

Award of available spectrum: 2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz

Summary

We briefly summarise the main points in our response to this consultation:

Vodafone supports Ofcom's decision to authorise use of the spectrum bands 2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz. However, we believe that before this occurs Ofcom should resolve the uncertainty about 2G liberalisation and see no reason why this should frustrate Ofcom's timetable. Failure to address this issue risks distorting the outcome of the auction.

Vodafone has been a long-standing supporter of Ofcom's generic licence conditions (technology neutrality, tradability, conditions of tenure and absence of roll-out conditions). Vodafone urges Ofcom to consider putting the licence terms for existing mobile licences (at 900 MHz, 1800 MHz and 2.1 GHz) on an equal footing with the successful bidders in the expansion band auction.

Vodafone appreciates Ofcom's desire to design an efficient (and as simple as possible) auction. However, we believe that the proposed auction contains some restrictions on the flexibility of bidding behaviour and pricing which seem to be unnecessary:

- The auction design pre-supposes that that the relative preference of bidders between different frequencies within the 2.6GHz band is small relative to the overall price. However, if some bidders have very different valuations for alternative parts of the spectrum (and we believe that this may be the case because interference conditions will differ across the band and may be severe in particular parts of the band) then the auction scheme proposed may mean that spectrum is not allocated to the bidders that value it the most.
- We are not convinced at this stage that there is no prospect of substitution between paired and unpaired lots in the 2.6GHz range. By precluding the ability of bidders to switch between paired and unpaired spectrum in the 2.6GHz band, the auction may force bidders interested in *either* paired or unpaired spectrum to bid for both so as to reserve their position, which may distort the outcome of the auction.
- We recognise that the logic of the 2:1 paired-to-unpaired ratio from the point of view of the efficient trade off between FDD and TDD uses within the band being auctioned. However, we note that the efficient price paid for FDD and TDD need not reflect this strict interchangeability, but rather the value that bidders place on the spectrum in different uses. There is no reason that this value should be in the ratio 2:1.

- It is not clear to us why bidders should be required to submit a BAFO at every stage.

Vodafone would find it helpful if Ofcom could organise a seminar or event where it could react to all comments on the auction design.

Vodafone is disappointed that the proposals on SURs are not yet mature enough to form the basis of a spectrum auction. We urge Ofcom to progress this work in collaboration with the industry.

Question 1: Do you agree with these proposals for the awards of the three bands or have any other comments on the contents of this document?

See the summary of our views above.

Question 2: Do you agree with the analysis in section 5 or have any comments on adjacent interference issues?

Section 5 identifies significant potential sources of interference from neighbouring frequency bands and neighbouring countries. The assumptions used in the studies in the associated Technical Compatibility Report seem to be generally appropriate¹. However, we feel that the consultation document understates the results. In particular, the studies of interference with France suggest that most of Kent and much of East Anglia and Sussex could be affected, and the studies of interference from Ireland show that all of Northern Ireland and the densely populated areas of the North West of England plus West Wales and the South West of England could be affected.

Vodafone recognises that these studies are based on worst-case assumptions. However, the affected areas will still be significant when more representative assumptions are used. In the case of MMDS in Ireland, we understand that the studies equate to the highest values permitted in the MMDS licences. While the MMDS operators might not make use of these highest values at present, there is presumably nothing to prevent them increasing their transmit powers or antenna heights in the future. In the case of coordination with France, the exact situation will not be known until the operators in both countries start to plan their networks; this must, of course, be after the licence award in UK.

For both France and Ireland, the interference scenarios are different for different portions of the band. This could give rise to differences in the valuation of lots.

Parts of the 2.6GHz band are allocated to space services in some regions of the world, and these allocations are used (or planned to be used) by several countries outside of Europe. As recognised in paragraph 5.15, this issue is the subject of agenda item 1.9 of WRC-07. The high importance given to this issue by European Administrations

¹ There is an inconsistency between the diagram in section 4.2.3 of this report and section 6.2.1 of Comreg document 98/67 (which defines the frequency band as 2524 – 2668MHz), and we would be grateful if Ofcom could clarify which is correct.

and by RSPG² suggests that there is a significant potential for interference from satellite systems. The ITU-R Conference Preparation Meeting for WRC-07 (CPM-07) did not make much progress on this issue. The outcome of WRC-07 is therefore not certain, and the impact of interference from satellite systems on the use of the 2.6GHz bands in the UK cannot be quantified until after WRC-07, in late November 2007.

Many of the allocations to space services only cover parts of the 2.6GHz band. This could lead to a significant difference in valuation of different lots. Very little technical information is available in the public domain about planned or operational satellite networks. We would therefore encourage Ofcom to publish the information that it receives as a member Administration of ITU-R.

Ofcom should explicitly confirm that the analysis in section 5 of the consultation document addresses all of the systems of which it is aware in the 2500-2690MHz band or neighbouring bands that might potentially impose constraints on the use of this band through interference or the need for protection of those systems.

Question 3: Do you agree that Ofcom should authorise use of the spectrum bands 2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz?

Yes. However, Ofcom should decide the issue of 2G refarming before auctioning the 2.6GHz and 2010-2025MHz bands. See our response to question 5 below.

Question 4: Do you agree that awarding licences by auction would be the appropriate mechanism for authorising use of the spectrum bands 2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz?

Vodafone supports the use of auctions as a fair and transparent means of allocating spectrum.

Question 5: Do you agree that it is likely to be in the interests of citizens and consumers to proceed with the award of the 2.6 GHz and 2010 MHz bands as soon as practicable, rather than to delay the award pending reduction in uncertainty relating to other bands?

No. Vodafone considers that Ofcom must resolve uncertainty about the refarming of 2G spectrum before it auctions the 2.6GHz spectrum; whether this requires Ofcom to delay the auction is, in the first instance, largely up to Ofcom. Spectrum liberalisation in the 2G band is hardly a new issue and if Ofcom expects to consult on 2G refarming “in the early part of 2007” and release the 2.6GHz band “by the end of 2007” then sufficient time exists to resolve the matter without any costs in terms of delay to the 2.6 GHz plans. Even if some delay does result, this should be balanced against the benefits of a more efficient and equitable auction as a result. There are no good reasons to suppose that Ofcom cannot resolve these refarming issues (the European

² RSPG Revised Opinion on WRC-07; RSPG07-162 final, Opinion 3bis (pp7-8).

Commission has now concluded that the GSM Directive is to be revised so as to allow refarming to UMTS and expects to have done so before the end of 2007), or that the obstacles are such that any delay would be unacceptable.

To ignore this issue risks distorting the auction to the specific disadvantage of a particular class of operators (the 2G operators) and thereafter competition to the detriment of consumers. To see this consider what will happen in the absence of a decision on refarming. Mobile (2G) operators will enter the auction not knowing how much of and when a substitute input –2G spectrum– is available to them to deploy to provide 3G services. Bidders will presumably attach a probability to the timing and nature of a decision on refarming but constrain their bids in the 2.6GHz for fear of ending up with spectrum that is surplus to requirements (because 2G spectrum can be used for UMTS) and subsequently must be off-loaded in the secondary market at a loss (or held on the books but not earning an economic return). In this manner the absence of a decision on refarming risks an outcome in the auction which does not put spectrum in the hands of those that turn out to value it the most; since an incumbent operator may ‘incorrectly’ outbid a new entrant because it lacks critical information about refarming. Thus, holding the auctions in advance of the re-farming decisions will increase the possibility of over/under bidding by 2G operators and, more importantly, result in spectrum being awarded to a party that, post a refarming decision, does not value the spectrum as highly as one of the losing parties.

Ofcom states in paragraph 6.76 that “[t]o the extent that there might be any inefficiencies in allocation of spectrum under an early award, it will always be possible for these to be addressed through trading in the secondary markets (e.g. if one party acquired more spectrum than they subsequently needed then they could sell this at a later date)”. We have two points here. First, secondary markets do not mean that Ofcom can or should ignore inefficiencies if these can be removed without delay. Second, although Ofcom’s claim would be true in a very efficient spectrum trading market we know that Ofcom has previously expressed doubts about the efficiency of such markets in order to justify the continuation of Administrative Incentive Pricing on tradeable spectrum. In section 7 of its August 2004 Statement on Spectrum Trading Ofcom states that:

“Ofcom is concerned that spectrum trading alone, while an important aid to more optimal use of the spectrum, may not be fully effective at promoting efficiency.....

In its early stages of development the spectrum market may be less than fully effective at promoting efficiency because:

- *if transaction costs are higher than the difference between the buyer’s and the seller’s valuation of the spectrum, trades will not take place;*
- *equally, trades may not happen if there is asymmetric information between buyers and sellers, i.e. they have differing views of what the spectrum is worth. This means that in some circumstances they will not be able to negotiate a trade, as it may not be apparent to both parties that each would benefit;*
- *if the value of spectrum is appreciating, licensees may hold unused spectrum in the expectation of future gains. Under such circumstances it may not be*

attractive to sell spectrum if the expected future price is significantly greater than the current market price;

- *good information about the possible valuations of spectrum by potential buyers and sellers is necessary for the efficient functioning of a spectrum trading market. If this information is limited or incomplete, trades may be deterred.*

.....Transaction costs in relation to trades, on the other hand, could be quite high if the seller is negotiating with several parties. Moreover, if the transaction costs of a putative trade are too high then the trade will not happen and the potential economic benefit will be lost.”

If Ofcom has revised its review of the relative efficiency of spectrum trading markets then we would expect to see this reflected in the setting of AIP charges. If not, then it seems rather a stretch to suggest that secondary trading will rectify the inefficiencies of the auction process (and even if they did it is unnecessary to incur these inefficiencies in the first place).

It is important to emphasise that the current uncertainty about 2G refarming, unlike say the uncertainty about the nature and timing of decisions on the spectrum released by the digital switchover or the L-band, will not affect bidders equally and therefore cannot be tackled by simply making available information to all interested parties. All operators are subject to uncertainty about the DDR spectrum and will need to take a view about whether its future release will impact their participation in the 2.6GHz auction. However, only the 2G operators face material uncertainty about use of the 900 and 1800 MHz bands. The reference to Ofcom’s “*stated spectrum management policy*” providing “*a clear indication of the general policy framework that Ofcom is seeking to implement. By gradually introducing or proposing to introduce trading and liberalisation to specific licence categories*” is welcome but insufficient to assuage our concerns since the critical factors in determining a strategy in this auction are the amount of 2G spectrum that can be refarmed and when.

Vodafone agrees that it is unrealistic for Ofcom to remove all regulatory uncertainty. Our case is that when uncertainty a) affects potential bidders in a materially asymmetric manner b) has the potential to distort the outcome of the auction and competition and c) can be resolved by Ofcom in a timely manner then this is what should be done.

Ofcom considers delaying the auction but justifies its decision to proceed without interruption on the basis of a cost benefit analysis and concludes that “*[d]elaying the award of spectrum would lead to those benefits being forgone during the period of delay. The loss of these benefits is likely to be more material than [sic] the potential benefits that delay might bring (e.g., in terms of further information on the availability of other spectrum).*” However, this amounts to mere assertion. Respondents to this consultation are not able to judge for themselves whether Ofcom has struck an appropriate balance in its decision since it has not made public either its market research or its analysis of the benefits to citizens and consumers from releasing this band or a quantification of the benefits of a reduction in any particular element of uncertainty. For example, how has Ofcom quantified the benefit of ‘innovation’ (“*the*

largest source of benefit”) and how sensitive are its conclusions to changes in its magnitude? In addition, the cost reductions achieved by the 5 MNOs are expected to be “*very material*” and yet there is no opportunity for respondents to assess this analysis and apparently is no analysis of how uncertainty over refarming will impact this calculation.

Ofcom justifies this approach because of its concern that the economic analysis on which it relies could influence the commercial behaviour of parties who may be interested in participating in these awards and that “*it is undesirable for a regulator to influence commercial behaviour in this way*”. This argument is extremely weak. Firstly, Vodafone doubts the premise. Operators who intend to commit millions in spectrum and infrastructure costs will make up their own minds about the value of the spectrum. Reports from consultants will have the same status as any other independent source of information. Secondly, Ofcom has not applied the same reasoning elsewhere. For example, in the case of the DDR consultation, it has released a report of its consumer research.

In light of our comments above we suggest that Ofcom retests its decision to proceed with the auction in the absence of a decision on 2G refarming against its own criteria:

whether the information available on substitute spectrum at the time of an early award is likely to be sufficient to allow bidders to make reasonable assessments of their requirements and, if there are areas of uncertainty, how material an impact these might have on the efficiency of the award (measured against the outcome that could be expected in the absence of such uncertainty);

If the current degree of uncertainty about the timing of 2G refarming and the amount of spectrum involved persists then incumbent 2G bidders will have insufficient information to assess their requirements. Vodafone expects this to have a material impact on the efficiency of the award and notes that Ofcom has identified advanced mobile telephony services, mobile television and “*cost reductions that existing operators, in particular the 5 MNOs, could achieve by having access to more frequencies*” (paragraph 6.41) as potential uses of the spectrum.

whether, even if there were to be material uncertainty at the time of the award, a delay in award would materially increase the degree of certainty in relation to this information (or, put another way, how long a delay might be needed in order to allow for a material increase in certainty); and

Vodafone believes that an Ofcom decision about 2G refarming would materially increase certainty about this matter even if the decision was subsequently appealed (i.e., uncertainty was not eliminated altogether). Furthermore, it is by no means clear that any delay to the auction is required. Even under the current timetable there appears to be adequate time to consult thoroughly, make a decision and get the 2.6GHz auction away on time.

how the gain in efficiency of the award from this increase in certainty might compare to the benefits that would be forgone by delaying the award.

Ofcom should be in a position to carry out this analysis and expose the results to interested parties.

Question 6: Do you agree Ofcom should aim to award the bands 2500-2690 MHz, 2010-2025 MHz and 2290-2302 MHz by the end of 2007, while keeping the position on the 2.6 GHz and 2010 MHz bands under review in the light of possible developments in European regulatory fora?

See our response to question 5. Vodafone notes that uncertainty about the future RSC decisions is uncertainty that affects all potential bidders for the 2.6GHz band equally and therefore, provided the risk is still considered to be 'low', Vodafone does not see the need to delay the auction. Vodafone agrees that it is prudent for Ofcom to monitor developments in the position of the Commission and RSC and also to make it clear to potential bidders the consequences of a binding harmonisation decision at odds with the award of the band (the likelihood of which we consider to be low).

Question 7: Do you agree that Ofcom should authorise use of the spectrum bands 2500-2690 MHz, 2010-2025 MHz and 2290-2300 MHz?

Yes. However, Vodafone urges Ofcom during its deliberations over 2G and 3G liberalisation to consider putting the MNOs on an equal footing with the successful bidders in the expansion band auction i.e., once trading and liberalisation are introduced for these classes of licences then they should become undated, technology neutral, with a fixed minimum term³ and subject to a five year revocation period. We suggest that the coverage obligations are removed from the 3G licences once Ofcom has verified compliance with the 80% coverage obligation.

At this point Vodafone normally makes a plea for Ofcom to clarify further what it means by 'spectrum management reasons' as a basis for revoking licences. To date this request has gone unanswered. However, we repeat it for the sake for consistency and in the hope of a reply.

The consultation document does not address the important issue of licence-exemption of terminals: if the draft licence conditions are read at face value, then every terminal would require a site clearance certificate for every location where it might be used. We assume that this is not Ofcom's intention.

The R&TTE Directive (Directive 1999/5/EC) places obligations on operators of public telecommunications networks in relation to connection of terminals. In the UK, these provisions are partly implemented through documents called Interface

³ We suggest 10 years in the case of 2G and until 31st December 2021 for 3G; consistent with the existing licence.

Requirements⁴. If a class of terminal is licence-exempted, the interference characteristics of terminals connected to a network are largely defined by Ofcom through the Interface Requirement and not through the licence granted to the network operator.

The current Interface Requirements for terminals intended to connect to public networks have been developed on the assumption that the technology or technologies to be deployed in a particular band are known *a priori*. Ofcom intends that this will not be the case for the bands in this licence award. It is therefore important for Ofcom to publish a draft Interface Requirement prior to the auction, so that potential bidders can comment on it, and can assess the potential for interference from licence-exempt terminals operating on neighbouring frequencies.

Question 8: Do you have views on whether or not there should be a “safeguard” cap on the amount of spectrum that any one bidder could win in an award for the 2.6 GHz bands and, if so, do you have a view on whether 90 MHz would be an appropriate size for a safeguard cap?

Vodafone is agnostic on this matter. We see no particular need for a safeguard cap and note Ofcom’s previous comments in relation to its Competition Act powers. Furthermore, if Ofcom is correct about the demand for this spectrum then surely a cap is unnecessary?

Question 9: Do you agree with Ofcom’s proposal to package spectrum as lots of 2 x5 MHz for paired use and 5 MHz lots for unpaired spectrum and to allow the aggregation of lots by bidders?

Yes

Question 10: Do you agree with Ofcom’s proposed approach to allowing the respective amounts of paired to unpaired spectrum for the band 2500-2690 MHz to be varied (maintaining the 120 MHz duplex spacing and allowing additional unpaired spectrum, if needed, at the top end of the band)?

Vodafone supports the principle that market mechanisms are used to determine the uses of spectrum.

Question 11: Do you agree with Ofcom’s proposals for a 5 MHz restricted block between FDD and TDD neighbours and between TDD and TDD neighbours and with a modified out-of-band base station mask for second adjacent 5 MHz blocks?

Vodafone agrees with Ofcom’s proposals for restricted blocks between FDD and TDD neighbours and between two TDD neighbours. However, this represents an inefficiency in the use of spectrum. It may therefore be in the interests of operators to

⁴ The Forward to these documents gives an overview of their purpose.

reduce this inefficiency, either by using equipment with improved performance or by coordination. Ofcom should therefore ensure that the process is in place for operators to reach bilateral agreements and then obtain variations to their licence conditions in a timely manner, so that this does not delay the deployment of networks.

Vodafone accepts that some restrictions may be needed in respect of second adjacent channels. However, these restrictions might require special filtering in base stations, which would impose an additional cost on deployment. It is worth recalling that somewhat similar conditions were imposed in the 2GHz 3G auctions; they were subsequently found to be unnecessary, and were removed.

Question 12: Do you agree with Ofcom's proposals to award the 2010 MHz band as a single 15 MHz lot?

Yes

Question 13: Do you agree with Ofcom's proposals to award the 2290 MHz band as a single 10 MHz lot?

Yes

Question 14: Do you agree with Ofcom's proposals to combine the award of the 2.6 GHz and 2010 MHz bands and to hold the award of the 2290 MHz band separately and in advance?

Yes

Question 15: Do you agree with Ofcom's proposals for a two-stage auction design for the 2.6 GHz and 2010 MHz bands?

As a general principle, Vodafone supports the idea of conducting a simultaneous auction for 2010 MHz and 2.6GHz spectrum. This is because Vodafone agrees with Ofcom's general preference that the allocation of spectrum should be as technology and service neutral as possible.

We understand that much of the complexity of the proposed auction arises from Ofcom's wish to allocate the available spectrum in as efficient way as possible. Nevertheless, the proposed auction contains some restrictions on the flexibility of bidding behaviour and pricing which seem to be unnecessary. Ofcom should also consider whether it may be possible to simplify the auction process further. We therefore present a number of comments and suggestions that may have the effect of making the auction process both more flexible and simpler.

Differences in valuation between generic lots

Our understanding is that the auction consists of two stages:

- The “principle auction stage”, which itself consists of a “clock stage” and a “best and final offers” stage; and
- A “final assessment” stage.

We agree that, given the complexity of the auction process it would be very difficult for participants to bid for specific frequency lots and that therefore it is more straightforward to bid for generic lots, and then allow the allocation of lots won in a secondary process.

However, we note that the auction design pre-supposes that the relative preference of bidders between different frequencies within the 2.6GHz band is small relative to the overall price **and** that bidders will not consider paired and unpaired 2.6GHz lots as being substitutes for each other.

However, if some bidders have very different valuations for alternative parts of the spectrum (see answer to question 2 above) then the auction scheme proposed may mean that spectrum is not allocated to the bidders that value it the most.

If participants have to bid for generic lots then they will bid for the expected value of such a lot to them. This expected value includes the difference in valuation between alternative parts of the spectrum *and* the bidder’s judgement as to the likelihood of obtaining its preferred spectrum in the final assessment phase. For example, a bidder may place a high value on part of the spectrum, but have little or no use for another part. The bidder may know that it can bid its full valuation for its preferred spectrum in the final assessment stage. However, it also knows that it may be unsuccessful. In that case it is not simply a matter of the bidder failing to obtain spectrum it would like because it was outbid. Rather, in this case the bidder will be required to buy spectrum for which it may have little or no use. This possibility in the final assessment stage will have a material impact on bidding behaviour in the principle auction stage. Its initial bids will have to factor in the expected likelihood of being left with low value spectrum at the end of the process. Consequently the amount it will be willing to bid could be very low. A further consequence of this is that it may fail to obtain spectrum at all, even if it has a higher valuation for its preferred spectrum than that of the winning bidders.

In our view this is not simply a theoretical possibility, as our answer to question 2 shows. These sources of interference affect different spectrum blocks to different extents, leading to a patchwork of impairments. The impact of these on valuation of the blocks will depend on the business case of the operator. However, the impact would be substantial on any bidder intending to deploy a free-standing network at 2.6GHz, and still at least pro-rata for an existing operator seeking extra spectrum (probably to the proportion of urban population that is affected). For some classes of user (e.g. PMSE), this variation could be as large as 2:1.

If bidders do place very different valuations on alternative parts of the 2.6GHz spectrum then this undermines the case for auctioning 2.6GHz spectrum in generic lots. We recognise the potential complexities that this proposition could introduce to the auction process. Nevertheless, we consider that Ofcom should reconsider the

premise that differences in valuation between generic lots are small and the consequences that abandoning this assumption might have for the auction design.

The need for more flexibility

Furthermore, we are not convinced at this stage that there is no prospect of substitution between paired and unpaired lots in the 2.6GHz range.

Ofcom has concluded that spectrum in the 2010MHz range is potentially a substitute or complement to unpaired spectrum in the 2.6GHz range. This underpins the proposed auction provision that eligibility for 2010MHz spectrum and unpaired 2.6GHz spectrum should be inter-changeable. However, Ofcom has further assumed that there is limited prospect of substitution between paired and unpaired lots in the 2.6GHz range. Hence it has excluded the possibility of inter-changing eligibility in the auction between bids for paired and unpaired lots.

In Vodafone's view it is neither reasonable nor necessary to restrict such interchangeability between paired and unpaired lots. For example, WiMAX and 3GPP LTE (long term evolution) are widely discussed in the specialist press as being alternative technologies for wireless broadband.

By precluding the ability of bidders to switch between paired and unpaired spectrum in the 2.6 GHz band, the auction may force bidders interested in *either* paired or unpaired spectrum to bid for both so as to reserve their position, which may distort the outcome of the auction.

Alternatively, if a bidder considers paired and unpaired spectrum to be substitutes, albeit imperfect ones, it is possible that the auction could lead to an inefficient allocation in the following circumstances. If a bidder considers a paired lot to be more valuable than two unpaired lots it would choose to bid for paired lots, provided the price ratio between paired and unpaired is fixed as is envisaged. However, if the price rises to the point where demand for unpaired lots is nine lots or fewer then the price of unpaired spectrum will be frozen and the clock auction will continue, raising the price of paired spectrum and the relative price of paired to unpaired. In this process there may come a point where the price ratio of paired to unpaired rises to such a level that a bidder would prefer to switch its demand to unpaired, but under the proposed rules, the bidder could not do so.

This problem would be prevented if bidders are allowed to switch their bids between paired and unpaired 2.6GHz spectrum. We believe that this is consistent with Ofcom's objective to achieve the most efficient possible allocation of spectrum. Furthermore, given the auction design set out in the consultation we do not see why this additional flexibility should be precluded from the outset by assumption.

Restrictions on the relative price of lots

We understand that the clock auction stage will set two prices at each round, one for the 2010MHz lot and one for a 10MHz paired 2.6GHz lot. Provided there is excess demand for both paired and unpaired 2.6GHz lots, the price per MHz of paired and

unpaired 2.6GHz spectrum will be held equal, so the price of each 5MHz unpaired lot will be fixed at half that of a 10MHz paired lot. This ratio is maintained unless the demand for unpaired lots falls to nine or fewer before the end of the auction, in which case the price of unpaired lots will be held, while the price of paired lots, and hence the ratio of paired to unpaired will be increased.

We recognise that the logic of the 2:1 paired-to-unpaired ratio from the point of view of the efficient trade off between FDD and TDD uses within the 2.6GHz band being auctioned. However, we note that the efficient price paid for FDD and TDD need not reflect this strict interchangeability, but rather the value that bidders place on the spectrum in different uses. There is no reason that this value should be in the ratio 2:1.

But if the ratio of value placed by bidders on spectrum for FDD and TDD use at the margin is different to the presumed 2:1 ratio, and considering the 2.6 GHz spectrum on its own, then the outcome of the auction is likely to be a “corner solution” where either all the 2.6GHz spectrum is allocated to unpaired lots (if the value of a paired lot is less than twice that of an unpaired lot at the margin) or 14 paired lots are sold (if the value of a paired lot is more than twice that of an unpaired lot at the margin). Subject to how the BAFO process functions, this could even lead to some unpaired lots being left unsold.

This possible outcome, with 2.6GHz unpaired lots not going to the bidder that values them most, would not reflect an efficient allocation of spectrum. We therefore ask Ofcom to consider introducing separate clock prices for paired and unpaired lots, perhaps beginning in a starting ratio of 2:1. This would require a behavioural rule to decide by how much each clock price rises at the start of each new round (such a rule seems desirable even if there are only two clock prices, see below for further discussion on this matter).

We also note that Ofcom is proposing setting a fixed ratio for eligibility to be switched between bands (between 2010MHz and 2.6GHz unpaired in the Consultation). In our view this could also lead to some distortion or strategic behaviour if the relative price of the spectrum were to vary significantly from this fixed ratio. We would suggest Ofcom considers again the possibility of making the “rate of exchange” between spectrum types dependent on the closing prices at the end of each round of the auction. This would apply both to the exchange between 2010MHz and 2.6GHz unpaired as discussed in the Consultation and to the exchange between paired and unpaired 2.6GHz lots, under the proposal included in these comments.

The “best and final offer” process

The role of the “best and final offer” (BAFO) in the auction is to map out the shape of each bidder’s demand curve so that, in the event that the clock stage of the auction closes at a point where there is excess supply of any type of spectrum it will be possible to allocate this spectrum in the most efficient way possible.⁵

⁵ However, there are plausible reasons why a bidder might not bid in line with its true valuation. Consider the following simplified example:
There are 10 generically identical lots

We accept the need for a BAFO process, but consider that the proposals in the Consultation may be over-complex and could be simplified. In particular we consider that the proposal for all bidders reducing their bid to submit BAFOs at each round of the auction could be onerous and unnecessary.

This is because, except in certain particular circumstances, it is very unlikely that a BAFO lodged by a bidder will be material in the final allocation if that auction round is not the final round, or close to it. BAFOs lodged after the clock stage has finished will, by definition, be at a higher price than any BAFOs lodged at earlier rounds and so will take precedence over those previous offers. Only if it proves impossible to match supply and demand from the BAFOs lodged after the clock stage finishes might it be necessary to rely on BAFOs made by bidders in earlier rounds.

However, it can only be impossible to match supply and demand from the BAFOs lodged after the clock stage finishes if there are indivisibilities in the combinations of lots that bidders are prepared to take. For instance, suppose in round x of the auction total demand equals total supply plus 1 lot, but in round $x+1$ a bidder reduces its bid from 4 to 2 lots. If it puts in a BAFO for 4 and for 3 lots it will be possible to match supply and demand exactly without resorting to BAFOs lodged in earlier rounds. However, if the bidder lodges a BAFO *only* for four lots (signalling that it can use 2 or 4 lots but has no use for 3 lots) it may be necessary to revert to earlier BAFOs to look for the highest bid (or bids) available to take up the three remaining lots.

It seems therefore that it could be excessively onerous for bidders to lodge BAFOs at each stage of the clock auction where they reduce demand. Even if such bids are not mandatory, the additional complexity makes the auction more difficult to understand and may discourage bidders less experienced in auction processes.

As an alternative, Ofcom should first consider determining a rule for the movement of prices between rounds of the clock auction that minimises the chance of there being a

Bidder A would bid up to £30 each for either 3 or 4 lots
Bidder B would bid up to £35 each for 4 lots
Bidder C would bid up to £25 each for 3 lots

The clock auction will end when the price per lot exceeds £25 and Bidder C drops out. If all bidders are honest in their BAFO bidding, then the outcome will be 3 lots to A, 4 lots to B, and 3 lots to C, each lot going for £25.

But suppose instead that Bidder A only submits a BAFO bid of £30 per lot for a 4-lot package and does not submit any bid on a 3-lot package. Then the outcome will be 4 lots to A and 4 lots to B, each lot going for £25, with 2 lots unsold. Bidder A may very well prefer this outcome.

So Bidder A does better by concealing the fact that it would be willing to settle for 3 lots.

This kind of issue may arise in the Ofcom auction. If a bidder ideally wants a larger number of lots, does it "admit" that it would be willing if necessary to settle for a smaller number? If it does admit this in its BAFO bidding, it may well end up less happy than if it had not done so. However, if it does admit it, it may end up with nothing. This is bidder uncertainty, which tends to lead to inefficient auction results.

significant discrepancy between supply and demand at the end of the clock stage. This could be achieved by linking the round-to-round movement in price to the difference between supply and demand in the previous round and the change in bids in the previous round.

Secondly, the BAFO stage could be confined to occurring *only* at the end of the clock stage. At this point all parties that have bid for lots during the course of the auction can submit BAFOs for a number of lots no greater than the number they bid for in the last round in which they placed a bid. To minimise any potential risk from bidding behaviour being distorted at this stage by bidders being able to infer whether it was their demand reduction alone that tipped the auction into excess supply, these sealed-bid BAFOs should be submitted after the auctioneer has determined that there is excess supply, and before bidders know the outcome of the last round of the clock auction. In this case they will know the bids from the previous round, and the fact that there is excess supply. They will not however, know how much demand has fallen by. Such a rule should significantly reduce the complexity of the BAFO stage.

Winning Prices

We believe that the rules regarding winning prices (A8.170 - 18.173) are insufficiently clear, for two reasons:

Generally, it will be very hard for a bidder to anticipate what the results of its bid might be in terms of what it will end up with and at what price.

More specifically, as the rules are stated, we believe there is sometimes no outcome satisfying the required conditions. Consider the following example:

There are 10 generically identical lots:

Bidder A would bid up to £10 each for 10 lots

Bidder B would bid up to £20 each for 3 lots

Bidder C would bid up to £14 each for 4 lots

Bidder A is willing to pay £100 for the whole set of 10 lots. It is clear that bidders B and C between them are willing to pay a higher total, so the lots should be allocated to them. But what will they each end up paying?

Consider two (of a range of) possible outcomes:

- Outcome 1: B pays £44 for 3 lots, C pays £56 for 4 lots
- Outcome 2: B pays £60 for 3 lots, C pays £40 for 4 lots

Which of these will result from the auction rules? We believe that, as the rules stand, there is in fact no possible outcome satisfying them. Outcome 1 does not meet rule A8.170, because Bidder C would prefer Outcome 2 (and Outcome 2 leaves the seller just as well off). Outcome 2 does not meet rule A8.170, because Bidder B would prefer Outcome 1 (and Outcome 1 leaves the seller just as well off). A similar argument could apply to any other division of the £100 between Bidders B and C.

If this analysis is correct then it is important that the working of the second price rule are clarified.

Question 16: Do you agree with Ofcom proposals to award the 2290 MHz band through a second price sealed bid auction?

Yes

Question 17: Do you have a preference for either of the two approaches to specifying technical licence conditions?

Ofcom has no alternative to using the approach of transmitter spectrum masks in defining the licence conditions if it wishes to meet the timescales set out in the consultation document. The proposals for spectrum usage rights are not mature enough to proceed straight from this consultation to an Information Memorandum and draft regulations.

Vodafone is a supporter of spectrum liberalisation. We believe that the definition of spectrum usage rights is an important component in achieving this long-term objective. The consultation on spectrum usage rights was an important first step in that direction. However, much further work was needed, as was highlighted by Vodafone and others in responses to that consultation. It is disappointing that Ofcom has not significantly developed the SUR concept since its previous consultation; as Ofcom notes it has only “*worked out the SUR parameters for the bands under consideration*” in the current consultation (paragraph 9.39).

Spectrum usage rights inherently comprise two parts – the technical licence conditions and the regulatory framework of rights and obligations in which these conditions are applied. However, the proposals for SUR in this consultation only address the technical conditions – there are no proposals for the regulatory framework⁶.

A right only has value if it is capable of being enforced. Vodafone believes that, for proposed approach for SUR, the costs of enforcement to the affected licence holder can be so great as to make the rights unenforceable in practice. In particular, in order to determine whether another licence holder is exceeding its SUR, it can be necessary to turn off its own network in the affected area and its surroundings for the period of the measurements⁷. This would clearly not be acceptable to its customers.

⁶ For example, annex 9 of the consultation document only contains a draft licence for the transmitter spectrum mask approach.

⁷ The approach taken by Ofcom to the definition of SUR makes it effectively impossible to measure out-of-band emissions in the presence of a co-channel signal, which will generally be significantly stronger. Ofcom’s approach precludes the use of directional measurement antennas, and there is no other technique that can be applied generally. The level of out-of-band interference is likely to fluctuate with the traffic load on the network that is causing it. It would therefore be necessary to make measurements of SUR parameters during the busy hour, which would cause greatest disruption to customers who lose service during the measurement period. It is also impossible to distinguish between different potential sources of interference, such as the networks operating in the assignments above and below the affected one.

As the proposals for SUR are basically only an implementation of the proposals in Ofcom's consultation on SUR, Vodafone's comments in response to that consultation still stand, and we ask that they are considered again as part of the response to this consultation.

In the SUR consultation, Vodafone suggested an alternative approach to the definition of SUR, based on aggregate PSD (transmitted power spectral density) within a specified area (see paras.18 – 21). We continue to believe that this approach could overcome many of the difficulties that have been identified with the approach currently preferred by Ofcom (based on aggregate PFD). It is probably now too late to develop this proposal for the awards of spectrum addressed by this consultation. However, we would recommend that Ofcom considers it again for future awards.

Question 18: Do you have any comments on the transmitter spectrum masks defined below?

We believe that the spectrum masks on existing 3GPP specifications are an appropriate basis for the spectrum masks. They are particularly suitable for this purpose, as they specifically take into account the European situation for this frequency band.

It is imperative that Ofcom does not impose any additional requirements, especially on terminals, that would result in the need for dedicated products for the UK market. This would result in UK consumers losing the benefits of economies of scale of a pan-European or global market.

Question 19: Do you have any comments on the SUR parameters defined below?

As the proposals for spectrum usage rights are not mature enough to be used for the current set of spectrum awards, we have not reviewed the band-specific proposals in great detail. However, these proposals highlight some general issues in the definition of SUR.

The SUR for paired and unpaired spectrum are based on different areas ("A km²" in the document). There does not seem to be any rationale for this difference. It could complicate enforcement of rights (for example where a block has paired spectrum on one side and unpaired on the other) and future flexible use of spectrum through bilateral agreement.

The SUR are based on the PFD exceeded at 50% of locations, which is based on expediency in measurement rather than appropriateness. Almost all systems that might be deployed in these bands will require a coverage exceeding 90%. As there are several sources of loss of coverage, the percentage of locations at which the PFD should not be exceeded (Z %) needs to be of the order of 1%. Such a substantial difference between the SUR and the practical needs of spectrum users creates uncertainty in the valuation of spectrum blocks.

The Consultation document proposes SUR for heights above ground level of 1.5m and 10m. There will be many situations when it is not possible to make measurements evenly distributed over an area as small as 0.14km² at the upper height. It is also unclear what will be the reference point for height.

Question 20: Do you have any comments on the SUR methodology and assumptions detailed in this annex?

As the proposals for spectrum usage rights are not mature enough to be used for the current set of spectrum rewards, we have not reviewed the band-specific proposals in great detail.

Vodafone continues to believe that there is no benefit in Ofcom defining Indicative Interference Levels.

It is unclear how Ofcom has derived values in 1MHz bandwidth from ACLR values. The power spectral density of an emission is not normally constant across an adjacent channel, so this cannot be done simply by bandwidth scaling.

The extensive use of the phrase “it is assumed that” in this section is worrying. It is unclear what will be a requirement and what will not, and which of the parameters are based on evidence.

Question 21: Do you have any comments on the use of the Visualyse tool as described, on the assumptions or the propagation model proposed in this annex?

Visualyse seems to be an appropriate tool to use in the studies described in this consultation. However, if modelling forms part of the definition of individual spectrum usage rights, it is important that this does not rely on the use of a specific proprietary software package.

Vodafone therefore welcomes the proposal by Ofcom to make a version of the Generic Radio Modelling Tool publicly available.

Question 22: Do you have any comments on the assumptions detailed in this annex?

The assumptions for system parameters described in Annex 13 are taken from existing documentation, and can therefore be assumed individually to be appropriate. However, they may still be inconsistent with assumptions made elsewhere in the consultation document.

There is a large difference between the assumed base station transmit powers for FDD (+35dBm typical) and TDD (+27dBm typical). Both values are taken from ECC Report 45, where they are associated with different deployment scenarios. This

difference is probably the result of an assumption that the TDD base stations were part of a combined network using both WCDMA and TD-CDMA, with the TDD base stations providing hotspot coverage. However, this is not consistent with the assumptions for the likely use of unpaired spectrum elsewhere in the consultation document, or with products available for either TD-CDMA or WiMAX.

This difference in transmit powers causes the different measurement areas for TDD and FDD in the SUR proposals. The consequences of this are discussed in the response to Q19.