



Commission for
Communications Regulation

DotEcon's responses to the comments received from interested parties in response to ComReg consultation Document 15/70 on 3.6 GHz spectrum award

A report for ComReg

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**An Coimisiún um Rialáil Cumarsáide
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DotEcon comments on consultation responses

Prepared for ComReg

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1 Introduction

1. As ComReg's expert economic adviser, in this document DotEcon sets out its understanding of the responses received to ComReg consultation document 15/70, in particular Chapters 4 and 5 (where the issues raised are related to the design of the award process), analyses those responses and makes recommendations in light of those responses. This document does not deal with responses related to the benchmarking or minimum prices, which are covered in a separate document.
2. To keep in line with the structure of the consultation document, we summarise the responses, our assessment and our recommendations under each of the questions posed by ComReg.

2 Chapter 4

Do you agree with ComReg's preliminary views set out in Chapter 4 and, in particular, that:...

...the band plan for the 3 400-3 600 MHz sub-band should be TDD (in line with the preference expressed in the 3.6 GHz EC Decision)

3. 3IHL, Vodafone, eircom, Imagine, Aptus, Digitalforge, Ripplecom all agree with the proposal to award the available spectrum with a TDD band plan.
4. Viatel also agrees with the TDD band plan, but suggests that a flexible solution to keep part of the band for TDD or FDD (as in Slovakia) may be better given that one respondent to the previous consultation (PermaNET) "expressed interest for FDD deployment and that existing usage is widespread on FDD".

Analysis and recommendations

5. The majority of respondents on this subject have indicated their support for making the 3.6GHz band available on a technology-neutral basis within a TDD band plan. The only respondent to suggest the potential need to support a FDD band plan was Viatel, and that was on the basis that it might be beneficial for another operator (and would be consistent with supporting existing usage). This other operator would appear to be PermaNET, which indicated an interest in FDD in its previous response to Document 14/101.
6. On the basis of the responses received to Document 15/70, there does not appear to be any compelling economic argument for making any of the 3.6GHz spectrum potentially available on a FDD band plan.
7. The proposals set out by PermaNET have been discussed by ComReg in Document 15/70, and were considered by ComReg to be incompatible with the 3.6GHz EC Decision; no further evidence has been submitted to contradict this view. The document also sets out the technical inefficiencies that could result from a flexible band plan allowing for FDD and TDD, highlighting that such a solution could lead to the uplink spectrum being inefficiently utilised.

8. Viatel suggests a similar approach to that used in the Slovakian 3400-3600MHz auction, where two 2x20MHz lots were available for either FDD or TDD use (alongside the TDD only 20MHz lot). Specifically, Viatel proposes that the frequencies 3410-3435MHz / 3510-3535MHz are made available for FDD or TDD; this is the available spectrum below state services and the corresponding frequencies with a 100MHz duplex spacing.
9. Viatel's proposals are not in line with the 1:2 uplink/downlink balance suggested by PermaNET, which wanted 10MHz uplink blocks to be paired with suitable 20MHz downlink blocks. Therefore, Viatel's suggestion would not necessarily allow FDD operators to acquire spectrum in the most efficient configuration. In contrast, offering all spectrum in a TDD configuration, as highlighted by ComReg in Document 15/70, "allows flexibility to adjust the uplink downlink configuration subject to operator agreements over time as the asymmetry in traffic changes".
10. Whilst a CCA format can allow spectrum to be configured flexibly in FDD or TDD patterns, this would also inevitably introduce significant additional complexity to the auction.
11. To accommodate Viatel's proposed band plan, it would be necessary to have at least one additional lot category (relative to ComReg's current proposals) to account for the split of spectrum between the uplink and downlink FDD/TDD sub-bands and the need for additional guard bands; without this additional category, TDD bidders would be subjected to significant uncertainty over whether they would ultimately be able to acquire contiguous frequencies. However, additional lot categories increase the number of packages that need to be evaluated by bidders, complicating preparation for and bidding in the auction.

12. An alternative approach, rather than offering additional categories to permit bidders to assemble spectrum blocks to allow for FDD use, is for the auction to allow for multiple possible band plans, with whichever band plan has highest value winning out. This approach was used in the Dutch 2.6GHz auction in 2010, though in the end the flexibility was not used and the same band plan was deployed for this band as in other EU states. Whilst this approach is possible within a CCA format, it again significantly increases complexity, both of the auction rules and of the decisions that bidders need to make.
13. Whilst we consider that the complexity of the award structure as currently proposed is manageable and justified by the corresponding benefits it brings, not least in accommodating possible regional demand for spectrum, a number of respondents have called for a process that is less complex than the MBSA award, whilst many (if not all) of the incumbent FWALA operators have little or no experience with spectrum auctions. Therefore, it is undesirable to introduce additional complexity to the process unless there is a clear benefit in doing so.
14. Given that responses were overwhelmingly in favour of the use of a TDD band plan in the 3.6Hz band, the lack of evidence for the need to support the option of a FDD band plan, and the additional complexity that making some spectrum available for FDD or TDD (as proposed by Viatel) or using a flexible band plan would entail, we consider that ComReg is strongly justified in maintaining the proposed approach of making the entirety of the available 3.6GHz spectrum available in a TDD band plan only.

...regions should be established in line with the principles identified by ComReg

15. A number of comments were received on the approach to establishing regions.
16. 3IHL and eircom agree with the principles identified by ComReg, while Eircom and Premier Broadband “broadly agree” with the plans for regional licences.
17. Digitalforge disagrees with proposals on the basis that the regional structure, in combination with the pricing structure, would prevent it (as a small fixed wireless operator) from obtaining licences due to cost. Digitalforge proposes a rectifying measure in the form of lower licence fees or smaller regions.
18. Rapid Broadband also believes that the number of regions is too small and will prevent FWA operators from being in a position to bid, specifically highlighting Munster as an example of where FWA operators will struggle. Rapid Broadband also asks for clarification on whether ComReg would view multiple WISP’s bidding together as anticompetitive.
19. Airwave believes that the regions proposed (specifically Munster) are too large for FWA operators, who may not be able to serve an entire region. It proposes that in order to avoid a situation within a region where there is one MNO and one FWA operator, a mechanism for sub-letting should be envisioned, with licensees obliged to sub-let channels not in use within a reasonable timeframe and the costs regulated on the basis of the initial cost of the spectrum. It further points out that every effort should be made to ensure that at least two FWA licences are awarded in every region.
20. Real Broadband indicates a desire for some of the spectrum to be assigned in more localised regions, as well as an obligation on larger providers to sub-licence unused spectrum.

21. The four-operator¹ joint response also proposes obligatory sub-leasing of unused spectrum, as a solution to situations where an operator may wish to use a transmitter located in another region to serve customers in its own region.
22. BBnet and KerNet Broadband agree with the approach taken by ComReg (assuming the Option 2 boundaries are used), but suggest that spectrum trading is necessary for established small/medium WISP's to deliver NGA services, and that a pricing model for this needs to be "clearly set out and transparent".
23. Munster Wireless also considers the approach to setting regions as detrimental to small providers in that the coverage area of licences is too large, while subletting of spectrum is cost prohibitive.
24. As part of its submission, Imagine sets out proposals for an alternative licence structure, suggesting:
 - a National licence of at least 160MHz of spectrum designated for NGA services with specific rollout conditions, and licenced through an administrative award (A-type licence); and
 - other licences with less stringent rollout obligations that may be awarded using the approach currently proposed by ComReg (B-type licences).
25. Imagine submits that the proposed approach to establishing regions for these B-type licences is sensible, but that regions outside urban areas need to align with the NBP.
26. Vodafone also proposes that regions should be aligned with the regional split used for the NBP, whilst Ripplecom suggests that the maps produced by ComReg should be shared with the DCENR.

¹ Lightnet, permaNET, Ripplecom, and WestNet

27. Viatel broadly agrees with the principles proposed by ComReg, but suggests that key elevated rural areas around each urban region should be taken into account when determining the urban region boundaries. Viatel suggests that the areas covered by the urban licences could be established in a similar manner to the existing FWALA scheme with an appropriately sized radius. Viatel further suggests that it may be important to include an interference contour zone.

Analysis and recommendations

28. Many of the responses from existing FWA operators highlight their concerns over the number/size of the proposed regions, and in particular that the regions are too large for the smaller operators.

29. However, as discussed in section 2.4 of DotEcon's previous report on the design of the award (Document 15/71), increasing the number of regions has a significant impact on the complexity of the auction:

- A greater number of regions leads to an exponential increase in the number of possible combinations of regions that may need to be evaluated and valued by bidders. This increases the amount of preparation and analysis that bidders may need to undertake, which might arguably disadvantage less sophisticated bidders.
- When using a combinatorial auction format, the computational demands on the auctioneer in calculating the winning bids and prices to be paid increase exponentially with the number of regions (which may need to be limited in some way, potentially by restricting the number of package bids that bidders can submit, which in turn may create

complications for bidders if this constraint prevents them from bidding on all packages they would wish to bid for, forcing them to choose between packages).

- If package bidding were not adopted, then with more regions it would become increasingly difficult for bidders to assess their chances of obtaining their desired footprint, which would introduce aggregation risks where there are complementarities across regions. A greater number of smaller regions will result in larger aggregation risks.
- With many open auction formats (including both the SMRA and the CCA), a greater number of smaller regions may give greater options for strategic bidding whenever switching across regions is allowed.
- With a larger number of regions, there are greater demands on the auctioneer in terms of setting reserve prices and licence conditions. The risks of regulatory failure may be greater as a result.

30. Again, we note that a number of respondents have highlighted either their inexperience with auction processes or their desire for the process to be simpler than the auction used for the MBSA. Therefore, any modifications of the proposals that would increase complexity for bidders would need to demonstrate sufficient benefit to be justifiable.

31. Furthermore, we understand that there may be implications for the efficiency of spectrum use. Increasing the number of regions could potentially increase the number of regional boundaries where the same frequencies are held by different bidders (depending on the outcome of the auction). As there are limitations on signal level at regional boundaries, this could impact on quality of coverage and engineering costs unless there was coordination amongst licensees.

32. It is not practical to attempt to establish a regional split that satisfies every existing and potential user of the spectrum;

this would entail creating regions sufficiently small that they could be reassembled to meet these different demands, which would lead to a high degree of complexity within the auction. A balance must be struck between the complexity of the award process and the flexibility allowed for acquiring spectrum in sub-national areas, and some reliance on the secondary market and/or bidding consortia may be appropriate.

33. One option available to bidders seeking spectrum in smaller regions is to bid as a consortium, which would be permissible under the award rules. Smaller parties who, for example, may not individually be able to provide services across the entirety of a region could form a consortium and place a joint bid for the spectrum required. This solution would allow operators with footprints smaller than the proposed regions to access spectrum. We note that no evidence has been presented to suggest that there are significant practical impediments to bidders forming consortia or similar business arrangements ahead of the auction to exploit spectrum regionally.
34. Even if the necessary arrangements are not in place pre-auction, the secondary market should provide further opportunities for operators to arrange suitable access to regional spectrum after the auction. As noted in Document 15/71, a number of spectrum transfer options are allowed in Ireland, including:
- a straight transfer of a current licence to another party;
 - sub-division of a current licence by geographical area and/or frequency range; and
 - short-term sub-leasing arrangements
35. Secondary trades of these types can help to remedy any inefficiencies resulting from the initial spectrum award:

- an operator that cannot or prefers not to cover the entirety of a region in which it won spectrum can transfer or sub-let the part of the licence it is not currently using; and
- an operator that did not win spectrum in some or all of the regions in which it wishes to operate may acquire or sub-lease unused spectrum from the winners in those regions.

36. Secondary trades can similarly be used to overcome the finer details of the location of boundaries between licensees (e.g. to address the issues highlighted by Viatel).

37. ComReg has also proposed a number of transitional arrangements that could assist operators (in the short-to medium term) with adapting to the new regional structure and establishing any longer term agreements with other operators. Therefore, time will be available to help operators put in place any necessary measures to resolve inefficiencies in the boundaries and spectrum endowments, and to mitigate any risks to continuity of services.

38. Overall, there should be good incentives for parties to use sub-leasing to resolve such issues. These could be enhanced by allowing base stations deployed using leased spectrum to count towards rollout obligations.

39. Therefore, we consider that the concerns raised regarding the size of the regions and setting specific boundaries should be mitigated through a combination of possible consortium bidding, transitional arrangements (in the short-to medium term), secondary trading and sub-leasing.

40. Munster Wireless claims that subletting spectrum would be cost prohibitive for smaller operators. However, no evidence or supporting argument is offered to back up this claim. A licensee should have good incentives to sub-licence spectrum that it is not using, as it would be better off receiving some

revenue contribution for unused spectrum than receiving none. To the extent that smaller operators are concerned about their bargaining position in respect of sub-licensing after the auction, they have the option of forming consortia in advance of the auction.

41. Furthermore, even if regions were subdivided more finely (with the concomitant increase in auction complexity this would involve), this still would not guarantee that the needs of individual operators are all met, as the specific boundaries may not suit them. Indeed, it is implausible to suppose that boundaries can be established that will conform to the requirements of *all* potential bidders, rather than just particular parties.
42. Some operators have proposed that ComReg should specify an obligation to sub-licence spectrum that is unused in particular areas, possibly with regulated prices, and/or establish a spectrum trading mechanism and corresponding pricing structure. However, no evidence has been provided to suggest the need for such intervention by ComReg in any follow-up trades because a solution cannot be achieved through negotiation. It is also not clear that any mandatory leasing obligation would be feasible under the Authorisation Directive, which refers to spectrum transfers being at the initiative of the rights holder. It should therefore be the responsibility of the relevant parties to establish suitable agreements over conditions and pricing.
43. The number of regions currently proposed by ComReg (nine) is already towards the upper limit suggested in our previous report for keeping auction complexity manageable. The benefits that might be gained from using a larger number of smaller regions do not in our opinion justify the additional complexity that would be created, which itself could risk affecting the efficiency of the outcome. In the absence of a clear case for the superiority of an alternative regional

structure, we recommend maintaining the proposed approach with regard to the number of regions.

44. The proposal by Imagine (and some other respondents) to designate a portion of the spectrum for NGA services through an administrative award is discussed further elsewhere. Here we consider the suggestion that a combination of a national licence and a number of regional licences is used. Such a mix would require a decision by ComReg in advance of the award on the appropriate split of the band between national and sub-national licences; there is a risk that this could be incorrectly set and result in an inefficient outcome. In addition, offering some spectrum as a national licence could be detrimental to many of the existing (or future) regional FWA operators, who may not be able to bid for such a national licence (and therefore may be unable to compete for a significant amount of the available spectrum) without forming a nationwide bidding consortium. In particular, if the national licence were designated for FWA NGA services, as Imagine proposes, this would seem to greatly favour those FWA operators that are able to provide a national service by potentially eliminating competition from the regional players.
45. With an appropriate award design, such as the CCA proposed, bidders are able to express value for national or sub-national licences with no aggregation risk. Therefore there is no need to offer any of the spectrum solely as a national licence; such demand can be expressed as a bid for a package of regional licences.
46. Vodafone and Imagine suggest that the regions should be aligned with the regional split used for the NBP. At the time of publication of the consultation, this was not feasible as the NBP regional split had not yet been established. However, we understand that ComReg will now align the regional split used in the 3.6GHz awards with those used for the NBP. This

does not affect the urban areas but changes the definition of rural regions to 'East', 'Border, Midlands & West', 'South East' and 'South West'. Our companion report on minimum prices takes account of these revised regions.

...the regions identified in Option 2 should be used for the proposed award

47. With the exception of those who disagree with the number and size of the regions (discussed above), the respondents who specified a preference in general supported the regions proposed under Option 2.
48. Aptus, BBnet, eircom, Eircom Ireland Ltd, KerNet Broadband, Net1 Ltd, and Ripplecom indicate that they agree with the definition of regions under Option 2.
49. The 4-Operator response broadly agrees with Option 2, but with the proposed amendments as discussed above.
50. Viatel suggests using the Option 2 regions but incorporating Laois County into the Wexford-Carlow-Kilkenny-South Tipperary-Waterford region, to address issues with the Carlow town urban area currently being split across two rural regions. Viatel argues that this "should not provoke any great imbalance between regions" and that further issues could be resolved through sub-leasing of spectrum.
51. 3IHL generally supports the regions under Option 2 but suggests that the 5 cities are combined as a single region to reduce auction complexity and on the basis that everyone who would want to bid for urban service would want to cover all cities.

Analysis and recommendations

52. Viatel has requested an amendment to the border definition where it considers there is an inefficient split of the local area. There are potentially a number of other cases where minor “tweaks” to the border definitions would be beneficial for a particular operator. However, we note that ComReg has stated its intention not to make adjustments to the boundaries to suit the needs of individual operators, and indeed it is likely to be impractical to attempt to design the borders in a way that is optimal for all parties. Since inefficiencies in the border definitions can be resolved through secondary trading, facilitated by the transitional arrangements that allow time for this to take place, there does not appear to be any compelling economic argument for ComReg to make any amendments to the boundaries proposed.
53. 3IHL has suggested that the cities are combined into a single region, on the basis that any operator interested in the cities would want spectrum in all five. However, we do not consider it prudent to rule out the possibility that some participants may wish to target subsets of the cities, either in addition to or instead of all cities combined. For example, a regional operator may wish to provide coverage in an entire region, including any city in that region, but attribute no value to cities outside that region.
54. In addition, even if two operators (for example) would ideally wish to acquire a licence for all cities (but have valuation for subsets of the cities), it may be the case that the optimal and efficient outcome is to divide the cities between them (i.e. where the bidders place higher relative values on different cities); such an assignment would not be possible if the cities were combined. With the CCA format proposed by ComReg, bidders are able to express valuations for any combination of

lots without the risk of being awarded a subset of the package bid for. Therefore, with a regional split including the five urban areas:

- bidders wishing to acquire packages containing all five cities and who are not interested in a subset can reflect this in their bids without aggregation risk by including each of the cities (or none of the cities) in every package bid for – the complexity for these bidders in terms of evaluating the packages to bid for is the same as if the cities were combined; and
- bidders who have business case for packages containing a subset of the cities may express their valuations in their bids – whilst this increases the complexity for those bidders in terms of increasing the number of packages to consider, it does allow flexibility for targeting a variety of desirable packages, increasing the chance of winning spectrum and maximising surplus.²

55. We therefore believe that there is no material advantage in combining the cities into a single region, and that doing so risks disadvantaging some bidders and having a detrimental impact on the efficiency of the award. Our recommendation is to keep the cities as separate regions and allow bidders to choose their preferred combination.

² Bidding for a range of packages increases the likelihood of one of those packages being compatible with the bids of other bidders, increasing the chance of winning some spectrum for those bidders that may not be the strongest over all five cities. In addition, the winner determination and pricing process ensures that each winner is awarded the spectrum package (with associated price) that maximises surplus given the bids it submitted and the bids of all other bidders.

...a licence duration of 15 years should apply to the 3.6 GHz band.

56. Premier Broadband, Viatel, and Net1 Ltd agree with licence duration, although Viatel suggests that ComReg may consider a 5-year extension after expiry of the initial licence period if there is no requirement for the spectrum to be reclaimed at that point.

All other responses to this question argue that a licence term of 15 years is too short, with most suggesting 20 years as more appropriate.

57. 3IHL supports indefinite term or rolling licences, with a minimum term of 20 years, claiming this would promote continuous investment and avoid a period of “zero investment incentive” in the run up to the expiry date. 3IHL also suggests that 20 years would be compatible with commitments for providing FWA as part of the NBP.

58. eircom also proposes indefinite licences with a minimum term of 20 years to support continuous investment. eircom questions the justification for a 15 year licence on the basis of an 8-year physical asset life for mobile elements (and disagrees that 8 years is the correct lifespan in any case), and argues that choosing a shorter licence term on the basis of avoiding long term inefficiencies due to changing market conditions is not appropriate. eircom suggests that ComReg could feasibly propose indefinite licence terms with the potential for licences to be revoked if necessary, as has been done in the past.

59. Airwave argues that 15 years is too short, as migration from existing unlicensed networks will take time and may not be practical/affordable immediately, and that 20 years would be better. Airwave suggests also that a new (award) process is

completed 5 years before licences expire (irrespective of the licence term).

60. Vodafone, Imagine, Aptus, Ripplecom, KerNet Broadband and BBnet all agree that the licence duration should be 20 years to align with the NBP. BBnet suggests this would give greater investment certainty to operators. Imagine claims that not doing so would discriminate against FWA operators in any NBP tender and could lead to difficulties in terms of compliance with State Aid Guidelines. Ripplecom also claims that not aligning licence terms with the NBP could prevent the 3.6GHz spectrum from being used for any NBP tender submission.
61. Eurona Ireland Ltd believes a licence term of 20 years would encourage more long-term large-scale investment. It suggests that a review of spectrum use should be undertaken every five years, that a consultation with spectrum holders should be conducted 5 years before licences expire, and that licences should be extended by a further 10 years subject to performance conditions.
62. Digital Forge would like a licence term of 20 years to provide investment security and security of service for customers, and also suggests a consultation with operators 5 years before licences expire.
63. Carnsore Broadband, Real Broadband and the four-operator joint response also indicate a preference for a 20-year licence term.

Analysis and recommendations

64. In documents 14/101 and 15/70, ComReg sets out its policy and preferences regarding licence duration. In particular, ComReg is of the view that licences with a finite duration of 15 years are appropriate to strike the right balance between

generating sufficient investment incentives for licence holders, and providing ComReg with the ability to reassign spectrum and ensure efficient use in the long run. ComReg has discussed in detail the reasoning behind its choices, and has set out its views regarding the arguments for longer and/or indefinite licence terms.

65. Furthermore, ComReg has indicated a strong desire to maintain a consistent approach across spectrum awards, in order to provide regulatory predictability. We note that the proposals put forward by ComReg would be in line both with its approach in previous awards³, and also with international practice.
66. With these points in mind, we do not consider there to be any substantial differences between the 3.6GHz award and previous awards (such as the MBSA), or that substantive evidence has been provided in response to Document 15/70, to suggest that ComReg should deviate from its previously adopted approach to setting the licence duration.

³ For example, licences awarded in the MBSA process had a finite term, with a duration of between 15 and 17 years.

3 Chapter 5

Do you agree with ComReg's preliminary views set out in Chapter 5 and, in particular, that:...

...a combinatorial clock auction is the preferred auction format;

67. Eircom and Viatel agree with the proposed CCA format.
68. Vodafone would accept a CCA (as long as it is less complex than the MBSA), but would prefer an SMRA.
69. 3IHL disagrees with the use of a CCA and suggests an SMRA or a simple clock auction (SCA).
70. Many respondents (Imagine, Premier, joint response from 4 operators, KerNet Broadband, Ripplecom, BBnet) disagree with the use of any auction process to award the entire spectrum available, favouring alternative options such as an administrative award, though some respondents may accept the use of an auction process subject to some substantial amount of spectrum being reserved for FWA – e.g. Imagine agreed with the use of a CCA to award part of the band, subject to another part (160MHz) being reserved for FWA and awarded administratively. Whilst not suggesting alternative approaches, Airwave suggests that ComReg should make efforts to ensure there are at least two FWA operators in each area.

Analysis and recommendations on use of an auction process

71. Among those who oppose the use of an auction in general, there appears to be a common belief that awarding spectrum to the highest bidder may not produce the efficient or most

desirable outcome. Specifically, these respondents assert that an auction process relies on the existence of a competitive and well functioning market in services for end-customers, but DCENR clearly believes that there is market failure in broadband provision (Ripplecom and BBnet).

72. One argument made is that the higher valuations of some bidders, particularly large bidders, may reflect anti-competitive motives (e.g. spectrum hoarding), as well as greater financial resources. Another argument is that, in any case, certain bidders may have high private valuations (e.g. MNOs anticipating potential use for capacity purposes) but no intention of serving rural areas, which is socially beneficial as recognised by the NBP. Several respondents believe that an alternative procedure (e.g. with spectrum reserved for FWA) would promote NBP objectives and reduce expenditure through the NBP.
73. The EC Decision for the 3.6GHz band precludes ComReg from assigning some of this spectrum for particular applications. Rather, spectrum should be assigned in a technologically neutral manner to allow the uses identified in the Decision. In any event, we note that any concerns about market failure, including in relation to the provision of broadband to rural areas, are intended to be addressed through the NBP process, in compliance with State Aid rules.
74. Airwave has suggested that ComReg should make every effort to "ensure a duopoly does not occur and that at least two FWA spectrum awards are made in each area to ensure active and reasonable sub-letting of channels". Whilst Airwave does not put forward any proposals for how this should be achieved, we note that intervention by ComReg to this end would be earmarking spectrum for a particular use. This would be contrary to the principle of service and technology neutrality set out in the EC 3.6 GHz Decision, and we cannot see any grounds for intervention on the basis of

market failure, which, as discussed above, is being addressed through the NBP process.

Analysis and recommendations on use of the CCA format

75. Among those who oppose the use of the proposed CCA specifically, many respondents mention the complexity of the format. There are concerns that it may disadvantage some bidders (3IHL), in particular inexperienced bidders (Real Broadband, joint response from 4 operators, Digital Forge, KerNet Broadband) or smaller bidders who will be outbid by larger ones (Ripplecom). Specifically, Vodafone argues that the CCA is more susceptible to “price setting” behaviour by experienced bidders, whereas a SMRA would provide greater transparency and certainty. 3IHL believes the risk of gaming in this award is small and aggregation risks are not significant due to the large number of blocks, so the use of a CCA is not justified.
76. DotEcon’s report acknowledged the perceived complexity of the CCA and the potential for bidders to be discouraged or disadvantaged. For this reason we identified the need for adequate bidder training and support. We reiterate that substantial efforts should be made to ensure that inexperienced bidders are comfortable participating in the auction. However, this should largely mitigate problems related to complexity and potentially disadvantaged bidders.
77. We note also that perceptions of complexity may have been exacerbated by previous CCAs that used a more complex design than the one we propose. For example, the MBSA involved significant complexity in order to deal with time slices, which would not apply to the present award. Many

previous CCAs also did not use relaxed activity rules⁴; without relaxed activity rules there can be greater substitution risks and therefore more complex bidding decisions. Aside from addressing substitution risks, relaxed activity rules with a final price cap should help to make the open stage more informative (by incentivising truthful bidding) and the final outcome less uncertain, both of which contribute to reducing complexity for bidders.

78. While the CCA rules may be perceived as complex, it is important to note that the complexity of bidding decisions and the risks faced by bidders in alternative formats may be significantly higher, even if the auction mechanics

⁴ During the clock rounds of the CCA, bidders are restricted in what they can bid for on the basis of the number of eligibility points they hold at the start of a round (their "eligibility"). Each lot has a number of associated eligibility points, and under standard activity rules a bidder cannot bid for a package for which the sum of the eligibility points associated with the lots in the package (for simplicity in this note, we will refer to this as the size of the package) exceeds the bidder's eligibility. Whenever a bidder bids for a package that is smaller than its eligibility, the bidder's eligibility for the next round is reduced and the bidder is restricted further in terms of the size of the package it can bid for in subsequent rounds. Under a truthful bidding strategy, a bidder will reduce its eligibility whenever the most preferred package at prevailing round prices is smaller than the package bid for in the previous round. Note also that a reduction in eligibility implies a maximum value difference between the package bid for and the larger packages it could have bid for instead, based on the clock prices at that time. Problems arise if, after a bidder has reduced eligibility, the relative prices of the lots available then change such that the bidder would want to bid on a package that is larger than its current eligibility. With standard activity rules, it would not be possible for the bidder to switch to its most preferred package, which could negatively affect the price discovery benefits of the clock rounds, and could affect the supplementary bids the bidder is able to submit. The relaxed activity rules deal with this problem by allowing bidders to bid for packages larger than eligibility, as long as doing so is consistent with the value differences implied by the bids submitted in earlier rounds when the bidder reduced its eligibility.

superficially appear simpler. The reason is that the use of a regional lot structure with a large number of lots across categories can create relatively large substitution and aggregation risks, which the CCA addresses directly; a simple clock auction or a sealed-bid combinatorial auction would deal with aggregation risks only, and have other shortcomings. The regional lot structure also increases vulnerability to gaming, as explained in our report.

Therefore, we disagree with 3IHL's assertion that gaming risks are low and that the large number of available lots reduces aggregation risks, because the regional nature of the award means that gaming and aggregation risks are significant.

79. Because of these features of the proposed CCA, we disagree with Vodafone's claims that an SMRA would provide greater transparency and certainty. In particular, we note that the significant substitution and aggregation risks associated with a regional lot structure can create a high degree of uncertainty in a SMRA about the package that may ultimately be won by a bidder, whereas the CCA addresses this type of uncertainty. Furthermore, the use of relaxed activity rules for the clock stage together with a final price cap also increases certainty for bidders.

80. We consider that Vodafone's concerns about 'price setting' appear to be overstated. It is true that the CCA is theoretically susceptible – under certain conditions – to strategic behaviour aimed at influencing the prices paid by others. There is academic literature (e.g. Levin and Skrzypacz,

2014,⁵ Knapek and Wambach, 2012,⁶ and Janssen and Karamychev, 2013⁷) showing how this may take place.

81. However it is important to note that opportunities for price driving are not strictly a feature of the CCA, and other formats – such as the SMRA – are also potentially susceptible under similar conditions. In either a CCA or SMRA auction, price-driving strategies require sufficient information about other bidders' likely demands.
82. For example, suppose there is a single lot in region X. Bidder A does not wish to acquire the lot, but expects that Bidder B wishes to acquire it at any price of up to 1000. With either auction format, Bidder A can make bids up to an amount close to, but less than 1000, to maximise the price paid by Bidder B without Bidder A winning the undesired lot. The success of this strategy is of course heavily dependent on Bidder A's estimate of Bidder B's valuation being accurate; should Bidder B stop bidding for the lot before Bidder A, there is then a significant risk that Bidder A will end up winning spectrum it does not want and having to pay for it. In practice, the likelihood of such strategies being used would depend less on the auction format, and more on the degree of information certain bidders have about other bidders' demand and the perceived benefits of increasing the prices paid by other winners.

⁵ Levin, Jonathan, and Andrzej Skrzypacz, 2014, 'Are Dynamic Vickrey Auctions Practical?: Properties of the Combinatorial Clock Auction', No. w20487, National Bureau of Economic Research.

⁶ Knapek, Stephan, and Achim Wambach, 2012, 'Strategic complexities in the combinatorial clock auction', No. 3983. CESifo Working Paper: Industrial Organisation.

⁷ Janssen, M. C. W., and Vladimir A. Karamychev, 'Gaming in Combinatorial Clock Auctions', No. TI 13-027/VII. Tinbergen Institute Discussion Paper Series, 2013.

83. For the 3.6GHz award, the demand and valuations of potential bidders are likely to be uncertain, which introduces a material risk that strategic bids placed for the purpose of driving up prices for others become winning bids, preventing a bidder from winning its preferred package. Furthermore, it is also far from clear that bidders would in fact gain any significant benefit from making other winners pay more.
84. In some cases the CCA could allow a bidder to make some supplementary bids that the bidder knows cannot become winning bids (independently of any expectation of others' demands), but that could affect the prices paid by other bidders. For example, with information about aggregate demand in the final clock round, it is straightforward to calculate a 'knockout bid', which guarantees that a bidder will win its final clock package and any other supplementary bids (provided they are not set too high) could not become winning bids. However, this guarantee is typically lost once these other supplementary bids are made above the price of the package at final clock prices. Furthermore, such supplementary bids are in any case always constrained by the final price cap and by the revealed preference constraints from each clock round in which the bidder dropped eligibility. Therefore, in a CCA, a single bidder's ability to influence prices paid by others would be rather limited, unless the bidder had deliberately made strategic clock round bids to artificially 'loosen' its revealed preference constraints in the supplementary round (which is a point made in the academic literature).
85. However, such a strategy of distorting clock bids to slacken the constraints on supplementary bids to permit price-driving bids is risky. It may compromise the bidder's ability to win its desired package (e.g. the clock phase may end unexpectedly, leaving the bidder with an undesired package as its final clock package which could be difficult to then

'unwin' in the supplementary round). Examples of strategies in which distorted clock bids permit price driving in general rely on unrealistic assumptions about the information that one bidder has about the likely valuations and bidding strategy of other bidders. In practice, lack of information is a significant impediment to such strategies, which may run a risk of eventually winning a package that is not a preferred outcome for an uncertainty (and likely modest) benefit in making other winners pay more.

86. On this basis, we consider the scope for and likelihood of price driving in the 3.6GHz auction to be limited. Furthermore, since opportunities for price driving are not specific to the CCA (and in particular are also possible with the SMRA), we do not see any need to change our recommendations on auction format for this reason.

...a single 25 MHz frequency-specific lot be adopted for frequency 3410 MHz – 3435 MHz;

87. Many respondents did not express an opinion in relation to this question.
88. Eircom, Vodafone and Viatel agree with the proposal for a 25MHz lot. However, Viatel agrees only if State use is to continue in the band and would like to see ComReg questioning its continued use. Vodafone notes that including a 25MHz lot adds to auction complexity and that it is unclear how it affects the assignment round.
89. On the other hand, 3IHL and Imagine express a preference for awarding all spectrum as 5MHz lots. Imagine does not justify this, while 3IHL argues that grouping spectrum together into a single 25MHz lot reduces flexibility unnecessarily, because any aggregation issues can be resolved in the assignment round. 3IHL also suggests

moving existing users in order to make all available spectrum contiguous.

Analysis and recommendations

90. We understand that relocation of the State services is unlikely to be feasible within a reasonable timescale. If it were possible for existing users to relocate, such that all available spectrum formed a contiguous block, then auctioning all spectrum as 5MHz lots in a single category would be optimal.
91. Assuming that existing users do not relocate, the 25MHz lot would be offered as a frequency-specific lot within each region and therefore would not affect the assignment round, which has the only purpose of assigning frequencies that correspond to generic 5MHz lots won in the principal stage.
92. Without existing users relocating, it is incorrect to assert that the 25MHz lot limits flexibility “unnecessarily”. Under the demand assumptions that we understand to be plausible, assigning all spectrum as 5MHz lots could favour some bidders over others. For example, suppose Bidder A has a relatively high valuation for 50MHz of contiguous spectrum as opposed to two non-contiguous 25MHz blocks, whereas Bidder B is not averse to receiving a non-contiguous assignment of two 25MHz blocks. By offering 70 5MHz lots we cannot guarantee that winning bidders will receive a contiguous assignment (for example, if all winners win six lots or more each, it is impossible to award a contiguous assignment to all bidders). This uncertainty would affect Bidder A but not Bidder B, thereby placing Bidder A at a disadvantage. On the other hand, offering the 25MHz lot separately allows Bidder A the option to bid only for 5MHz lots in the upper part of the band, with a guarantee that any

winning assignment will be contiguous, while Bidder B may opt to bid on the 25MHz lot if this is cheaper.

93. It would be possible to award all spectrum as 5MHz lots with separate lot categories for the upper and lower parts of the band, but given that it seems unlikely that any bidders would be interested in receiving an assignment with a contiguous block smaller than 20MHz, it is unlikely that multiple bidders would efficiently be accommodated within the lower part of the band. Therefore, it is preferable to define a single 25MHz lot in order to simplify the auction process and preclude inefficient outcomes.

...Sixty five (65) frequency-generic lots of 5 MHz each should be adopted for frequencies between 3475 MHz – 3800 MHz;

94. Several respondents agree with the use of 5MHz lots (Aptus, Digital Forge, Viatel, Vodafone, 3IHL⁸, Imagine), but some express a preference for larger lot sizes. Eircom believes that ComReg should consider 20MHz lots as this size is likely to be closer to users' minimum requirement. Ripplecom also favours 20MHz. Imagine notes that 20MHz would be preferable, but 5MHz lots are necessary "to ensure that it is possible to assign the entire band with no unused 5MHz blocks". Eurona believes that block sizes should be no less than 50MHz.

⁸ Though 3IHL argued for all spectrum to be awarded as 5MHz lots, as explained above.

Analysis and recommendations

95. We acknowledge that some bidders may have a minimum requirement greater than 5MHz (e.g. 20MHz or 50MHz). However, the CCA does not expose bidders to any risk of winning fewer lots than required (aggregation risk), so there is no potential benefit from increasing the lot size, other than a modest simplification in terms of a lower number of available lots and a lower number of possible packages, which does not appear to be the justification offered by respondents. In fact, since the spectrum in the upper part of the band is not divisible by 20MHz or 50MHz, it is not guaranteed that larger lot sizes would simplify the process overall (e.g. a separate lot category would likely be needed for a residual lot of a different size).
96. While offering very limited potential benefits, using larger lot sizes would have significant potential downsides. It would limit the flexibility that bidders have in expressing demand for precise quantities above any minimum requirement and therefore could lead to an inefficient outcome (e.g. with 20MHz lots we may have two bidders winning 40MHz and 60MHz each, whereas the efficient outcome would have been to assign 50MHz to each bidder). The risk of unsold spectrum also increases when bidders can only express demand in relatively large 'steps'.
97. Therefore, we recommend maintaining the 5MHz lot size in the upper part of the band.

...a competition cap should be set and, further, that such a cap be within the range of 150 MHz to 250 MHz. ComReg is mindful of the alternative uses to which this spectrum can be put and the potential impacts this can have on competitive dynamics in the relevant market concerned (for

example fixed of mobile). Accordingly, ComReg welcomes input on any other factors which should be taken into account when establishing the level of any competition cap;

98. Among those who express a view on the size of the competition cap there are various preferences.
99. Several respondents favoured a 100MHz competition cap (Aptus, Premier Broadband, the joint response from 4 operators, Digital Forge, Eurona, KerNet Broadband, Ripplecom, BBnet, Airwave). Viatel favours a 150MHz competition cap. Eircom favours a competition cap in the range 150MHz – 200MHz. 3IHL believes the competition cap should not be set below 150MHz. Imagine believes that a competition cap of at least 160MHz is required.⁹ In summary, no respondents specifically favour a competition cap of over 200MHz, some respondents would accept a competition cap at or close to the lower bound proposed by ComReg (150MHz) and some respondents favour a competition cap smaller than 150MHz.
100. With regard to input on the specific factors that should be taken into account, respondents discussed several points.
101. ***The number of possible winners:***
Eircom does not favour a 250MHz competition cap as it potentially allows only two winners and potentially an asymmetric outcome. Viatel argues that allowing at least three operators is essential. Aptus argues that a 100MHz competition cap has the benefit of allowing four competitors serving rural areas and Eurona notes that it avoids the possibility of having only two operators (assuming no unsold spectrum). Airwave suggests that ComReg should make

⁹ Consistent with its recommendation to award a 160MHz licence administratively.

efforts to ensure there are at least two operators (specifically, FWA operators) in each area.

102. ***Allowing bidders to express reasonable demand:***

Imagine makes clear that it believes some plausible business cases benefit from large amounts of spectrum (160MHz).

3IHL believes that the competition cap "should be large enough to ensure that no valid application or type of use is eliminated" (at least 150MHz).

103. ***Spectrum hoarding and under-utilisation:***

Imagine argues that fixed line operators may have incentives to hoard spectrum in order to restrict competition in the "fixed line NGA market", so ComReg should impose caps specifically on existing fixed NGA providers. Proponents of the 100MHz cap argue that this tighter cap is necessary to prevent spectrum hoarding and under-utilisation, which may otherwise be facilitated by a loose cap and weak rollout obligations.

104. ***Existing spectrum holdings:***

Vodafone disagrees that competition caps for this band can be assessed separately to mobile assignments and believes that existing holdings across all bands should be taken into account when setting caps.

105. ***Gaming in the auction:***

Vodafone believes that loose competition caps could be conducive to strategic bidding, "to raise the price for other bidders without the intention of securing spectrum".

106. Finally, some respondents also proposed that the competition cap might only apply for a limited time period. Ripplecom and BBnet propose that a 100MHz cap could apply for the first two or three years and it could then be relaxed, allowing the operator to obtain further spectrum, if certain criteria has been met (e.g. number of subscribers).

Analysis and recommendations

107. Our view is that a 150MHz competition cap may be the most appropriate choice in light of the variety of views expressed by respondents.

108. The relationship between the competition cap, the possible number of winning bidders and the expression of reasonable demand was set out in our earlier report. A 150MHz competition cap would ensure a minimum of three winners (assuming no unsold lots) who win at least 50MHz each. Alternatively, the 100MHz competition cap proposed by some respondents would ensure a minimum of four winners (assuming no unsold lots) who win at least 50MHz each, but the tighter cap would restrict the range of demand that can be expressed. A 160MHz competition cap would ensure a minimum of three winners who win at least 30MHz each, but it has the disadvantage that it allows two winners to win a total of 320MHz above state services, leaving a single residual 5MHz lot that is unlikely to be desirable for any bidder.

- Any choice in relation to 'reasonable' expressions of demand requires a view of plausible demand structures. Responses by 3IHL and Imagine support the idea that reasonable uses could benefit from significantly more than 100MHz. On the other hand, many other responses effectively imply that those respondents would be happy to seek only 100MHz or less.
- Any choice in relation to the desirable number of winners is a policy choice that depends on a view being taken about the competitiveness of downstream markets on a prospective basis. A reasonable view may be that ensuring a minimum of three winners is

sufficient, particularly if this reduces risks of suppressing reasonable expressions of demand.

109. With regard to the possibility of spectrum hoarding, Imagine's argument seems to be based on a "worst possible outcome" where eircom wins more than 250MHz and does not use (or under-utilises) the spectrum, avoiding cannibalising revenue from its own fixed line services and preventing any competition from FWA operators, which would require at least 100MHz. We note that this outcome can be disregarded as it would not be possible even if ComReg's proposed upper bound for the cap (250MHz) were adopted.

110. In general, concerns about spectrum hoarding and under-utilisation relate to the alleged possibility that larger bidders (e.g. MNOs and/or fixed line NGA providers) could win the maximum permitted amount of spectrum, at least partly with the motivation of preventing potential competitors (smaller FWA operators) from winning. If this were seen as a genuine concern, it could constitute an argument for tighter competition caps in order to increase the minimum number of winners, although we note that appropriate rollout obligations would seem to be a more direct and effective way of dealing with spectrum hoarding concerns. For example, three large spectrum-hoarding bidders could theoretically win all of the available spectrum with a 150MHz competition cap, but with a 100MHz cap they would still leave at least a residual 50MHz for other bidders. However, with a 150MHz competition cap, any anti-competitive spectrum hoarding by a single bidder would still leave 200MHz for other bidders. Therefore, substantial detrimental effects on competition from spectrum hoarding may only be plausible when multiple large bidders behave in this way.

111. We do not agree with Vodafone's view that it is necessary to take into account existing spectrum holdings. Unlike other

bands that have previously been awarded, 3.6GHz spectrum is not a core mobile band and under a 150MHz competition cap there is no reason why any particular outcome should cause a material distortion in the downstream mobile market, as any 3.6GHz spectrum that is used to provide mobile services could only be used to deliver incremental improvements to existing mobile networks. Therefore, there is no justification for imposing bidder-specific competition caps based on existing holdings.

112. With regard to Vodafone's comments about price driving, it is true that if the auction were conducive to price driving then allowing relatively loose competition caps might increase the scope for price-driving strategies. However, we have argued above that concerns about price driving appear to be overstated. In any case, since we propose a competition cap at the lower bound of the range initially proposed by ComReg, it is unlikely that the competition cap would be excessively loose in any sense intended by Vodafone.

113. We do not agree with proposals for a competition cap that would vary over time or only apply for a limited period of time, in a pre-determined way. These proposals envisage operators potentially being able to acquire additional spectrum, beyond the cap that applied to the auction, after a period of time. However, this would only be possible if there happened to be unsold lots from the auction that could subsequently be awarded, or alternatively if some spectrum had deliberately been set aside for the purpose of being awarded subsequently. In either case, this approach would introduce substantial uncertainty and would entail additional complexity in this award that could not feasibly be dealt with at this stage in its planning. With the first option, the outcome of the auction (in terms of unsold lots) is uncertain; bidders would therefore bid in the auction not knowing if

and how much additional spectrum may be available to them 2 or 3 years later. With the second variant, the decision of how much spectrum should appropriately be set aside would be uncertain and any winning bidders may still not be sure about how much additional spectrum they could obtain later (depending on how the subsequent award process would work). For the avoidance of doubt, we understand that in the event that there is unsold spectrum, then ComReg may or may not decide at some point in the future that additional spectrum could be awarded to operators that would give them total holdings in the 3.6GHz band that exceed the cap set for this auction. Any such decision would be based on a view of how the market is developing.