed auction design, and that in any case the recently released shared spectrum bands provide a lower-cost approach to market entry. Vodafone has also proved willing to facilitate sharing of our spectrum in locations where we are unlikely to use it.

- That the managed process would be vulnerable to legal challenge by stakeholders. We note that the alternative of an auction was already heading for the legal system prior to Ofcom launching this consultation, so it seems strange to discount a managed approach on the basis that there *may* be a legal challenge. However, as set out above, there is already significant support for adopting a managed approach. The backstop of an award via auction still exists, and if the detail of the agreed process dissatisfies an applicant to the degree of risking legal action, then that fallback could be invoked.
- That awarding the spectrum at reserve pricing would be below market value jeopardising efficient usage of spectrum and reducing the amounts raised from the exercise. ✂. A managed award would be a negotiated process whereby those wishing to utilise the spectrum would agree what represents an efficient allocation. Compromises would be made by all parties in order to secure an outcome which overall is best for the UK economy. Whilst the reserve price paid could be less than prices that an auction could yield, our analysis is that it would be competitively neutral, and in any case would be many times what any third party has been willing to pay for similar spectrum. In a competitive market, it is a reasonable assumption that any saving would either ripple through to consumer pricing, or increase investment in 5G services. In any case, the underlying value of the spectrum to each operator are unaffected by price at which it is acquired. Therefore, the incentives to use the spectrum (or potentially trade it away in case of a subsequent change in value) remain unchanged by the award mechanism.

We urge Ofcom to reconsider its opposition to this pragmatic, sensible proposal. It would entirely meet Ofcom's statutory duty of ensuring efficient usage of spectrum. If we are wrong, and the mobile operators cannot agree a solution, then the groundwork that Ofcom has carried out to design an auction framework remains, and could be invoked. Ofcom should move rapidly to consult on the proposal that has stakeholder support, rather than being locked into a dogma of the answer being an auction, regardless of the question and circumstances.

[8] We note that in the 2018 auction Airspan were prepared to pay a maximum of £5M/5MHz of 3.4GHz spectrum, whereas this approach would see applicants paying £20M/5MHz.

# 3. Auction considerations

## 3.1 Background

Notwithstanding our belief that a managed allocation of spectrum would be superior to an auction in the particular circumstances faced in a Covid-19 environment, we turn now to the questions raised by Ofcom's analysis in setting the auction rules.

Ofcom has concluded that an operator failing to acquire any 3.6GHz spectrum would not present any competition concerns – all of the operators can get along perfectly well without additional spectrum. Under Ofcom's logic, whether the additional spectrum acquired is fragmented implicitly cannot present competition concerns, because if an operator does not need *any* spectrum, it certainly does not need *contiguous* spectrum. Further, if an operator absolutely needed contiguous spectrum, then Ofcom puts faith in market mechanisms – a trade of spectrum – to resolve the matter.

We absolutely disagree with this thesis.

First, if additional spectrum is unnecessary, then this seriously calls into question why the 3.6GHz band has been cleared at all, causing incumbent satellite and fixed-link users (including Vodafone) to be evicted[9]. The approach also puts Ofcom at odds with its international counterparts who have ensured that non-fragmented spectrum is made available, at odds with the views of equipment vendors, and of course, at odds with the views of operators, who (other than Three) have consistently argued for access to contiguous spectrum.

Much of Ofcom's technical analysis relies on the use of the SUT model. A stakeholder has quite correctly identified that Ofcom failed to consult on this model before using it to draw conclusions. In Section 3.2, we provide comments on the SUT model presented by Ofcom, and put it into the wider context of planning a network; we also examine issues around the usage of Dynamic Spectrum Sharing (DSS).

Ofcom then optimistically predicts that if operators do need contiguous spectrum, this will be achieved by market mechanisms (spectrum trading). It is remarkable that a regulator would rely on market mechanisms to resolve an issue that is very largely of its own making, rather than addressing the issue itself. In common with other stakeholders, Vodafone has consistently argued that Ofcom should address the fragmentation of the 3.4-3.8GHz band. When Ofcom first proposed the release of spectrum in the 3.4GHz band in 2013, we supported Ofcom's original proposal to move UK Broadband to one end of the band in order to minimise the prospect of fragmentation. Ofcom concluded this was not necessary, leaving the 3.4GHz band itself fragmented and necessitating rules in the 2018 auction to work around this. When UK Broadband was acquired by Three prior to that auction, Vodafone wrote to Ofcom suggesting that the fragmentation issue

[9] Whilst it could be asserted that the incumbents have not been evicted, instead just lost protection for their usage, for commercial purposes the two are equivalent; loss of protection is analogous to being allowed to remain in a property but not close the door.

be looked at afresh[10]. Ofcom declined. In the 2018 auction, Vodafone became neighbours with Three – fundamentally affecting the trades that are now possible under a market mechanism – not by choice, but because of the auction rules Ofcom devised to mitigate the issues caused by its inaction on defragmentation. When UK Broadband then sought to get the licences reissued to facilitate a contiguous block of spectrum and regularised to allow 5G usage, Vodafone highlighted to Ofcom that this presented an opportunity to defragment the band[11]. Rather than seizing this opportunity to gain concessions in return for massively increasing the permitted transmit powers in the Three/UK Broadband licences, Ofcom portrayed the situation as being one over which it had no control, acquiescing to allow the change. Even now, when stakeholders have presented credible whole band defragmentation proposals, Ofcom has fallen back on optimism that Three will voluntarily choose to trade spectrum to allow its competitors access to contiguous spectrum. ✂

### 3.2 Technical modelling and alternatives to contiguous spectrum

The focus of the present consultation is whether Ofcom's usage of the SUT modelling is both relevant and technically correct, and also whether Ofcom is right in arguing that DSS will assist operators in refarming spectrum to 5G. In this section, we address each in turn.

We agree that SUT modelling is a tool in operators' planning repertoire that assists in predicting the likely idealised performance experienced by a single user of a single service in a mobile mast sector. Whilst the choice of use cases on which to apply the SUT model was arbitrary, we do not see anything in Ofcom's SUT analysis with which we would fundamentally differ (we note that the original analysis, on which we were not afforded the opportunity to comment, was incorrect).

The findings of Ofcom's analysis are striking, however, for what is left unsaid in the consultation. For example, if we look at Figure 1 of the consultation, the differential in the required SINR for 4K mobile video between a 50MHz connection and a 100MHz connection is 9dB. What the consultation fails to address is the question of *"so what?"*. The *"so what?"* answer is 9dB equates to a tripling in cell radius size for the larger block of spectrum – this equates to a requirement for an operator stranded with lower spectrum stocks to deploy thousands of additional masts nationally – potentially tens of thousands - to achieve the same level of service with the smaller spectrum block. Figure 1 below presents the analysis from another angle, plotting the download SUT at the cell edge for various spectrum block sizes. The contrast in cell sizes, hence difference in volume of masts required to provide coverage at a given throughput, is significant. For example, at 20Mpbs, the cell radius can be as much as 435m with a 90MHz carrier, but only 390m for a 50MHz carrier – this equates to the cell footprint being 25% larger. The difference in cost base between an operator with 100MHz of spectrum and one with half of that is therefore enormous – conservatively this is hundreds of

[10] Letter ✂
[11] "Vodafone Response to Ofcom's Consultation: Variation of UK Broadband's Spectrum Access Licence for 3.6GHz spectrum", August 2018, https://www.ofcom.org.uk/__data/assets/pdf_file/0032/117779/Vodafone.pdf

£millions, even if it proved practicably possible to deploy the additional masts, given planning constraints and local opposition (both to masts in general, and 5G masts in particular).

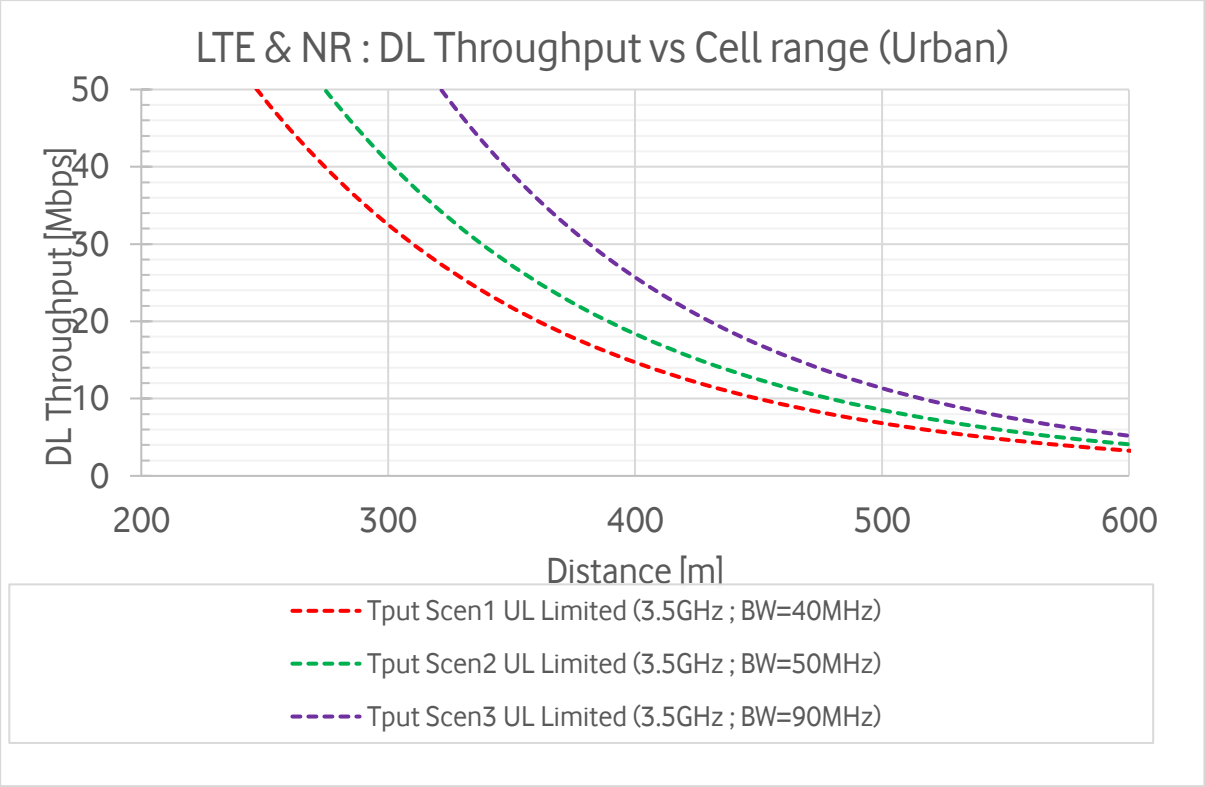


**Figure 1** - Effect of bandwidth on cell size

The SUT model only provides an idealised view, however. The predicted results quickly fall away when mast sectors become loaded, with throughput dropping by over 20% at the cell edge. Theoretical model predictions of what would happen if they were the only user in an area are of little interest to the real-life consumer that cannot utilise the 5G service that they've been sold.

Even in this idealised model, Ofcom's analysis shows that some services are impossible to provide without spectrum stocks being boosted from those that it was possible to acquire in the 2018 auction. These are not hypothetical services that few people will want; already, ✂. Other prime use cases are around private mobile networks for Industry 4.0; Vodafone's white paper on industrial 5G spectrum policy[12] provides a series of examples from across Europe where 5G has been leveraged to improve operational efficiency. Ofcom has questioned whether services will need large blocks of spectrum – the white paper shows that companies do have that demand, and in the UK Vodafone is the leading provider of enterprise mobile services so would be the natural choice to fulfil that demand. In this context, we consider that Ofcom has focussed too narrowly

[12] "An Industrial 5G Spectrum Policy for Europe", Vodafone with input from Arthur D Little & Compass Lexecon, https://www.vodafone.com/content/dam/vodcom/files/public-policy/5g-report/an-industrial-5g-spectrum-policy-for-europe.pdf . Chapter Two provides case studies of e.Go, ABB, Shell, Vienna International Airport, Deutsche Fußball Liga and Finavia where usage of 5G technologies have increased the efficiency of their operations.

on consumer use cases to the detriment of the industrial applications that are just as important to the UK economy.

Ofcom has suggested that having fragmented spectrum would not unduly disadvantage operators - the SUT model points to the relatively narrow gap between the curves of, for example, the "40+40MHz" and "80MHz" use cases[13]. This represents a very restricted analysis, however, and fails to take into account the other reasons why contiguous spectrum is favoured.

As SUT is a very idealised model, in practical terms it is only one of a series of tools in our repertoire; when planning our network greater focus is put on the capacity supported. Figure 2 below illustrates how spectral efficiency is affected by SINR. As the SINR is reduced, i.e. towards the cell edge, the supported capacity falls to below one. Given the spectral efficiency is expressed as bps/Hz, inherently a larger amount of spectrum increases the capacity of the cell. As accepted by Ofcom, fragmenting spectrum reduces the capacity that can be supported; Ofcom has quoted 6% but our analysis shows the true figure to be 10-20%. A large block of spectrum is therefore considerably superior in capacity terms to fragmented spectrum, and also to smaller blocks of spectrum.

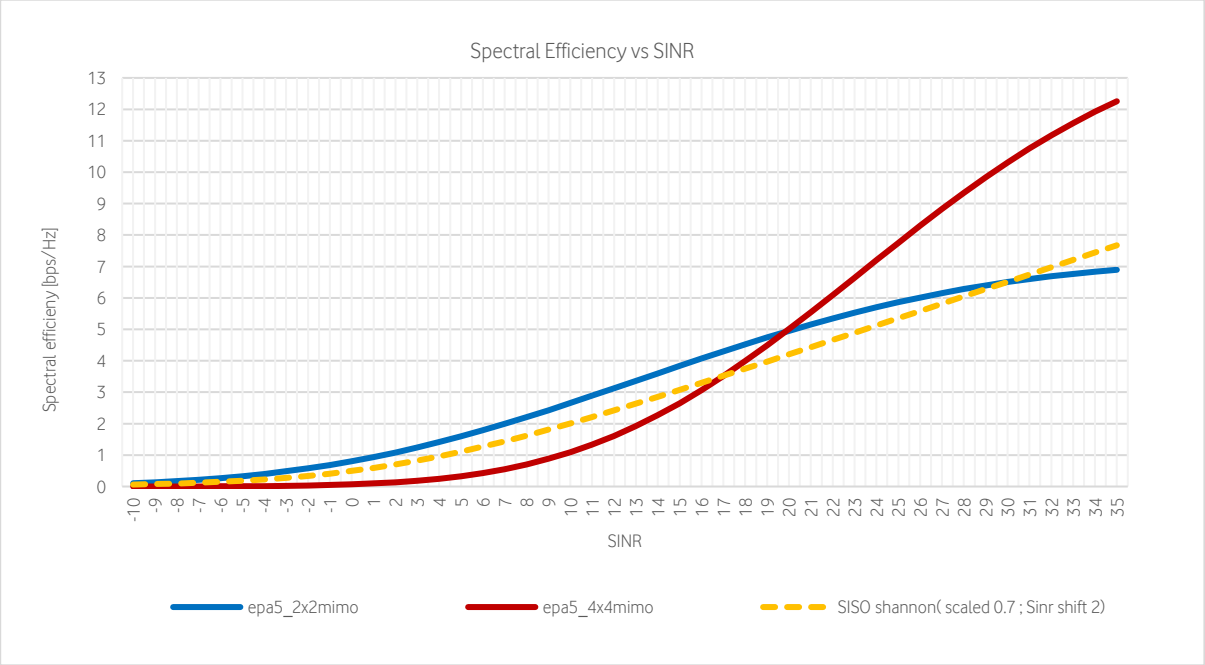


**Figure 2** – SINR effect on spectrum efficiency

Our tools show that limiting capacity to 40MHz or 50MHz of 3.xGHz spectrum causes significant deployment issues. To achieve an equivalent service outcome to deploying 80MHz+ of spectrum necessitates either the densification of the mast grid, or the usage of 64x64 Ma-MIMO antennas, these having profound implications both in terms of form factor and cost when compared to 32x32 Ma-MIMO. Further, from a practicable

[13] E.g. Figure 1 of the consultation.

standpoint, an efficient approach is to deploy dual-purpose antennas that provide both passive functionality in lower bands and active Ma-MIMO functionality in the 3.xGHz band – such an approach avoids the need for site leases to be renegotiated, as they are a one-for-one swap out for existing antennas (see Figure 3). However, these dual-purpose antennas are not available in 64x64 configuration, leaving a quandary between minimising deployment cost/time-frames and maximising capability. Such a conflict does not apply to operators with 80MHz+ of spectrum, representing a clear competitive advantage.

**Figure 3** – dual-purpose antennas

It must be emphasised that Vodafone's existing holdings are at the bottom of the 3.4GHz band, and we had little choice in this given the rules of the 2018 auction[14]. We have explained at length that network equipment capable of spanning the 300MHz between Vodafone's currently licensed frequencies and those on offer in the forthcoming auction is not currently available, except from a High Risk Vendor whose role in

[14] The best that we could have achieved would be to occupy 3430-3480MHz, which would not resolve the tuning issue presented here.

the UK network Government wishes to reduce, or even eradicate. Even 300MHz equipment would limit Vodafone to using the bottom 30MHz of the spectrum to be awarded. Our latest information is that there is little prospect of new-entrant vendors supporting the required 300MHz+ range, meaning the fragmented spectrum made available will thwart initiatives to avoid High Risk Vendors in this band, such as OpenRAN. Established alternative vendors will not have equipment available until ✂[15]. By that time, Vodafone plans to have rolled out 5G capability to thousands of masts, with this equipment rendered redundant if we then need to replace it with equipment capable of a 300MHz tuning range. Our alternative is to deploy multiple antennas per mast sector to serve the fragmented band, but this has significant power implications and is unsightly for the local population. For a large number of masts deploying extra antennas would necessitate a rebuild, which would delay rollout, compromise 2/3/4G services whilst the work is carried out, and may not be possible in many cases due to planning opposition. Fragmented spectrum unequivocally affects our ability to deliver a full suite of 5G services.

We turn now to the topic of DSS. Vodafone agrees that DSS will be available in a series of spectrum bands (we do not comment on Telefonica's concerns about whether a solution is available for 2.3GHz equipment, given that we are not a licensee in that band). However, Ofcom appears unduly optimistic about the effects of DSS deployment.

DSS is an interesting technology, and ✂. However, there are significant interplays with Government's requirement to limit the involvement of High Risk Vendors in the network. DSS inherently means the same access equipment serving both 4G and 5G. If the vendor of 4G equipment is either not allowed to be used for 5G, or the scope of its involvement is constrained, this means that DSS with 5G cannot be deployed without replacing the 4G equipment. ✂

Further, we do not believe that Ofcom is correct to observe that capacity may be reduced by 7-10%[16] when compared to operating static 4G and 5G carriers; our vendor research indicates that the loss in throughput of 5G in a DSS carrier is more than ✂ when compared to a discrete 5G band[17]. Deploying DSS will also be problematic where the existing 4G spectrum is already heavily loaded, and these locations are inherently where an operator would be seeking to deploy 5G technologies.

There are also issues with device compatibility with DSS:

- ✂
- ✂, and
- ✂.

[15] ✂.
[16] Consultation para 1.51
[17] We would be happy to take Ofcom through our analysis to derive this value.

In addition, we note that in a DSS deployment, latency is set by 4G as the lowest common denominator, thus sacrificing one of the key benefits of 5G. In summary, DSS is a tool that we are exploring, but is not the panacea that Ofcom has suggested.

Drawing these elements together, we do not accept the assertions that re-farming of 4G spectrum is a viable substitute for securing additional spectrum in pioneer bands, nor that fragmented 3.xGHz spectrum is a reasonable alternative to contiguous. Inability to obtain contiguous spectrum ✂. Some applications, notably industrial ones that should underpin the UK's future digital economy, will simply not be possible for years as a direct consequence of spectrum policy.

We respect Ofcom as an expert regulator. However, it is not an expert in building and operating mobile networks. Every operator (with the exception of Three, already possessing 100MHz+ of contiguous spectrum) and every equipment vendor has repeatedly stated that 80-100MHz of spectrum is required to fulfil the 5G promise, and to maximise efficiency of spectrum this should be contiguous. The European Commission has taken expert advice and baked the same logic into its 5G spectrum requirements. We remain at a loss as to why Ofcom considers it efficient usage of spectrum to leave it in a fragmented state.

Ofcom considers that spectrum trading would mean that operators would have the opportunity to obtain the contiguous spectrum recommended by the European Commission and available to our European counterparts. In the next section, we turn to why we cannot share Ofcom's optimism.

### 3.3 Trading to yield contiguous spectrum

Ofcom places faith in the market to produce efficient usage of spectrum. ✂.

We believe that Ofcom is fundamentally wrong to expect that private trades will get the UK out of the mess of fragmented spectrum. There is a scenario where this would happen, but it is amongst many scenarios that do not result in defragmentation, and it is therefore wildly optimistic to rely on this approach to fulfil a statutory duty that spectrum be used efficiently. The result could well be impaired services, increased equipment costs (leading to higher retail pricing), and making the already complex task of reducing the UK's reliance on High Risk Vendors even more difficult. We urge Ofcom to reconsider, if not to adopt Vodafone's managed spectrum release ideas, then at the least to implement a full 3.xGHz band defragmentation exercise.

# 4. Conclusions

There is a compelling case for a managed award of spectrum in preference to the conventional auction approach.

In the event of an auction-based approach, then we remain convinced that Ofcom should properly address the issue of fragmented spectrum to deliver on its statutory duties. Operators need contiguous spectrum: we do not quibble with Ofcom's SUT model, but it provides a narrow view and fails to address the impact on cell capacity and indeed the conclusions that Ofcom draws do not reflect the impact on cell size. DSS will be

useful to operators, but its usage is hampered by considerations around High Risk Vendors. It is therefore inevitable that operators with fragmented spectrum stocks will wish to convert them to contiguous ones.

Ofcom places faith in private trades delivering this contiguous spectrum. However, ✂. Reliance on market measures is a huge gamble.

Vodafone UK
June 2020

# Annex A – ✂

(Attached as separate file)