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Economic Consultant's Report

Issues relating to the award of spectrum in multiple bands in Ireland

Prepared for ComReg by DotEcon (Non-confidential version)

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A report for ComReg

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1 Introduction

1.1 Background

1. In June 2009, DotEcon was engaged by ComReg to advise on a number of aspects of a potential award of liberalised 900MHz and 1800MHz spectrum. By this time, ComReg had already consulted on a number of issues relating to this award (in ComReg consultations 08/57 and 09/14). ComReg published a report presenting our findings (09/99c) in December 2009 alongside its own related response to consultation and further consultation (09/99). In that report, we considered that there was no great need to award liberalised 1800MHz spectrum, but we made a number of recommendations for the design of an award of 900MHz spectrum, including recommendations on an auction format, minimum licence fees and licence conditions.

2. Following that December 2009 report, greater certainty has emerged regarding the timing of 800MHz spectrum availability. As a result, we subsequently considered the case for auctioning 800MHz spectrum in a unified process with 900MHz spectrum and the implications of such an award process. Our assessment and recommendations were published in two separate documents, one on the update of our recommendation on minimum fees (10/71b) and the other covering all other aspects of the proposed joint award (10/71a); these were published alongside ComReg's consultation (10/71) in September 2010.

3. Shortly after this, in December 2010, a further report from DotEcon (10/105a) was published alongside ComReg's own consultation (10/105). This considered aspects of the proposed award process arising from the potential inclusion of 1800MHz spectrum in the planned joint award of 800MHz and 900MHz spectrum.

4. Throughout the process, stakeholders have responded to each of ComReg's consultations on issues relating both to our assessment and recommendations and to ComReg's proposals.

5. In this current report, we review a number of aspects of the spectrum auction proposed in Ireland for the award of spectrum in the 800MHz, 900MHz and 1800MHz bands until 2030. In particular, we:

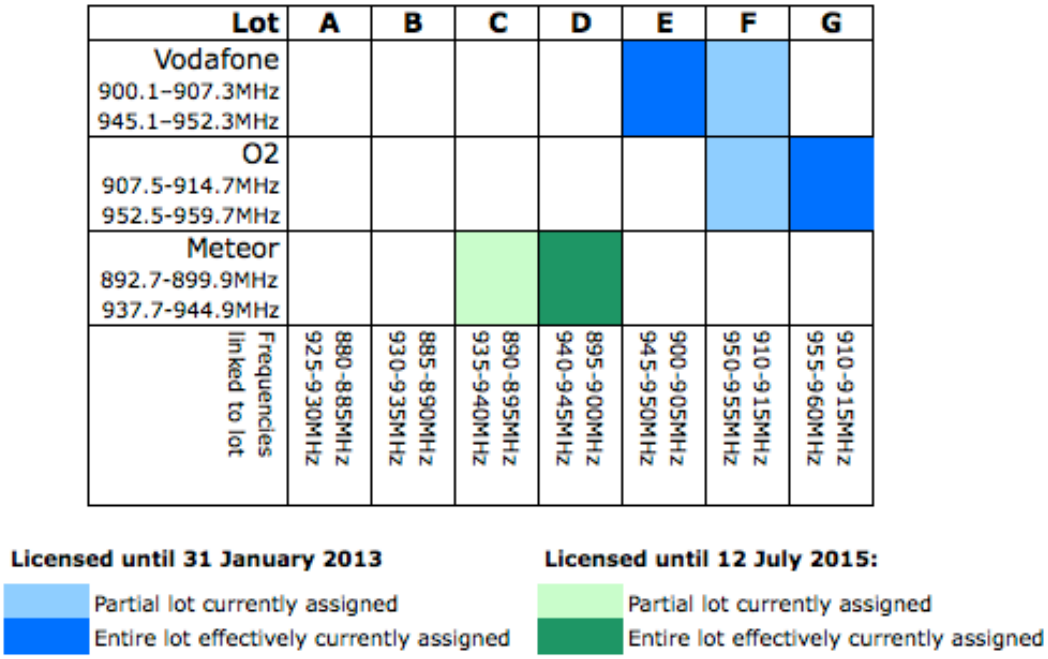
   - Summarise relevant background issues, our previously stated views and the related proposals where relevant;
   - Consider any relevant views expressed by stakeholders in their responses to the various reports that have developed these proposals; and
   - Consider whether these views have been adequately taken into account in the design of the proposed award process, or otherwise consider whether there is a reasonable case for modification of the process in some way.

6. By way of background, in this section we start by setting out an overview of the spectrum bands considered in this report.

1.2 The 900MHz band

7. The 900MHz band contains 2x35MHz of paired spectrum (880-915MHz paired with 925-960MHz). At present, there are three mobile network operators with spectrum licences within the 900MHz band: O2, Vodafone and Meteor. Each existing licence relating to this band provides rights of use for 2x7.2MHz of 900MHz spectrum for providing GSM services only. Frequencies linked to existing licences are at the upper end of the band with separations of 200kHz between adjacent licences. As illustrated in Figure 1, there is 2x13.4MHz of spectrum in the 900MHz band that is currently unassigned. Of this, 2x12.7MHz forms a contiguous block of currently unallocated spectrum at the lower end of the band.

Figure 1: 900MHz band



8. O2 and Vodafone's original licences expired in May 2011. They were issued interim licences (under SI 189 of 2011) that expire no later than 31 January 2013, assuming no advanced commencement of liberalised 900MHz licences, and coinciding with the intended commencement date of licences for 800MHz spectrum (considered in more detail in the following sub-section). Meteor's existing licence covering frequencies in this band expires in July 2015.

9. The superior propagation characteristics of sub-1GHz spectrum has the potential to create significant cost savings for operators in providing advanced data services by providing such services using fewer, larger cells in rural areas than where these services were to be provided using higher frequency spectrum. A study of these efficiencies commissioned by ComReg concluded that the cost savings to be gained by an operator using 900MHz spectrum are estimated to be 26% when compared to 1800MHz spectrum, and 35% when

compared to 2.1GHz spectrum (with which 3G services are currently being provided).[1]

10. Note that the supply of spectrum in the 900MHz band is limited compared with the likely future requirements of operators. Therefore, in the long run, it may be necessary to use the 900MHz band alongside other spectrum below 1GHz to most effectively make use of the known efficiencies of operating 3G or more advanced technologies at these frequencies.[2]

1.3 The 800MHz band

11. In July 2010, the Minister for Communications, Energy and Natural Resources provided greater certainty regarding the availability of 800MHz spectrum, announcing that this spectrum will be available following switch off of analogue TV broadcasting at the end of 2012.[3]

12. Spectrum in the 800MHz band is intended to become available from a common date of 31 January 2013. The 800 MHz band would be made available in compliance with the EC Decision[4] on the 800 MHz band. It is our understanding that relative to spectrum within the middle of the band (lots C and D), spectrum at the top and bottom of the band (lots A and B and lots E and F respectively) would not be subject to any additional restrictions due to neighbouring use other than compliance with the conditions set out in the EC Decision. Therefore, for the purposes of an award process, all of the 800MHz spectrum could be treated as homogeneous.

13. The preferred CEPT plan for the 2x30MHz of 800MHz spectrum (spectrum to be made available in the 790-862MHz frequency range) envisages paired use of this spectrum, packaged as six blocks of 2x5MHz (791-821MHz paired with 832-862MHz as illustrated in Figure 2) with fixed duplex separations and a centre gap of 11MHz. While CEPT has considered a number of other options including mixed use and unpaired use only, because of the relatively limited amount of spectrum in this band, mixed paired/unpaired use is not envisaged; the guard blocks that this would require between paired and unpaired users would be large as a proportion of the available spectrum and so unlikely to be economically efficient.

[1] ComReg (July 2008), "Liberalising the use of the 900MHz and 1800MHz spectrum bands", ComReg Consultation 08/57.

[2] The rationale for including 800MHz spectrum in a unified award process with 900MHz spectrum is set out in detail in DotEcon report 10/71a and ComReg's report on the same subject (10/71).

[3] See ComReg document 10/59.

[4] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:117:0095:0101:EN:PDF

Figure 2: 800MHz band

Lot	A	B	C	D	E	F
Frequencies linked to lot	791-796MHz 832-837MHz	796-801MHz 837-842MHz	801-806MHz 842-847MHz	806-811MHz 847-852MHz	811-816MHz 852-857MHz	816-821MHz 857-862MHz

14. The propagation characteristics and technical restrictions in the 800MHz band are very similar to those of 900MHz spectrum. Similarly, spectrum in these bands is ideally packaged into lots of equal size.

1.4 The 1800MHz band

15. Where 800MHz and 900MHz spectrum might be allocated in a unified award process, it is necessary to consider the issue of whether 1800MHz spectrum might usefully be included in this award process. This is considered in detail in Section 2**.**

16. The 1800MHz band consists of 2x75MHz of spectrum, 1710–1785MHz paired with 1805–1880MHz. At present, there are three spectrum assignments of 2x14.4MHz each in this band. Given their respective locations within the band, 2x26.4MHz of the 2x31.8MHz of 1800MHz spectrum that is currently unassigned is in one contiguous block at the lower end of the band (see Figure 3).

Figure 3: 1800MHz band

Lot	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Vodafone 1736.3-1750.7MHz 1831.3-1845.7MHz															
O2 1750.9-1765.3MHz 1845.9-1860.3MHz															
Meteor 1765.5-1779.9MHz 1860.5-1874.9MHz															
Frequencies linked to lot	1710-1715MHz 1805-1810MHz	1715-1720MHz 1810-1815MHz	1720-1725MHz 1815-1820MHz	1725-1730MHz 1820-1825MHz	1730-1735MHz 1825-1830MHz	1735-1740MHz 1830-1835MHz	1740-1745MHz 1835-1840MHz	1745-1750MHz 1840-1845MHz	1750-1755MHz 1845-1850MHz	1755-1760MHz 1850-1855MHz	1760-1765MHz 1855-1860MHz	1765-1770MHz 1860-1865MHz	1770-1775MHz 1865-1870MHz	1775-1780MHz 1870-1875MHz	1780-1785MHz 1875-1880MHz

Licensed until 31 December 2014
Partial lot currently assigned
Entire lot currently assigned

Licensed until 12 July 2015:
Partial lot currently assigned
Entire lot currently assigned

17. Vodafone and O2's licences are due to expire on 31 December 2014, while Meteor's licence is due to expire approximately 6 months later on 12 July 2015. These similar, but non-identical, expiry dates of the incumbents' licences could

present complications for packaging spectrum in the 1800MHz band, regardless of whether this spectrum is allocated as part of a sub-1GHz award process. This issue is considered further in Section 8**.**

1.5 Structure of this document

18. We first consider issues related to how spectrum is made available including:

    a) what spectrum should be included in the proposed award;

    b) what spectrum caps should be applied for such an award; and

    c) what policy ComReg might adopt if certain conditions were to arise as part of the award process.

19. We then consider details of the award itself. We note the agreement of stakeholders with:

    a) the use of the combinatorial clock auction format; and

    b) use of the relative cap activity rule.

20. We consider integration of an early liberalisation option for existing spectrum licensees in the 900MHz and 1800MHz bands and inclusion of all spectrum in the relevant bands in the process of assigning frequencies to licensees. Finally, we consider the details of licences allocated to bidders in the proposed award process, specifically, how spectrum sharing would be incorporated into the auction design were this permitted, licence conditions and issues relating to the payment of fees linked to such licences.

21. The views of respondents on aspects of the current proposals are presented in the respective Annexes. A summary of responses to each aspect of the proposed award process is incorporated into the relevant sections of the report.

22. DotEcon has had access to an advanced draft of a number of sections of ComReg's response to consultation and further consultation (published alongside this report as ComReg document 11/60). However, the views expressed in this report are those of DotEcon only and do not necessarily represent the views of ComReg.

PART A: COMPETITION ISSUES

2 Spectrum to be included in the award

23. In this section, we first briefly describe the likely requirement for both low and high frequency spectrum (explained below) for operating an efficient mobile network. We then consider the rationale for multi-band awards. Following this, we reflect our views to date on, first, the case for inclusion of 800MHz spectrum in the proposed 900MHz auction and, second, the inclusion of 1800MHz spectrum in the proposed sub-1GHz award. We consider the views of respondents on these possibilities. We then state our recommendation given these responses.

2.1 Background

24. For the provision of mobile wireless communications services, an operator would ideally have a mix of low and high frequency spectrum for providing its services in a cost-effective manner:

- Owing to the relatively greater distances that low frequency spectrum (below 1GHz) propagates, and the greater ability of such frequencies to penetrate solid objects and to provide in-building coverage, these frequencies would be used to provide widespread network coverage.
- This would be supplemented by high frequency spectrum (above 1GHz) in areas with relatively high population density, providing capacity to carry the high levels of traffic that may be demanded in such areas. In this case, the relatively inferior propagation of higher frequencies could be helpful in limiting cell radii and allowing more rapid frequency re-use.

25. Within the category of 'low frequency spectrum', at present there are two bands that have the technical characteristics to fulfil the role of such spectrum in providing wireless communications services and are harmonised at an EU level for use in the provision of such services (with the resulting benefits of equipment availability for these frequency bands):

- The 800MHz band; and
- The 900MHz band.

26. Within the category of 'high frequency spectrum', at present there are three bands that have the technical characteristics to fulfil the role of such spectrum and are harmonised within the EU:

- The 1800MHz band;[5]
- The 2.1GHz band; and
- The 2.6GHz band.

[5] Note that mobile services have been successfully deployed on a national basis using only spectrum in this band. For example, the UK's largest mobile operator, EverythingEverywhere (a merger between T-Mobile and Orange) operates using predominantly spectrum in the 1800MHz band and does not at present hold usage rights for any sub-1GHz spectrum.

27. Of these various bands, spectrum in Ireland is, or is due to, become available for award with a high degree of certainty in the foreseeable future in three specific bands: 800MHz, 900MHz and 1800MHz. It is therefore necessary to assess what relationship there might be between the demand of operators, both existing and potential, for spectrum in one of these bands and their demand for spectrum in other bands, as this may affect the efficiency of the allocation of spectrum in these bands.

2.2 Rationale for multi-band awards

28. A unified award process is likely to lead to more efficient allocation of spectrum where an operator's valuation of spectrum in one band depends on what spectrum it holds, or expects to win, in another band. There are two forms that these valuation linkages could take:

- *Substitutability:* Spectrum in different bands may be substitutable from the perspective of an operator if it can use either band for provision of services to customers. This does not preclude the possibility that there may be differences between the bands in how effective or cost-efficient they are for providing particular services (i.e. substitutability is imperfect). An example is the use of spectrum at different frequencies having a common role in providing capacity.
- *Complementarity:* Spectrum in different bands may be complementary from the perspective of an operator if it can use spectrum in these different bands together to provide services more effectively or at lower cost than with just one band. An example is the use of low frequency together with high frequency spectrum to provide coverage with capacity in high demand areas.

29. It is entirely possible that spectrum in two bands might be substitutes for some users yet complements for other users. Also, the situation may depend on how much spectrum in each band is acquired. For instance, any spectrum might do to add capacity if there is no other economic alternative, yet cost-effective deployment may require a mix of spectrum in different bands.

30. In the case where spectrum in different bands is either substitutable or complementary, the demand for spectrum in a particular band (and the value placed on this spectrum) may be affected by the availability and price of spectrum in other bands. As a result, whether such spectrum is awarded in a unified or multiple consecutive processes may affect the efficiency of the allocation of spectrum across interested parties.

31. In a unified multi-round award process, bidders can observe the relative prices of spectrum in different bands and adapt their valuations and consequent demand for spectrum across those bands in response to these emerging relative prices. In contrast, where substitutable or complementary spectrum is awarded in multiple, unlinked and consecutive award processes, operators' valuations of spectrum in different bands will necessarily be based on the *expected* price of substitutable and complementary spectrum to be awarded in subsequent processes, rather than the actual price. However, bidders will very likely be incorrect in their expected relative valuations, and as a result may lead to an inefficient allocation of spectrum.

32. In situations where no substitutability or complementarity exists between spectrum in particular bands, there is no potential benefit lost by awarding them in consecutive awards, as the bands become available. Clearly, if spectrum in different bands is unrelated, then it becomes possible to use simpler award processes. However, equally there is little cost to linking the awards provided this does not create unnecessary or disproportionate delay.

2.3 DotEcon's stated views and recommendations to date

33. In its previous reports, DotEcon has considered the substitutability and complementarity across various bands and whether this gives rise to efficiency benefits in combining various bands in a unified award. Our conclusion throughout has been that there are likely to be such benefits and that these outweigh any increase in the complexity of the award.

34. In its first report for ComReg on the liberalisation of spectrum in the 900MHz and 1800MHz bands (published in December 2009 by ComReg as document 09/99c), DotEcon expressed the following views on the substitutability and complementarity of spectrum in the 800MHz and 900MHz bands and of low frequency spectrum and 1800MHz frequencies:

- **800MHz and 900MHz spectrum**
  - For mobile network operators, spectrum in the 800MHz band is potentially a close substitute to 900MHz spectrum. The 800MHz band has similar propagation characteristics to 900MHz spectrum, both bands being located at frequencies suitable for wide-area and in-building coverage. For operators, the key difference between 800MHz and 900MHz spectrum in the short run is timing and likely equipment availability; in the long-term this point of differentiation between 800MHz and 900MHz spectrum is likely to diminish in importance.
  - Efficient deployment of higher bandwidth data services will require access to wider contiguous blocks of spectrum in the long run. Using the 800MHz band and the 900MHz band together would allow access to larger blocks of contiguous spectrum whilst facilitating competition amongst operators, as all would have similar access to the most efficient radio technologies.
  - It is likely that the 900MHz and 800MHz bands could, in the long-run, need to be considered together if operators are to hold sufficient amounts of spectrum to allow deployment of high-bandwidth, high-coverage services. Therefore, these bands are likely to become closer substitutes in the long run.
- **Low frequency (800MHz, 900MHz) and 1800MHz spectrum**
  - 1800MHz spectrum has propagation characteristics that make it a potential complement to 900MHz (and also 800MHz) spectrum for an operator trying to deploy a mobile service cost-effectively. It can be used to fill in with additional capacity whilst low frequencies with longer propagation are used to provide coverage.
  - 1800MHz spectrum could equally be considered as a substitute to lower frequency spectrum if the latter is not available in sufficient

quantity or commands a price premium. For example, there are a number of operators in other countries that use spectrum solely in the 1800MHz band for their GSM operations (e.g. Orange in the UK, now merged with T-Mobile and branded as EverythingEverywhere).

35. Following the emergence of new information on the availability of 800MHz spectrum from early 2013, in that second report (10/71a) we considered the details of an award process for liberalised spectrum in the 900MHz and other bands in light of the new situation for 800MHz spectrum. The second report also considers the responses received to ComReg consultation 09/99. This report (10/71a) set out the general merits and drawbacks of award processes such as auctions:

- *Valuation linkages across bands:* Spectrum in different bands is becoming more substitutable given developments in recent years – increased adoption of a service- and technology-neutral approach to licensing, increased band harmonisation, increased equipment availability for providing similar services in different bands, etc. Operators therefore face a large number of possible combinations of spectrum in different bands that might be used for providing services. Operators may view spectrum in different bands as complementary, substitutable in general or substitutable beyond a given minimum spectrum portfolio (substitutable at the margin).
- *Inefficiency in sequential processes:* The optimal choice of spectrum that an operator might wish to hold may be affected by the relative prices of spectrum in different bands. Therefore, operators would benefit from being able to make their choice between different combinations of spectrum in a unified, multi-round process, as these choices would be based on actual relative prices (as opposed to expected relative prices upon which bidders make these choices in sequential processes). This promotes greater efficiency of the award outcome.
- *Flexible mix of spectrum across bands:* There is a high level of uncertainty surrounding the structure of demand by bidders in the award. In addition to the use of a unified process to award the spectrum in question, it is important that bidders be permitted to express their value for the maximum number of alternative combinations of spectrum that they would have value in being awarded. This would in turn ensure that the winning allocation of spectrum is as efficient as possible.
- *Facilitation of entry:* A joint award of 800MHz and 900MHz spectrum would increase the possibility that there would be entry into the market on account of the increased probability that such an entrant might be awarded sub-1GHz spectrum given the increased supply of such spectrum.
- *Cementing of downstream outcomes:* It is possible that where 800MHz and 900MHz spectrum are awarded together, this may represent the last

opportunity to gain access to sub-1GHz spectrum for some time.[6] However, this is not a negative consequence of a unified award per se, as 800MHz spectrum would need to be awarded in the near term anyway, and awarding this spectrum in a separate award somewhat later has its own negative consequences.

- *Complexity:* For the use of a unified award process to be beneficial, one would need to allow switching between different types of spectrum. In addition, a greater supply of spectrum would mean a greater number of combinations of lots that a bidder might choose to bid for. This complexity is the downside to providing greater flexibility.

36. DotEcon report 10/71a also re-iterated the points made in 09/99c on the substitutability and complementarity across spectrum in the 800MHz and 900MHz and 1800MHz bands, in addition noting that:

- **800MHz and 900MHz spectrum**
  - The 800MHz band is fast becoming harmonised across the EU for the provision of electronic communications services, providing the necessary scale to ensure equipment availability;
  - It is proposed that all spectrum in the 800MHz and 900MHz bands is packaged into lots of the same size in Ireland i.e. 2x5MHz; and
  - From 2015 (at the latest), all spectrum in the 800MHz and 900MHz bands will have similar technical restrictions.
- **Low frequency (800MHz, 900MHz) and 1800MHz spectrum**
  - While low frequency spectrum and high frequency spectrum may not be very close substitutes due to their different radio propagation characteristics, these two different types of spectrum may still be substitutes at the margin for delivering capacity;
  - Where there is availability of substitutable spectrum (or more generally spectrum with any valuation linkage) the economic efficiency of spectrum allocation will be enhanced by using a unified process; and
  - The presence of 1800MHz spectrum in a common award process is likely to have greatest impact on entrants, as an entrant might treat high and low frequency spectrum as complements (i.e. it benefits from a mix) but also substitutes at the margin (i.e. it might make do with more high frequency spectrum even if it ideally would prefer low frequency spectrum).

37. The issues of complementarity of sub-1GHz and 1800MHz spectrum, and the potential substitutability of these types of spectrum at the margin, are reiterated in our most recent report for ComReg on the inclusion of the

[6] Since DotEcon report 10/71a was published in September 2010, the possibility of a second digital dividend has been discussed by ComReg. See section 7.1.5 of ComReg 11/28, "Review of the Period 2008 – 2010 & Proposed Strategy for Managing the Radio Spectrum: 2011 – 2013", found at: http://www.comreg.ie/_fileupload/publications/ComReg1128.pdf

1800MHz band in a joint award of spectrum in the 800MHz and 900MHz bands (published by ComReg as 10/105a alongside its own consultation document on the subject (10/105)). In 10/105a, we note that given these factors, awarding spectrum via a multi-round award process such as an auction and allowing bidders to transfer their bidding across sub-1GHz and 1800MHz frequencies in the open rounds of the auction (subject to certain constraints) as relative prices are revealed should allow for an auction outcome that is at least as efficient, if not more efficient, than that resulting from an auction where such transferability was not permitted. The issue of awarding spectrum via auction as opposed to an administrative assignment is considered in Section 3.

38. Since ComReg published DotEcon's first report in December 2009, a number of other EU Member States have run or are proposing to run processes for awarding spectrum in multiple bands via auction – what have often been called "big auctions". These include:

- Germany, which ran such an auction in May 2010;
- Spain, where a multi-band auction was completed in July 2011;
- The UK, where Ofcom is in the process of consulting on its proposals for an award of spectrum by auction including 800MHz and 2.6GHz spectrum using a combinatorial clock auction; and
- Switzerland, the Netherlands, Portugal and Austria, where plans are also being advanced for the award of spectrum in multiple bands in a unified process.[7]

2.4 Respondents' views

39. ComReg consultations 10/71 and 10/105 sought the views of stakeholders on two separate multi-band proposals:

- The inclusion of 800MHz and 900MHz spectrum in a unified award; and
- The inclusion of 1800MHz frequencies in such an award.

40. These issues were responded to separately by stakeholders, and the views of respondents on these issues are summarised and evaluated separately below.

41. In their responses to ComReg consultation 10/105 stakeholders generally re-iterated their respective positions as expressed in their responses to ComReg consultation 10/71. With specific regard to the inclusion of multiple bands in a unified award process, respondents to 10/105 also mostly referred to their previous submissions, re-iterated some of their key points or clarified their arguments. These views are reflected in the following summary of responses to both consultations.

[7] In addition, Malta proposed an auction as a follow-up alternative where it could not be agreed between operators how to allocate the spectrum available. However, as agreement was reached as to the allocation of available spectrum amongst operators there will not now be an auction in this case. Note that both Switzerland and the Netherlands appear likely to use combinatorial clock auctions.

2.4.1 Inclusion of 800MHz and 900MHz spectrum in a unified award

42. Based on responses to ComReg consultation 10/71, there was strong support for the unified sub-1GHz award proposal; of the 11 respondents to ComReg's direct questions on the potential award of 800MHz and 900MHz frequencies simultaneously, 10 respondents supported a unified award, at least in principle. Many respondents cited reasons for their support that are in line with those originally put forward by DotEcon in its previous reports:

- Spectrum in the 800MHz and 900MHz bands have similar propagation characteristics, and these types of spectrum are substitutes in the medium term; and
- This holistic approach to spectrum management will allow for a more efficient award outcome than where these bands were to be awarded separately.

43. A number of these responses were supportive of the joint award proposal subject to contingencies and provisos:

- The inclusion of 800MHz spectrum in the award should not be allowed to delay the availability or liberalisation of 900MHz spectrum, as such a delay would confer a competitive advantage on the three existing 900MHz operators.
- A multi-band award proposal should be considered in combination with other features of an award process that would ease the transition of operators across licensing periods, for example the use of an auction format using a "relative cap" activity rule, interim licences and flexible transition arrangements.
- Proposals for a multi-band award should include certainty regarding the availability and technical restrictions linked to 800MHz frequencies and licence rights such as spectrum sharing and spectrum pooling.

2.4.2 Inclusion of 1800MHz spectrum in an award of sub-1GHz spectrum

44. ComReg then considered a potential inclusion of 1800MHz spectrum into a unified award process of sub-1GHz spectrum.

45. Of the 11 stakeholders that responded to ComReg consultation 10/71, a total of 9 expressed a view on the inclusion of 1800MHz in the planned sub-1GHz award. Overall, the responses were mixed, with 5 respondents in favour of the inclusion of the 1800MHz band in the auction and 4 against its inclusion.

46. Reasons cited for the inclusion of spectrum in the1800MHz band in a sub-1GHz spectrum award, were that:

- It is a complement to sub-1GHz spectrum;
- Doing so would lead to greater economic efficiency;
- The resulting award would provide the best opportunity for entrants;
- Its inclusion is timely given the emergence of LTE in the 1800MHz band; and
- It would provide certainty for operators in terms of spectrum planning.

47. Of the stakeholders that did not support the inclusion of 1800MHz spectrum in an award of sub-1GHz spectrum (including three of the four existing mobile operators), reasons cited were that:

- Its inclusion might cause a delay to the sub-1GHz award process;
- There has been insufficient demand shown by stakeholders for 1800MHz spectrum; and
- Because of the similar propagation characteristics and thus closer substitutability between 1800MHz and other high frequency spectrum such as that in the 2.6GHz band, 1800MHz spectrum would be more suitably included in a joint award with 2.6GHz spectrum if and when 2.6GHz spectrum becomes available.

2.5 DotEcon commentary

2.5.1 Inclusion of 800MHz and 900MHz spectrum in a unified award

48. Given the benefits of a joint award of spectrum in the 800MHz and 900MHz bands and the wide-ranging support that stakeholders have expressed for their inclusion in a unified process, we consider there is a clear case for a unified award of 800MHz and 900MHz spectrum.

2.5.2 Inclusion of 1800MHz spectrum in an award of sub-1GHz spectrum

49. Addressing first the issue of delay raised by stakeholders, the necessary preparatory steps have been taken to ensure that the inclusion or otherwise of 1800MHz spectrum should not affect the timeline for a sub-1GHz award or indeed the availability of sub-1GHz spectrum. A consultation on the aspects of an award including sub-1GHz and 1800MHz spectrum was published by ComReg in December 2010. In general, many of the aspects of the sub-1GHz spectrum award have been applied consistently to the proposed award of spectrum in the 1800MHz band and as such have not raised issues additional to those being considered in any case as part of the sub-1GHz award consultation process.

50. Further, a significant issue – possibly driving many of the concerns about a potential delay of the sub-1GHz consultation and associated award process – was the imminent expiry of O2 and Vodafone's 900MHz licences. Given the pressing nature of this specific aspect of the award plans under consultation, this issue was taken out of the overall consultation process in order to speed up the resolution of this issue. ComReg has now addressed this issue in its response to consultation (11/29) and its Decision on the matter (D03/11). With the resolution of this issue, a considerable amount of debate surrounding the sub-1GHz award process has been brought to an end.

51. At present, therefore, there is no compelling reason to believe that the inclusion of 1800MHz spectrum in a sub-1GHz award process would cause any delay to the running of this process. Therefore, we believe that the objections to including 1800MHz due to the potential for delay are groundless.

52. Considering then potential demand for 1800MHz spectrum, this spectrum has long been prescribed as a band that could be used for the provision of advanced data services using Long-Term Evolution (LTE) technology once

equipment and devices became available for commercial deployment at these frequencies. ComReg took the view in its first consultation (08/57) on the future use of 900MHz and 1800MHz spectrum in July 2008 that the path to LTE in this band was unclear and, as such, this did not provide sufficient cause for ComReg to make this spectrum available in the near term subject to review in response to market developments.

53. There are two reasons that suggest that this spectrum would be more attractive to operators, existing and prospective, than initially envisaged if awarded for use from early 2013 (that is, simultaneous with the availability of spectrum in the 800MHz band):

- The prospect of entry into the market in Ireland would be less risky where such an entrant could secure all of its spectrum requirements in a unified award process. The use of sub-1GHz spectrum by an operator in providing increasingly fast data services will become more and more important in the coming years. All harmonised sub-1GHz spectrum available for use in providing these services will be made available in a unified process. Therefore, the proposed sub-1GHz spectrum award represents an important opportunity for existing and prospective operators to secure this type of spectrum for the provision of services. Given that 1800MHz spectrum is a complement to sub-1GHz spectrum and a substitute at the margin, the inclusion of this spectrum in the planned sub-1GHz award represents a rare opportunity to secure a combination of spectrum across low and high frequencies that would be sufficient to be an effective competitor within the market. This is in contrast to the case where obtaining the optimal combination of spectrum would be uncertain and might take a number of years owing to the time and effort required to compete in consecutive award processes.
- LTE is fast becoming a reality[8], and so demand for 1800MHz spectrum linked to the opportunity of deploying LTE using this spectrum may now be realised.[9] At the time when ComReg last considered demand for 1800MHz spectrum as part of its assessment on considered it should be included in an award process with 900MHz spectrum only (09/99), it was not clear when equipment for LTE in the band would become available. While a number of trials of LTE in this band were beginning to take place,

[8] In July 2011, the Global mobile Suppliers Association (GSA) reported that 24 operators have commercially launched LTE networks, in Austria, Denmark, Estonia, Finland, Germany, Hong Kong, Japan, Lithuania, Norway, Philippines, Poland, Singapore, South Korea, Sweden, USA, and Uzbekistan. Further, it anticipates that at least 91 LTE networks will be in commercial service by the end of 2012.

[9] Operators around the world have been trialling LTE in the 1800 MHz band, and there have been early LTE 1800 commercial launches in Germany, Lithuania, Poland and Singapore (source: GSA, July 2011). Australian incumbent Telstra has also announced it will launch LTE 1800 in cities later this year. Deutsche Telekom and France Telecom have joined together with TeliaSonera to nominate 1800MHz as their frequency of choice for rolling out LTE networks. Speaking at the LTE World Summit, executives from the operators called on vendors to develop devices for the band (source: http://www.telecoms.com/27870/european-giants-call-for-1800mhz-device-support-for-lte/, 18 May 2011).

this was on a limited basis, and handsets were not yet available. Since then, the market for LTE equipment and LTE-capable user devices in bands including the 1800MHz band has been growing rapidly to meet current and anticipated needs of operators and their customers.

54. For these reasons, it is reasonable to consider that demand for spectrum in the 1800MHz band has increased since ComReg's previous enquiry into the demand for allocating this spectrum, and that this demand may be higher still where 1800MHz spectrum is awarded alongside sub-1GHz spectrum. While there remains uncertainty as to the actual level of demand for 1800MHz spectrum, it is not necessary to know this with a high degree of certainty. Given the potential for there to be demand for this spectrum, and the benefits that would result if it were awarded to bidders that rolled out LTE using these frequencies, we recommend that this spectrum should be made available for award as part of the planned sub-1GHz spectrum award.

55. In any case, ComReg is proposing to set a minimum price for this spectrum that takes into account a conservative lower bound estimate of the market value of such spectrum (see DotEcon benchmarking report published as ComReg document 11/59 for our analysis and recommendation on this minimum price). As such, there would not necessarily be any risk of inefficiency associated with the award of part, but not all, of the spectrum in this band in the award process if the demand for this spectrum can be met by supply. Spectrum would simply be retained by the State and could be reallocated at some later date as circumstances suggested.

56. Turning then to the case for a joint award of 1800MHz and 2.6GHz spectrum when the latter becomes available on the basis of these bands being substitutes, we note that substitutability is not the sole motivation for a multi-band award process including high and low frequency bands. While 1800MHz spectrum is a substitute for sub-1GHz spectrum only at the margin, its complementarity to sub-1GHz spectrum is a strong driver of the benefits of its inclusion in the planned sub-1GHz award, especially in terms of creating the best possible opportunity for potential entrants.

57. Further, the main proponent of an award of 1800MHz spectrum with 2.6GHz spectrum, O2, has since its response to ComReg consultation noted that substitutable bands should be allocated in the same award process so that bidders can switch between bands as information is revealed about relative prices. It has asserted that under this same reasoning it could be argued that bands that are complementary should also be awarded together. It has also stated that the requirement on operators to take a holistic view when planning spectrum use and when buying spectrum at auction would appear to support the inclusion of the 1800MHz band in a multi-band award with 800MHz and 900MHz spectrum.[10]

58. Finally, as one consultation respondent rightly pointed out, to have two separate award processes, for high and low frequency spectrum in the

[10] O2 response to ComReg consultation 10/105, published in ComReg document 11/10 (February 2011)

proposed case, would result in a significant time lag between awards owing to the resources required to plan and complete an award process. This would mean that a winner of low frequency spectrum in the first award would not have the opportunity to acquire the high frequency spectrum necessary for an optimal network for a significant period of time after this first award. This could discourage a potential entrant from market entry and participation in the award process for sub-1GHz spectrum as it would incur the risk of not being able to obtain high frequency spectrum to complement its sub-1GHz spectrum, and would in any case have to make do with acquiring this spectrum significantly later.[11]

59. Without going into a detailed discussion of the 2.6GHz band, which is not part of this consultation process, it should be noted that the availability of 2.6GHz spectrum is not certain at this point. Spectrum in the 2.6GHz band may not become available before 2019 whereas some unassigned 1800MHz spectrum is available for an immediate award and the full band will be available for assignment from 2015. Therefore, it is unjustifiable on both spectrum efficiency and proportionality grounds to postpone the award of the available 1800MHz spectrum until the 2.6GHz band becomes available, nor does it seem reasonable to award exceptionally short licences for 1800MHz spectrum e.g. only until 2019. Further, this would not encourage efficient investment in networks using 1800MHz spectrum where it is licensed for such a short period.

[11] Note that this risk would not be the same for existing mobile operators, as they each have usage rights for spectrum in the 2.1GHz band.

3 Case for using an auction for the proposed award

60. In this section, we consider the relative merits of using an auction versus using a direct (administrative) assignment for the upcoming award of spectrum usage rights in the 800MHz, 900MHz and 1800MHz frequency bands in Ireland. We begin by outlining the benefits of a competitive process (auction) over a direct assignment of spectrum. There are strong general arguments for the use of auctions.

61. We then consider the specific characteristics of the award process currently planned in Ireland. Within this context, there are particular problems that would likely arise from the use of an administrative award process for spectrum, such as the roll-over of existing licences or liberalisation in the hands of existing licensees.

3.1 General arguments in favour of auctions

62. Because radio spectrum is a public resource, it is important that licences for spectrum usage are awarded in a way that is objective, transparent, non-discriminatory and proportionate while maximising the social value that can be obtained from using the relevant frequencies available. However, where spectrum is scarce, the demands of potential users necessarily conflict, as there are multiple ways of allocating these resources to the interested parties. An administrative allocation of spectrum is always subject to the fundamental limitation that the administrator may have relatively little information about which of these multiple ways of allocating a scarce resource generates greatest social value.

63. In contrast, spectrum auctions are designed to incentivise bidders to express their willingness to pay for spectrum licences, and aim to allocate the licences available to the bidders who value them most. The assumption underpinning the desirability of using an auction for awarding public resources is that the value of the licence to an operator should be a good proxy for the social value from granting the licence to that operator. With effective competition in the downstream market, we would expect the most efficient operator to be able to provide the greatest economic value from using the licence, and in turn generate the greatest profits.[12] Therefore, the outcome of an auction should be reasonably efficient unless downstream competition is significantly imperfect or could become imperfect in certain auction outcomes (e.g. if there is excessively concentrated of spectrum holdings). Clearly, there may still be issues about the relative efficiency of different auction formats for specific applications where demand has particular characteristics.

[12] Where bidders cannot limit competition in the market through their bidding behavior in the auction, any differences in expected profit by different bidders would reflect potential cost savings (that can then be partially passed on to consumers) or quality improvements (which would result in greater gross surplus from the provision of services overall) by the most efficient operators. Thus, greater profit expectations of a bidder from acquiring a given amount of spectrum in the auction should be the result of the bidder's ability to generate a greater social economic value.

64. The main drawback of awarding spectrum using an auction is the possibility that the profit that a bidder can expect from operating a licence does not reflect the social value they may be able to generate. In particular, this is a concern when bidders may be able to limit the number of winners and this has an effect on the level of competition in the downstream market. In these situations, bidders will take account of the profitability of restricting competition when determining how much to bid, whereas a restriction in competition will have a negative impact on social value. For this reason, an important consideration when using an auction for the award of spectrum is what measures may be required for ensuring that bidders are on a level playing field during the bidding process and cannot distort competition in the downstream market. Measures such as spectrum caps or reservations may be sufficient to address such concerns.

65. By contrast, the benefits from using a direct assignment are based on the presumption that the administrative body allocating the relevant spectrum has sufficiently accurate information to allow it to assess which bidder or bidders might generate the greatest social value from using the spectrum. Typically, bidders will need to submit detailed information about their ability to effectively use the licence and their business plans, and the administrative body would then assess the alternative proposals and make a decision as to how to best allocate the spectrum (as in the case of a comparative selection procedure or "beauty contest"). The main limitation of this approach is that it may be difficult for regulators to define objective criteria to distinguish between competing bidders. In many instances, the final decision may require some subjective judgement by the administrative body, which raises issues about non-transparency and may create discontent among applicants.[13] Another disadvantage of administrative awards is that such procedures are vulnerable to bidders exaggerating their business cases in order to increase their chances of being awarded a licence. Administrators are at a fundamental informational disadvantage to applicants and are unable to verify their claims.

66. The lack of information available to the administrator may also lead to biases in the assessment of applications based on historical performance. For example, past performance may be considered to be a good indicator for future performance in the case of existing operators, which might result in a bias in favour of proposals of operators or technologies already established in the market. This would disadvantage applicants whose entry depends on the allocation of the relevant spectrum, or whose business plan is based on novel services. However, in valuing licences, applicants will only consider their expectations of their future performance if they were to win the relevant licences. Further, divergences of past and future performance are more likely to occur at times like the present, where a step change in technologies deployed and the re-optimisation of networks have the potential to redefine

[13] For example, the legal process surrounding the case taken by Orange against the ODTR on a point of law, initially to the High Court and on appeal to the Supreme Court (Orange v ODTR (1998 no. 1216OP), Orange v ODTR (224 & 278/1999 & 14/200) significantly delayed the entry of Meteor into the Irish mobile market.

relative performance of market players who may respond differently to technological and market developments.

67. There are three main reasons why auction processes are typically preferred to direct assignments:

Allocative efficiency

68. The greater the number of applicants and the demand for spectrum usage rights in a band, the greater the potential number of alternative allocations of spectrum licences amongst the interested parties. In the case of a direct assignment, even if applicants are asked to present a business plan for effectively using a licence, the regulator has limited information about the value of the services that each applicant could provide depending on the bandwidth of frequencies assigned to the applicant. Given this limitation, the regulator may be unable to make an accurate assessment of the alternative allocation options, and there is a risk that spectrum will be allocated sub-optimally, both in terms of selection of applicants who are awarded spectrum and in terms of the amount of spectrum awarded to each successful applicant. Therefore, there is a risk that applicants seeking to provide high value services to consumers may be awarded less spectrum than would be efficient (in the extreme, none at all), while applicants with weaker business cases are awarded a licence when this is inefficient.

69. Notice that this is a particular problem where multiple bands are offered which may be substitutes and/or complements. Under these conditions, there may be very many possible configurations in terms of the combination of holdings across different bands that could be offered to spectrum users. The optimal configuration may be highly dependent on the technical and commercial plans of the users, which is typically unknown to the administrator.

70. In contrast, in an auction where the spectrum is offered flexibly in blocks that can be combined into a single licence, bidders are given the opportunity to express the value they place on different amounts of spectrum (which is linked to the value of services that they provide using the licence). The determination of winners in an auction process is based on maximising the value of bids accepted (and which can be accommodated within the lots available). Therefore, provided that the bids received reflect the value that bidders place on the spectrum licences, and that the private value that bidders enjoy from exploiting a licence is a good proxy for the social value they will generate,[14] the selection of winners in an auction will yield an efficient allocation and thus yield the maximum social value from using the licences most effectively. Competition for spectrum reveals information about the relatively most valuable uses that is not available to an administrator allocating spectrum.

[14] As explained above, for a given level of competition, greater profits would result from greater economic value generated from using the licence, reflecting for example efficiency cost savings or greater quality in the provision of services. Therefore, provided that operators are not able to restrict the level of competition in the downstream market through their bids in the auction, this is a reasonable assumption.

Price determination

71. According to the relevant EU telecommunications legislation,[15] where spectrum is scarce, regulators have the discretion to set a price for spectrum licences that ensures an optimal usage of this spectrum. Efficient allocation requires that users pay at least the opportunity cost of the spectrum they hold (i.e. the highest value amongst alternative uses that is precluded). To the extent that a user of spectrum pays less than its opportunity cost, other potential users who do not have access to spectrum (or at least not as much as they would like) will be dissatisfied. Moreover, these excluded users are being treated unfairly by being discriminated against.

72. This raises the issue of what the optimal price of licences should be in a direct assignment. Because the regulator has limited information about the actual value of licences to applicants, it is difficult to set a price that ensures that all applicants are satisfied with the outcome and which ensures that the licences are made available to those applicants who value it the most and therefore ensure its optimal use:

- If the price is set too low, there will be oversubscription for spectrum relative to the amount available, meaning that the regulator will need to make a choice between alternative allocations (with the risk of selecting an inefficient allocation).
- If the price is set too high, demand for licences may be choked off, in which case some spectrum may end up unallocated. In this situation some spectrum could be inefficiently left unused if some potential applicants were willing to acquire a licence at a lower market determined price and use it to provide services to consumers.

73. Where there are multiple spectrum bands that may be substitutes or complements, a further problem arises that the relative prices of different bands may be difficult to determine in a manner that guides potential users to the most appropriate band to make best overall use of the available spectrum. We could end up with oversubscription of some bands at the same time as spectrum in other bands goes unsold.

74. In contrast, when awarding spectrum via auction, prices are determined within the process, increasing until there is no excess demand for the lots offered. The final auction prices are at a level at which winners are willing to acquire the relevant spectrum licences while losers are not willing to acquire this spectrum. In auction formats that are consistent with a second price rule (for example, in combinatorial auction formats that use a second price rule, or in SMRA auctions – where prices stop increasing when the strongest loser stops bidding), auction prices should broadly reflect the opportunity cost of allocating the licences to winners.

[15] Regulation 19(1) of the Authorisation Regulations (S.I. 335 of 2011).

Transparency of the process

75. In administrative processes the regulator may need to make choices, either between alternative allocations or in relation to the prices set for the spectrum licences. These choices can be based on pre-specified scoring rules and methodologies, but will nevertheless require some degree of subjective judgement (either when defining the methodology, or when the selection criteria are not unambiguously defined in the methodology). Even allowing spectrum to continue to be held in the hands of its existing licensees is an implicit judgement that there are no better alternative users.

76. For this reason, direct assignments are acutely vulnerable to criticism, in particular when spectrum is scarce, and raise the potential for grievance on the part of excluded users that are not awarded spectrum (especially where prices are set low and users enjoy substantial windfall gains). Such grievances may result in a legal dispute with detrimental effects for industry development and competition.[16] These problems arise regardless of whether there is an active process of assigning spectrum to a future user, or an implicit assignment in that spectrum is left in the hands of an existing user, for example by rolling over an existing licence.

77. In contrast, auctions can be designed to be completely transparent, reducing the risk of complaints and legal challenge from unsuccessful applicants. Auctions follow mechanical, pre-specified rules given the bids received and do not depend on the exercise of administrative discretion.

3.2 Specific issues for this award

78. There are a number of characteristics in the spectrum award proposed in Ireland that accentuate the potential problems of using a direct assignment. Even assuming there were no new entrants, a direct assignment for the upcoming spectrum award in Ireland might require some or all of:

- Liberalisation in situ for 900MHz incumbents, increasing each of their holdings to 2x10MHz, and awarding 2x5MHz of 900MHz spectrum to H3GI;
- Direct assignment of 800MHz spectrum to these four mobile operators; and
- Direct assignment of 1800MHz spectrum to these same four mobile operators.

Scarcity of sub-1GHz spectrum

79. Because the available spectrum needs to be offered in 2x5MHz blocks for technical reasons, it is not possible to determine a symmetric allocation of sub-

[16] As mentioned in footnote 13, the legal process surrounding the case taken by Orange against the ODTR on a point of law, initially to the High Court and on appeal to the Supreme Court (Orange v ODTR (1998 no. 1216OP), Orange v ODTR (224 & 278/1999 & 14/200) significantly delayed the entry of Meteor into the Irish mobile market.

1GHz spectrum amongst existing mobile operators. Therefore, the outcome of the award will inevitably result in some operators having more sub-1GHz spectrum than others.

80. Sub-1GHz spectrum is particularly valuable to operators, due to superior propagation characteristics that make it particularly suitable for wide-area, rural and in-building coverage. For this reason, the possibility of concluding an administrative assignment where some applicants are granted more sub-1GHz spectrum than others and that is acceptable to all interested parties seems highly unlikely.

Availability of spectrum in multiple bands

81. The current award process makes available a total of 2x140MHz of harmonised spectrum across three different bands. Therefore, the award process represents a one-off opportunity for shaping the future evolution of the mobile market. However, this presents a number of further difficulties for the regulator in determining how to allocate spectrum in a direct assignment, as there is no means to second-guess how bidders may value one mix of spectrum versus another:

- There are both substitutability and complementarity effects between different lots and which may vary across operators. For example, lots of 800MHz and 900MHz spectrum are considered to be substitutes in the long-run, while there may be some differences in the short-run due to the availability of equipment and GSM legacy markets. Similarly, sub-1GHz spectrum and 1800MHz spectrum are considered to be complementary (in that a mix may aid cost efficient network deployment) and yet substitutable at the margin (in that both provide capacity).
- Different potential users may have different plans for developing what they consider to be an optimal network given their current infrastructure and network architecture, which further influences their preferences over alternative combinations of spectrum in different bands and which may vary across operators.
- Different incumbents may have different plans on how to optimally migrate their customer base from GSM to 3G and 4G technologies. This also conditions their optimal requirements of bands that can be used for GSM services and bands suitable for new technologies.
- There are benefits that come from holding large contiguous blocks of spectrum, which will be factored into bidder preferences and associated valuations. However, owing to the uncertainty surrounding the development of technologies in different bands, bidders may also value holding at least some spectrum in different bands to insure themselves against competitive disadvantage if current schedules for equipment availability in different bands change. Different operators may have different ideas about how best to balance this trade-off, and these would be reflected in their valuations for different packages of lots.

82. It would be difficult for a regulator to incorporate these complex and sometimes user-specific preferences into an assessment of alternative

spectrum allocations across applicants in order to generate an efficient allocation. A particular problem is that there are clear tensions between operators holding a mix of spectrum across both 900MHz and 800MHz bands (which might reduce risks due to the timing of technology availability) and holding a larger single block of spectrum in one band (which provides greater spectral efficiency). Different operators might reasonably take quite different views about this issue.

83. In contrast, a multi-band auction with provisions for package bidding would allow bidders to express their value not just for different amounts of spectrum but also for different mixes of spectrum across bands. In particular, the proposed CCA format allows bidders to bid for a number of packages of spectrum across bands, expressing their preferences for both substitutes and complementary lots.

Pricing

84. Given the large amount of spectrum in the auction, which is available in different bands that may differ in value, a regulator would also struggle to set prices administratively that reflect the relative value of demand for spectrum in different bands. For example:

- 800MHz and 900MHz spectrum are considered to be substitutes in the long-run, which suggests that spectrum in these two bands should have similar prices; however, some bidders will still have preferences between spectrum in these two bands due to differences in the availability of equipment, suitability for GSM services and their existing infrastructure, which would suggest that prices for spectrum in these bands might differ.
- The rate at which a bidder might trade off less sub-1GHz for more 1800MHz spectrum is unknown, and may be different for different operators. Therefore, setting the relative prices for sub-1GHz spectrum and 1800MHz spectrum is difficult.

85. If relative prices are set inaccurately, the administrative body risks distorting the choices of applicants between different mixes of spectrum across bands in a direct assignment. This could lead to bidders filling in their applications in a way that maximises their pay-off, but which does not maximise the value of their spectrum use and resulting social value. Given the length of the proposed licences, such a distortion may have long run and far-reaching implications on the relative competitiveness of operators and, as a consequence, on market structure.

3.3 Mixed award combining direct assignment and auction

86. A number of responses early in the consultation process (responses to ComReg consultation 08/57 and 09/14) asserted that a mixed award process should be adopted by ComReg (for 900MHz spectrum), by which all spectrum in the band should be awarded by a combination of:

- direct assignment of 2x5MHz of spectrum in the band to existing operators;[17] and
- awarding the remaining spectrum via an auction process.

87. Such an approach would appear to be aimed at guaranteeing business continuity to existing operators, while not completely limiting the possibility that different bidders obtain different spectrum assignments based on their respective valuations. Predictably, as a combination of the two extremities, requiring the regulator to decide the outcome and allowing the market to decide the outcome, such an approach achieves only some of the benefits of an award via auction and is subject to similar drawbacks to a full direct assignment.

88. For instance, in the case of a hybrid award, because some of the spectrum available is allocated directly to some applicants, the number of alternative feasible allocations of the spectrum available across applicants is limited relative to the situation where all of the spectrum available were allocated via auction. This smaller number of feasible allocations from which to choose the most efficient outcome in the case of the hybrid approach means that the outcome selected from this smaller pool of feasible allocations may be relatively less efficient than under the auction alternative.

89. A hybrid approach has significant shortcomings in the wider context of a multi-band award:

- It could result in excessive fragmentation of spectrum holdings, which could lead to forgone benefits from contiguity of spectrum assignments. While we can expect all existing operators to bid for sub-1GHz spectrum, it may not be efficient to accommodate all such operators in the 900MHz band instead of allowing the process to determine whether they should be located in the 900MHz band only, the 800MHz band only or in both.
- Bidders in the auction may be seeking a mix of frequencies to achieve a minimum bandwidth. A partial direct assignment may be insufficient to guarantee a minimum amount of spectrum to be an effective competitor, and could lead to spectrum being inefficiently assigned if a bidder fails to acquire sufficient spectrum in the auction to be an effective competitor after the auction.

90. Although it is important to ensure that competition in the market is promoted, and that current users enjoy continuity of services, the mixed award proposals would seem to only partially protect incumbent operators, who would in any case need additional spectrum. At the same time, there is a considerable amount of spectrum offered in the auction, and thus it is highly unlikely that an existing operator would be left without sufficient spectrum for business

[17] Different respondents had different views on whether such 'existing operators' should include only those who currently hold spectrum licences in the 900MHz band (3) or all existing mobile operators (4).

continuity given the strong valuation that such spectrum would attract. Therefore, the risk that an existing mobile operator would be forced to exit the market in a full auction scenario is limited.

3.4 Overall assessment and recommendation

91. A direct assignment requires the regulator to determine both an allocation of available spectrum and prices to be charged. An assessment of the social value of assigning a licence to each applicant is needed to determine both the highest value users of spectrum (including the quantities and mix of lots across bands) and also the opportunity cost that needs to be paid by those highest value users.

92. Even a status quo allocation of new licences to existing holders involves an implicit assessment of the relative desirability of different allocation. However, such an assessment would depend on limited and potentially unreliable information. Applicants have an incentive to over-represent their value for the lots on offer to increase their chances of being awarded spectrum. Such an assessment unavoidably involves subjective judgements, which can be a source of discontent between applicants, and could potentially lead to legal challenge that might delay the award of licences.

93. The difficulties faced by a regulator in determining the allocation and prices in a direct assignment are especially acute in the upcoming award of spectrum in Ireland due to the large amount of spectrum available across multiple bands and the complexity of the drivers of value. Additionally, this award constitutes a key determinant for the structure and evolution of the mobile communications market in Ireland, and therefore the effect of errors in determining the allocation in a direct assignment process would be far-reaching and long-lasting.

94. In contrast, when effectively designed, auction processes provide the means and incentives for bidders to express their valuations for different potential packages of spectrum through their bids. The auction rules provide an objective process using these bids alone to determine the allocation of spectrum between applicants and to set prices that support this allocation. The auction process can be made transparent and robust to scrutiny by a third party, with the administrative body not having to make any decisions in assessing different outcomes.

95. A potential problem with auction processes is that, where the number of competitors in the downstream market is determined by the number of winners in the auction, bidders may take this into account and try to reduce the number of winners in order to enjoy greater profits in the downstream market. However, spectrum caps that limit the extent to which bidders can preclude competitors from acquiring spectrum can be used to prevent this problem. Therefore, the possibility of distortions of downstream competition does not provide an objection to the use of auctions *per se*, but rather requires any allocation process (be it an auction or an administrative allocation) to have appropriate rules to protect downstream competition.

96. A spectrum reservation for entrants would appear to be unnecessary, as the spectrum caps proposed provide for at least four winners of spectrum in the

auction. In addition, a spectrum reservation may be undesirable for a number of reasons:

- As there are four well-established participants in the Irish mobile market at present, if spectrum were to be reserved for an entrant, this would essentially be a reservation for a fifth potential national operator. While there appears to be demand for spectrum given the minimum prices proposed by ComReg from interested parties other than the existing mobile operators, the structure and strength of such demand is uncertain. The greater the reservation, the greater the potential cost of an inefficient allocation (if the allocation of the reserved spectrum were not optimal relative to the allocation where no spectrum was reserved). Conversely, if the reservation is small, then it may be insufficient to ensure that an entrant bidder will win sufficient spectrum for a viable business proposition; in this case, if the entrant bidder were to fail to win enough additional spectrum to that reserved for entrants, the reservation would also go unsold.[18] For this reason, establishing a spectrum reservation could potentially have a high opportunity cost if it resulted in unsold spectrum.

- It is possible that a fifth mobile operator could acquire spectrum in the auction and enter the market for mobile services. However, a fifth operator would only win spectrum in an open auction process without spectrum reservations if it placed a high value on the spectrum competed for, which would suggest a strong business proposition. However, this is not necessarily the case if spectrum is reserved for an entrant, as the entrant could then acquire spectrum simply because it did not face competition for the reservation, rather than as a result of a strong business case. Therefore, where the case for a fifth operator is weak, this needs to be considered against risk that a spectrum reservation might result in an inefficient auction outcome.

- If spectrum were to be awarded to a fifth bidder through a spectrum reservation and this bidder were to fail to generate a sustainable business, the operator may need to resell or return its licence. However, even with spectrum trading in place, none of the alternative options available for the failed operator's spectrum may be as efficient as awarding it in the auction, as once frequencies have been initially allocated, the value of the spectrum vacated by a failed fifth operator might be distorted because of contiguity issues. In this case, unless operators were reassigned frequencies (which could be costly in itself), the only available options would be to either award the spectrum to neighbouring users, or to have a fragmented assignment. This would

[18] Given that the proposed auction format allows for package bidding, an entrant would not be exposed to winning the reserved spectrum alone unless it specifically bids for this. However, where the bid submitted by an entrant includes additional spectrum, the bid may be rejected altogether. Thus, if no entrants bid for the reservation alone, there is a risk that the spectrum will go unsold even if bidders would value it in combination with other spectrum.

depress the value of these licences. This problem would worsen if neighbouring users were unable to acquire this spectrum due to the spectrum cap limitations.

97. Given these considerations, setting appropriate spectrum caps may be preferable to a spectrum reservation. The spectrum caps should be established at a level that prevents two incumbent operators from acquiring sufficient spectrum to ensure that no other operators can effectively compete, but which is sufficiently loose so as to allow bidders to compete for spectrum allows market determination of the exact distribution of spectrum within limits to protect competition.

98. Spectrum reservations for incumbents – for business continuity reasons – are unnecessary within an auction process. Moreover, even if some limit amount of spectrum were administrative granted to incumbents for business continuity reasons, this would raise many problems. There would be no easy means to determine the appropriate price. The intervention could significantly affect how 800MHz and 900MHz is distributed across different winners and distort competition for that spectrum that was not administrative granted.

99. Overall, we would recommend using an auction process, as it constitutes a more robust method for determining an efficient allocation and the prices that can support it, and is less prone to potential errors in assessing the value of alternative allocations between applicants.

4 Spectrum caps

100. In this section, we discuss the proposals for spectrum caps to safeguard efficient competition, both within the auction and downstream in providing mobile services, in a common award process for spectrum in the 800MHz, 900MHz and 1800MHz bands. First, we look at the proposal for spectrum caps, which were introduced in the consultation process in ComReg document 09/99 and developed further in 10/71 and 10/105. As the proposed spectrum caps found widespread support in the stakeholders' responses, we restrict this discussion to a brief summary of the main arguments and on updated commentary on the relevant arguments brought forward by respondents. Then, we look at the arguments for applying an additional cap that could be applied specifically to the first time-slice to address the potential difference between 800MHz and 900MHz spectrum in the short term and its potential impact on competition amongst existing players.

4.1 Background

101. While the issue of spectrum caps has been the subject of much commentary on the part of respondents to ComReg's consultations on the planned award process for spectrum in the 800MHz, 900MHz and 1800MHz bands, many of the views expressed on spectrum caps in the less recent responses are now redundant. This is a consequence of the fact that the subject of the consultation process has adapted over consecutive iterations in order to take into account both responses provided by stakeholders and events outside the consultation process that affect it (firstly, the availability of 800MHz spectrum in an award with 900MHz spectrum and, secondly, the proposal for inclusion of 1800MHz spectrum in a planned award of sub-1GHz spectrum). In this section, therefore, we consider only views expressed on the proposed spectrum caps for the most up-to-date auction proposal:

- A cap of 2x20MHz of sub-1GHz spectrum per bidder; and
- An overall cap of 2x50MHz of spectrum.

102. The proposal for a sub-1GHz cap of 2x20MHz per bidder was first put forward in our September 2010 report (10/71a) and ComReg's associated consultation (10/71) and as part of the proposed integration of 800MHz spectrum into the envisaged 900MHz award process. In that (10/71a) report we considered that a spectrum cap set for sub-1GHz spectrum should balance the benefits of protecting competition against the costs of doing so; that is, it should seek to obtain benefit from precluding *only* those outcomes that would undoubtedly result in harm to competition.

103. We considered the effects of a sub-1GHz cap set at three different levels:

- 2x15MHz;
- 2x20MHz; and
- 2x25MHz.

104. We noted that a spectrum cap of 2x15MHz would not be justifiable, as it would not permit the outcome where there were no entrant bidders and the four

existing mobile operators were awarded all of the sub-1GHz spectrum available.[19] Separately, we considered that a cap of 2x25MHz was simply too large as it would allow for a highly asymmetric outcome where two bidders were awarded 2x50MHz of the 2x65MHz of sub-1GHz spectrum available, which would be detrimental to the ability of at least one existing mobile operator to compete in the market. We concluded that a spectrum cap of 2x20MHz struck a balance between allowing for asymmetric spectrum holdings amongst spectrum winners based on the auction outcome while not allowing for the kind of extreme outcomes where competition could undoubtedly be harmed.

105. We then considered the issue of spectrum caps again in our December 2010 report (10/105a), describing the mechanics of including 1800MHz spectrum in the proposed sub-1GHz award. In our December 2010 report, we re-stated ComReg's objectives of ensuring efficient management and use of the spectrum and promoting competition in services. We noted that the requirement on it to be proportionate in its actions, in combination with these objectives, in the case of the planned multi-band auction, amounts to a requirement on it to constrain bidding freedom of operators in the auction only to the degree necessary to ensure that these objectives are met.

106. We noted the potential for loss of efficiency in setting spectrum caps tight enough to ensure that spectrum is available for potential entrants, and underscored the trade-off between setting a cap that ensures spectrum availability for entrants and the risk of spectrum going unsold inefficiently. We also noted the related trade-off in the less extreme case where sufficiently tight spectrum caps in effect ensure symmetric spectrum holdings by all operators, and where such a policy may also negatively affect efficiency.

107. We then considered the form of an appropriate spectrum cap given that the planned auction would include spectrum in multiple bands at frequencies both below 1GHz (low frequency spectrum) and above 1GHz (high frequency spectrum). This discussion took into account the stakeholder's responses received regarding the cap of 2x20MHz that had already been proposed for sub-1GHz spectrum as part of the planned sub-1GHz auction design proposals.

108. In evaluating this issue we noted the significance of whether the bands in question are substitutes and/or complements. Given our belief that 1800MHz spectrum is both complementary to sub-1GHz spectrum and substitutable at the margin, we concluded that an overall spectrum cap would be appropriate. Taking into account the objective of fostering competition and the importance of sub-1GHz spectrum, we concluded that such an overall cap should operate in addition to the previously proposed cap for sub-1GHz spectrum.

109. We considered the possibility of implementing a flexible overall cap, where the cap on the total amount of spectrum a bidder could be awarded would be

[19] Given that 2x65MHz of sub-1GHz spectrum will be made available, even if all four existing operators were to bid for the maximum amount of spectrum that they could be awarded, 2x15MHz each, this would still leave 2x5MHz of sub-1GHz spectrum unallocated.

smaller the greater the amount of sub-1GHz spectrum being awarded to this bidder. However, if the relative weights attributed to sub-1GHz and 1800MHz spectrum (i.e. the amount of additional spectrum that a bidder could bid for by bidding on one less lot of sub-1GHz spectrum) do not properly reflect the competitive implications of winning different mixes of spectrum, this may distort bidder preferences for different bands. Given the uncertainty about the exact terms of this trade-off, we concluded that a liberal overall cap in addition to the proposed 2x20MHz sub-1GHz cap would be appropriate.

110. We examined the case for including existing spectrum holdings, specifically 2.1GHz spectrum, within the spectrum cap, but concluded that the case for doing so was weak – holdings are small relative to the overall amount of high frequency spectrum usable for providing similar services, are symmetric across operators and, where the cap is high enough in the auction, are not likely to affect the competitive landscape after the auction.

111. As to the level of an overall spectrum cap, we considered that the award of the entire 1800MHz band to a single operator might limit competition. A cap of 2x50MHz seemed to allow a potential entrant to acquire a sufficient amount of bandwidth to compete with operators with sub-1GHz spectrum while still providing 2x25MHz for potential use by other operators.

112. We then evaluated the case where three bidders won 2x20MHz of sub-1GHz spectrum and considered the outcomes that this would allow with an overall spectrum cap set at different levels, in terms of:

- number of operators that could be awarded spectrum in the band given a particular cap;
- whether necessarily symmetric outcomes or a spectrum reservation for entrants would result from a given cap in practice; and,
- where relevant, what level of asymmetry of spectrum holdings the cap permitted.

113. On the basis of this examination, we concluded that an overall cap of 2x50MHz in combination with a sub-1GHz spectrum cap would best strike a balance between ensuring downstream competition and not imposing bidding restrictions at a level that would ensure symmetric spectrum holdings (with or without spectrum left for potential entrants).

4.2 Respondents' views

114. As part of the consultation process, stakeholders have been given the opportunity to express their views on a number of aspects of the proposed spectrum caps:

- In September 2010, stakeholders were invited to express their views in response to ComReg document 10/71 on the imposition of a sub-1GHz cap covering spectrum awarded in the 800MHz and 900MHz bands and, separately, the proposal to set this cap at 2x20MHz.
- Following this, in response to proposals laid out in ComReg document 10/105 in December 2010 for the inclusion of 1800MHz spectrum in the planned sub-1GHz auction, stakeholders were invited to submit

their views on the imposition of an overall cap of 2x50MHz in addition to the 2x20MHz cap on sub-1GHz spectrum previously proposed.

115. In general, there was widespread support for the imposition of a spectrum cap that covered both the 800MHz and 900MHz bands; all but one respondent supported the principle of a sub-1GHz cap.[20] Given almost unanimous support for this aspect of the proposals, we do not intend to consider the general principle of imposing a sub-1GHz spectrum any further.

116. In the paragraphs below, we consider separately the views expressed in relation to a 2x20MHz sub-1GHz cap and a 2x50MHz overall cap.

2x20MHz sub-1GHz cap

117. There were mixed views regarding the appropriate level of a sub-1GHz cap. In response to ComReg's proposal of a 2x20MHz cap:

- 4 of the 8 respondents that explicitly stated their view on the appropriate level of a sub-1GHz cap supported the proposal of a 2x20MHz cap; and
- the remaining 4 respondents were against the proposals to set a sub-1GHz cap at this level.

118. Those in favour of a 2x20MHz cap, including 3 of the 4 existing mobile operators, stated as reasons for their support of this cap that:

- It provides for fair and adequate apportionment of spectrum amongst operators;
- It will provide a reasonable amount of capacity for when the ecosystem will be able to use the 800MHz and 900MHz bands together; and
- It strikes a balance between avoiding extremely asymmetric outcomes in spectrum allocations, minimising the risk of spectrum going unallocated in the award process and providing any efficient new entrants with the opportunity to obtain access to spectrum.

119. Of those against this cap, two arguments were presented supporting a lower cap such as 2x15MHz:

- A higher cap would create the risk that there would be no new entrant after the auction; and
- A cap set at 2x20MHz risks the outcome that H3GI only wins 2x5MHz of sub-1GHz spectrum, which in the long term will put H3GI at a significant competitive disadvantage to incumbent operators.

[20] RTÉ's view that there should not be a sub-1GHz cap appears to be based on the assumption that bidders will not have the opportunity to bid in a way that allows them to actively reflect their value for certain frequency assignments versus others. In the current auction proposal, bidders would be able to reflect value differences for spectrum in the 800MHz and 900MHz bands in the main stage of the auction and value differences for different spectrum assignments within a band in the assignment stage.

120. In contrast, one respondent supported a higher or potentially more complex cap linking the award of the lowest frequency 800MHz lot and other higher frequency lots.

121. In response to ComReg consultation 10/105, which proposed to set a 2x20MHz cap in combination with a 2x50MHz overall spectrum cap, the four mobile operators responded on the issue of the 2x20MHz sub-1GHz cap in the same vein as before:

- One respondent argued that ComReg should set a spectrum cap of 2x15MHz with the possibility of relaxing this cap in the event that supply exceeds demand; and
- The other three operators agreed with the setting of a sub-1GHz cap at 2x20MHz, with two of these operators citing as a benefit of this cap the avoidance of the risk of extreme asymmetric outcomes.

2x50MHz overall cap in addition to the proposed 2x20MHz sub-1GHz cap

122. In relation to a 2x50MHz overall cap in addition to the proposed 2x20MHz sub-1GHz cap, there were 4 respondents to the relevant consultation proposing this cap (10/105). Of these 4 respondents, 3 expressed a view on this. Out of those, 2 were in favour of this cap, with one citing as reason for its support the reasonableness of the overall cap to avoid extreme asymmetries in the distribution of spectrum. In contrast, the other operator argued that this overall cap should be set at 2x40MHz to safeguard competition in the mobile markets.

4.2.1 DotEcon commentary

123. In this section, we consider the responses to the current spectrum cap proposals. Note at the outset that our view of the proposed caps in light of these responses is unchanged, and as such we have not introduced arguments in addition to those previously put forward in coming to our recommendation.

124. To reiterate, the objective in setting spectrum caps for this auction was to:

- On the one hand, ensure that the kinds of extreme outcomes that would likely result in harm to competition in the provision of services to end-customers would not be permitted; while
- On the other hand, ensure that, within this limit, the distribution of spectrum would be decided by competition in the auction and would not be dictated by the caps set on the amount of spectrum that individual bidders could be awarded.

125. In their responses to ComReg's proposals, the majority of respondents have agreed that the proposed caps would indeed prevent undesirable outcomes involving extreme spectrum asymmetries among market players.

126. Some respondents have argued that the proposed sub-1GHz spectrum cap is too high, while others have argued that the cap should be at least 2x20MHz or higher. We note that extreme outcomes that would be possible where the sub-1GHz cap were higher (two operators with 2x25MHz of sub-1GHz spectrum with 2x15MHz distributed in some way between at least two other bidders) and consider that such outcomes will likely have a damaging effect on

competition. Therefore, we do not consider further the option of increasing this sub-1GHz cap where four or more parties apply for sub-1GHz spectrum at the application stage.

Lower sub-1GHz spectrum cap for entry

127. The arguments for a cap of 2x15MHz on sub-1GHz spectrum and the arguments in favour of a spectrum reservation for entrants are considered together as in practice they have the same effect; the setting of a spectrum cap on the four existing operators of 2x15MHz of sub-1GHz spectrum would result in the certain availability of at least 2x5MHz of sub-1GHz spectrum for an entrant.

128. In respect of this assertion by respondents, we note that there are a number of possible effects of imposing a spectrum cap of 2x15MHz which necessarily sets aside spectrum for a bidder other than the existing mobile operators:

- Loss of efficiency, resulting from the preclusion of all more efficient auction outcomes where at least one bidder in the auction wins more than 2x15MHz of sub-1GHz spectrum.
- Spectrum going unsold inefficiently, which could happen in a number of different circumstances, including where: (i) entrant bidders bid only for packages of spectrum greater than the amount of spectrum reserved and the amount of these bids is not sufficient to out-bid existing operators, or (ii) potential bidders simply do not have sufficient value for the lot available at the minimum price.
- No effect at all, where the value to an entrant of the reserved spectrum is such that by bidding its valuation for this spectrum the entrant would have been awarded this spectrum in any case.

129. If it is efficient to award spectrum to a new entrant, they can obtain spectrum in the auction by bidding for it based on their valuations regardless of the presence or absence of the effective reservation. Therefore, the imposition of a 2x15MHz sub-1GHz cap, effectively reserving spectrum for an entrant, can only result in negative consequences for the efficiency of the auction outcome, as there is no obvious case on competition grounds for requiring such an outcome.

130. As an aside, the issue of setting aside spectrum for entrants is a policy issue for ComReg. ComReg has addressed the issue of setting aside spectrum for an entrant or entrants previously (in various parts of ComReg consultation 09/99) and considers the issue again in the context of current proposals (see the Regulatory Impact Assessment presented in ComReg document 11/60). ComReg has not, however, set out in any of its previous consultations an intention to set such a reservation for entrants on policy grounds.

131. Overall, therefore, given the high intrinsic value of sub-1GHz spectrum and the importance of ensuring that this spectrum is awarded in the most efficient way to ensure its most efficient use in providing services over the duration of the relevant licences, we do not consider that there is a case for imposing a spectrum cap of 2x15MHz, as it would likely result in inefficiency of the auction outcome for no obvious gain in terms of the competitiveness of service markets.

Lower sub-1GHz cap to avoid harm to competition

132. One of the existing operators, H3GI, has argued in its response that the proposed sub-1GHz spectrum cap of 2x20MHz would risk it only being awarded 2x5MHz of this spectrum. In response to this, we consider that the following points are important:

- A 2x20MHz sub-1GHz cap would not allow three operators to use their bids in the auction to prevent a fourth bidder from winning any sub-1GHz spectrum;
- With a sub-1GHz cap of 2x20MHz, the risk of only being awarded 2x5MHz of sub-1GHz spectrum does not apply only to one operator only but to all existing operators;
- If it were the four existing mobile operators competing for spectrum in the auction and if bidders were to bid for sub-1GHz spectrum based on their valuations for this spectrum, for one bidder to only be awarded 2x5MHz of sub-1GHz spectrum it would have to have incremental value of a second 2x5MHz sub-1GHz lot of less than the incremental value that each of the other three existing operators have for a fourth 2x5MHz sub-1GHz lot. The probability of this situation arising in reality is low, but where this were to be the case, the allocation of more than 2x5MHz of sub-1GHz of spectrum to that bidder would in fact not be efficient; and
- The proposed format for the award process is a multi-round combinatorial auction (a CCA), which should give all bidders the opportunity to observe how much others value this spectrum (in the aggregate) at round prices. In this case, each bidder can calculate the cost to it of pursuing various options relative to others (e.g. bidding on different amounts of spectrum in the auction with a view to facing different levels of cost and service capabilities over the duration of the resulting licences).

Given these points, we consider that the proposed sub-1GHz cap of 2x20 MHz strikes a good balance of the relevant factors in setting a sub-1GHz spectrum cap.

Lower overall cap to avoid harm to competition

133. Existing operator Meteor has argued against the overall spectrum cap being set at 2x50MHz on the basis that it would unfairly favour the large established operators O2 and Vodafone, affording them the opportunity to squeeze out the competitive tension created by smaller operators and potential new entrants.

134. In respect to this argument, we note again the objective in setting spectrum caps is to preclude outcomes, and only those outcomes, that are sufficiently extreme as to harm competition. Given this:

- This spectrum cap would allow for an 1800MHz-only entrant – where there were value in operating such an 1800MHz-only network, the proposed spectrum caps would provide such an entrant with the scope necessary to acquire as much spectrum as it might feasibly need for providing advanced data services using 1800MHz frequencies;

- The most asymmetric outcomes that might result given the market has four existing operators are:
    - Two existing operators winning 2x20MHz each of sub-1GHz spectrum and 2x30MHz each of 1800MHz spectrum; or
    - An entrant winning 2x50MHz of 1800MHz spectrum with the remaining 2x25MHz distributed amongst the existing operators, which also win all of the sub-1GHz spectrum available.

  Neither of these outcomes is unequivocally harmful to competition:
    - In the former case, the other two existing operators would between them be able to win 2x25MHz of sub-1GHz spectrum and 2x15MHz of 1800MHz spectrum. As for one bidder potentially being awarded 2x5MHz of sub-1GHz spectrum, the arguments in the previous sub-section apply. As for high frequency spectrum, even if in the most extreme case one of the existing operators were to be awarded no spectrum in the 1800MHz band, each of these operators has existing rights of use of high frequency spectrum in the 2.1GHz band, and further high frequency spectrum will be made available within the duration of the licences awarded in this auction.
    - In the latter case, again, given the existing holdings of high frequency spectrum in the 2.1 GHz band by each of the four mobile operators, and the award of 2x65MHz of sub-1GHz of spectrum amongst them under this scenario, there is no reason to automatically consider that such an outcome would be harmful to competition even though there would be some asymmetry across operators in the bands in which spectrum was held.

135. In contrast, the proposed alternative overall spectrum cap of 2x40 MHz would ensure almost fully symmetric outcomes where the number of alternative feasible allocations of spectrum amongst bidders would be small. For example, if only the four existing mobile operators were to bid in the auction, the outcome would most likely be that each existing operator would win 2x15MHz or 2x20MHz of sub-1GHz spectrum plus 2x15MHz or 2x20MHz of 1800MHz spectrum, or some small variant thereof. Given the number of alternative outcomes that would be precluded relative to the alternative 2x50MHz cap, it is highly likely that the imposition of such a cap would result in significant inefficiency of allocation, and potentially spectrum going unsold inefficiently. The benefit to competition of ensuring relatively symmetric spectrum holdings of operators after the auction is not clear, and in any case does not appear to be sufficiently great to offset the efficiency loss as a result of significantly limiting the breadth of feasible auction outcomes.

136. Given these points, and the importance of allocating the spectrum available in the most efficient way, we do not think that there is a case for lowering the overall spectrum cap on account of asymmetric outcomes resulting in harm to competition.

4.3 Additional cap on 900MHz spectrum in the first time slice

137. Together, the proposed sub-1GHz cap and overall spectrum cap (applying across both time periods) address the issue of preventing only those outcomes that are so asymmetric that they would undoubtedly harm competition. Setting caps at the proposed levels to achieve this objective assumes that:

- There are at least four bidders in the auction;
- 800MHz and 900MHz spectrum is closely substitutable in the long run (so that it is reasonable to use an overall sub-1GHz cap); and
- 1800MHz spectrum is complementary to sub-1GHz spectrum and is substitutable at least at the margin (so that it is reasonable to set an overall spectrum cap, as opposed to a 1800MHz-specific cap, in combination with the proposed sub-1GHz cap).

138. However, these caps do not necessarily address competition concerns that may result as a consequence of 800MHz and 900MHz spectrum not being close substitutes *in the short run*. These short run issues result from the fact that while similar from a technical perspective, mobile technologies evolve at different paces in each band:

- Spectrum in the 900MHz band has been used on a harmonised basis for the provision of 2G mobile services for many years, and equipment using 3G technologies such as HSPA and corresponding handsets are readily available in the market at present;
- Spectrum in the 800MHz band has only been harmonised relatively recently, and while equipment and handsets for use using this spectrum are fast being developed, at present only data dongles are available for use in this band. However, equipment manufacturers are focussing on technologies such as LTE for use in this band, and it appears at present that LTE handsets may well become available in the 800MHz band before they will become available for use in the 900MHz band.[21]

139. As part of their responses to ComReg consultations on the proposed auction, a number of stakeholders have asserted that the first time slice holds a level of importance in the 900MHz band that is disproportionate to the duration of this time slice. Reasons cited for this include:

- The simultaneous requirement to maintain GSM services and opportunity to launch 3G services in this band; and
- The fact that owing to widespread equipment availability, high-speed services using sub-1GHz spectrum will likely be launched first in the 900MHz band, and there would be an enduring competitive advantage for operators that have liberalised use of this spectrum to launch such services earlier than services can be launched using 800MHz spectrum.

[21] http://www.gsacom.com/downloads/pdf/gsa_lte_ecosystem_report_290711.php4

140. Therefore, given the high degree of importance attributed by potential bidders to 900MHz spectrum, it is prudent to consider the costs and benefits of a band-specific cap on 900MHz spectrum in the short term.

141. In considering these short-term competition concerns, one issue to consider is the relevant time scale. The second time slice commences in all bands in July 2015. By this date, it is expected that the 800MHz band will be well established, with harmonisation complete in EU member states, and there should be equipment and handsets available for deploying services using LTE (and potentially other advanced technologies) using either 800MHz or 900MHz spectrum. Therefore, it should be sufficient to consider band-specific caps in the first time slice only to address competition issues linked to imperfect substitutability of 800MHz and 900MHz spectrum in the short run.

142. Considering, then, the level of such a potential cap, we refer back to the consideration of a cap in the 900MHz band in ComReg's early consultations on an award process for liberalised 900MHz spectrum (ComReg consultations 08/57, 09/14 and 09/99). Among other things, ComReg noted that this cap promoted competition and reflected the likely needs of the existing 900MHz operators.

143. The imposition of a 2x10MHz cap on 900MHz spectrum in the first time slice would have a number of potential benefits:

- As part of the requirements on it in implementing the liberalisation of usage rights in the 900MHz band, ComReg is obligated to conduct this task of liberalisation without distorting competition. Given that the proposed cap would ensure that existing mobile operators would have the potential to win some 900MHz spectrum in the auction in the first time slice, a spectrum cap set at this level would seem to fulfil this requirement.
- A cap of this nature would safeguard competition against differing start dates for 800MHz and 900MHz spectrum. This would have the following implications:
    - Previous proposals for liberalisation of the 900MHz band as soon as the auction is complete and relocation in the band has been completed (as described in ComReg consultation 11/11) are contingent on the outcome of the auction and the impact that early 900MHz spectrum liberalisation might have on competition. If a 2x10MHz cap were to be imposed on 900MHz spectrum, it appears likely that early 900MHz liberalisation could be implemented for at least some 900MHz spectrum lots without raising concerns regarding distortion of competition. This would ensure that the benefits of high-speed (3G) data services would be realised at the earliest possible time.
    - If 800MHz spectrum were to become available for use later than currently scheduled, where such a delay is relatively short, this would not necessarily have negative effects on competition (though it would still have a negative effect on availability of very high-speed (4G) services).

144. A 2x10MHz cap on 900MHz spectrum in the first time slice would appear to raise a number of issues of potential concern, but none of these appear to be significant relative to the benefits:

- In our report considering a cap on 900MHz spectrum in the 900MHz award format proposed in December 2009 (09/99c), we considered that while a 2x10MHz cap was the appropriate level for such a restriction, given the number of existing mobile operators in the Irish market and their respective 900MHz requirements going into the auction, there was a significant risk of collusive behaviour amongst these operators. Specifically, we considered that there was a 'natural outcome' where existing 900MHz operators each win 2x10MHz of spectrum and H3GI wins 2x5MHz, and that bidders might therefore have an incentive not to bid for 900MHz spectrum up to their full valuation for this spectrum. However, there are reasons to consider that this issue is not of the same level of concern in the proposed award:
    - The cap is proposed for the first time slice only, covering a period of only two and a half years. Even if such effects did materialise during this period, it is highly unlikely that such effects would be carried over into the second time slice:
        - First, the risk associated with the failure to secure 900MHz spectrum in the second time slice would be much greater, as the consequences of this failure would be much longer lasting; and
        - Second, this natural outcome is only relevant where the three existing 900MHz operators require at least 2x5MHz of 900MHz spectrum each for maintaining GSM services. Given the value of this spectrum for liberalised use and the constant migration of customers to smartphones, this situation is unlikely to persist far beyond the first time slice.
    - Increased supply of sub-1GHz and total spectrum included in the auction means that the risk of tacit collusion on account of there being a self-evident division of spectrum across bidders reflecting their relative current market positions is reduced;
    - The combination of package bidding and the process of winner determination using the proposed auction format (described in Section 10) mean that where a bidder were to shade its bid for 900MHz spectrum in the first time slice and bid for other spectrum based on its valuations, this will translate directly into a decreased probability of winning a package of spectrum including 900MHz spectrum in the first time slice.[22]
    - In any case, limited transparency of the identity of bidders and their individual bids during the auction and market value based

[22] Consider a simple example of 2 lots, A and B, that have no reserve prices, and Bidder 1, that has a valuation of 5 for each of A and B. Assume that Bidder 1 needs A but decides to shade its bid for B, bidding only 2 for this. Given package bidding, this would mean that Bidder 1 would bid 5 for A and 7 for A and B. Given the process of winner determination, it is not simply the value of the bids that is considered (5 and 7) but the incremental value of awarding more spectrum (awarding B for an increment of 2). Therefore, bidding an incremental value of only 2 for B risks the possibility that the incremental value of awarding B to another bidder is more than 2, in which case Bidder 1 will be awarded A only where it would have been awarded B also if it had bid closer to its valuation for B.

minimum prices mean that attempting to engage in such behaviour will be risky and if successful the payoff from achieving this outcome will be relatively small.

- In the long term it may be beneficial for individual operators to consolidate all sub-1GHz spectrum holdings into the same band, and as such spectrum inefficiency may result from allowing bidders only to be awarded at most 2x10MHz in the 900MHz band. However, this restriction is only proposed for the short term and the benefit of large contiguous blocks of sub-1GHz spectrum is unlikely to be realised until the second time slice. However, it does not seem that imposing a more fragmented structure for the first time period entails a significant loss. We note that in its response to UK Ofcom's recent consultation on multi-band auction proposals in the UK, O2 noted that at present within the EU, only the UK and Austria have individual spectrum allocations of significantly more than 2x10MHz in the 900MHz band.[23] It asserted that the availability of LTE equipment using carriers of more than 2x10MHz is unlikely to emerge in the 900MHz band given this situation. While this condition is likely to change as 800MHz spectrum is allocated in EU countries and provisions are made for spectrum trading amongst sub-1GHz spectrum holders, this is unlikely to happen within the timescale of the proposed 2x10MHz cap.

145. It appears therefore that there is merit in imposing a 2x10MHz cap on 900MHz spectrum in the first time slice, and that the cost of doing so, if any, is small. On this basis, we recommend that such a cap be implemented in the proposed multi-band auction in addition to the sub-1GHz and overall spectrum cap already part of the current auction design.

4.4 Potential supplement to proposed caps: Spectrum floors

4.4.1 Introduction

146. The issue of using spectrum floors to ensure that effective competition is maintained was raised by H3GI as a result of Ofcom's proposals for the combined award of 800MHz and 2.6GHz spectrum in the UK. In particular, Ofcom has assessed that for competition to be safeguarded in the mobile market, there should be four national wholesale operators[24] after the auction with the minimum amount of spectrum (defined flexibly across bands)

[23] http://stakeholders.ofcom.org.uk/consultations/combined-award/?showResponses=true&pageNum=5#responses/*Telefonica_UK_Ltd.pdf*

[24] Notice that this measure is aimed at ensuring a certain number of effective wholesale competitors and does not preclude a greater number of retail operators (i.e. MVNOs). Also, post-auction network sharing at particular locations is not precluded, subject to regulatory approval and ensuring that there are still independent wholesale providers. Therefore, the number of networks at particular locations could be fewer than the number of wholesale providers. Although we use the term "national network operator" for simplicity throughout this section, Ofcom's primarily concern is ensuring a sufficient number of independent and effective competitor wholesale providers. Furthermore, Ofcom considers that a national wholesale operator needs access to spectrum nationally, but does not necessarily need to own spectrum.

necessary to compete effectively. It has proposed to ensure this by imposing spectrum floors for four operators in addition to spectrum caps.

147. As part of the consultation process for the planned award, in a letter dated 5 July 2011, H3GI communicated to ComReg that it supports the approach adopted by Ofcom, and that such an approach should be adopted in Ireland. Further to this, it submitted a report to ComReg prepared by Value Partners and Radio Regulatory Associates (VP-RRA) dated July 2011 in support of this view. Both H3GI's correspondence and the report it submitted in support of its view are due to be published by ComReg shortly.

148. In its report, VP-RRA asserts that:

1. There needs to be four national players in the Irish mobile market going forward.
2. In order to promote such an outcome, each of the four existing mobile operators in Ireland should be awarded at least 2x10MHz of sub-1GHz and 2x1800MHz spectrum from the spectrum to be made available in the proposed award process.[25]
3. If ComReg does not ensure this:
   - the operator in the weakest bidding position will only win 2x5MHz of sub-1GHz spectrum and no 1800MHz spectrum;
   - Its winnings will be less than the amount of spectrum required to be an effective competitor; and
   - Such an outcome from the auction would result in partial or full exit from the market, resulting in a substantial loss of welfare to society.
4. In order to ensure that all four existing operators have sufficient spectrum to compete effectively, ComReg should adjust the proposed limits on spectrum that individual bidders can be awarded:
   - Overall spectrum cap per bidder should be reduced from 2x50MHz to 2x40MHz; and
   - A spectrum floor of 2x10MHz of contiguous sub-1GHz spectrum should be set in addition to the proposed 2x20MHz sub-1GHz spectrum cap.

149. In this section, we first consider in detail the cornerstone claim of the VP-RRA report which underlies all of its other assertions: that there needs to be four national network players in the Irish mobile market going forward. We then consider the competition assessment carried out by Ofcom, which derived a need for four national network operators given UK conditions, and consider whether such an assessment can be carried over to the case of the proposed multi-band auction in Ireland. We conclude that while we accept that this is a reasonable action for Ofcom to take given the market conditions and the other features of the proposed award process in the UK, and having taken due

[25] Note that the persistence of four national players in the Irish mobile market is not guaranteed by any spectrum cap as such caps apply only to the outcome of the auction. Further, there are no controls within the proposed multi-band award process that govern the number of players that will exist in the market after the auction, as exit or consolidation could occur. This issue would be controlled, as it is now, by national and EU competition law.

consideration of the report by VP-RRA, we do not consider that there is a compelling case to adopt the same course of action in Ireland, where both market conditions and other features of the proposed multi-band award are different. In particular:

- The case for ensuring four fairly symmetric national network operators in Ireland is ambiguous[26] given the different size and geographical characteristics of Ireland and the UK; and
- The spectrum caps set for the proposed multi-band auction in Ireland will in any case ensure that:
  a) At least four bidders will win sub-1GHz spectrum; and
  b) Where these four bidders are the existing mobile operators in Ireland, these will all have the minimum amount of spectrum required to be an effective competitor in one of the scenarios proposed by Ofcom.

4.4.2 Assumptions underlying the VP-RRA report

150. In its report, VP-RRA assert at the outset that there needs to be four national network operators in the Irish mobile market, each holding a sufficient amount of spectrum. This is based on:

1) An FCC comparison of market structures and performance in the US, Western Europe and Asia Pacific with similar income levels, which found that the structure is converging to three or four national competitors per market in many countries.
2) The notion that a market with more operators is more competitive and, specifically, a market with four players is more competitive than a market with three players.
3) The fact that Ofcom has concluded in its competition assessment conducted as part of its design of an award process for allocating 800MHz and 2.6GHz spectrum that competition will be secured by ensuring that there are four effective national wholesale providers in the market.

151. It is not clear why either of the first two points should lead us to the conclusion that a fairly symmetric four network operator market is essential in Ireland and as such, that the four existing mobile operators should therefore be protected. In particular:

- The fact that Ireland has four existing mobile network operators at present does not necessarily mean that the long run market structure should involve four fairly symmetric network operators, as opposed to three operators or four network operators[27] that are not largely symmetric; and

[26] In this respect, we note that ComReg's objective to promote competition does not extend to ensuring a particular number of competitors, either in the auction or in the market for services provided using spectrum.

[27] Again, notice that this does not preclude the possibility of a greater number of retail operators, or indeed the number of independent wholesale providers exceeding the number of network operators.

- While in theory more competitors mean more intense competition, and this is indeed often the case, this statement neglects:
    - the issue of the efficient number of competitors, which takes into account the number of operators that it might be efficient for to duplicate network infrastructure to provide services;
    - the issue of economic feasibility of four mobile operators, as in the long-run this is not determined by the either caps or floors within the auction (which only have temporary effect on the distribution of spectrum immediately post auction);
    - the implications of spectrum scarcity and in particular, whether it might be desirable for operators to hold larger amounts of spectrum to facilitate delivery of advanced services and lower the incremental costs of additional coverage, provided that at the same time there is sufficient competition amongst a sufficient number of reasonably similar operators; and
    - whether asymmetric outcomes in terms of spectrum holdings may still be compatible with reasonably effective competition given the need to satisfy other objectives (for example, as the number of networks might vary by location, with operators having dissimilar needs for spectrum as result).

152. In particular, notice that it is impossible to look solely at the effect of an increase in the number of competitors without also considering the reduction in the amount of spectrum that at least some of those competitors can hold.[28] Given the increased benefits (network speeds in particular) that can be achieved when providing advanced data services using large contiguous blocks of spectrum, simple oligopolistic models of the benefits of additional competitors (e.g. the Cournot model) are not especially informative. Moreover, more networks mean higher marginal costs of bandwidth, affecting the incentives both to roll out new services and to compete for customers. Therefore, in the context of mobile telecoms, it does not follow that ever more competitors result in net benefits to society through greater competitive intensity. At some point, enforcing network duplication and spectrum scarcity effects overwhelm competitive benefits.

153. Of course, in the long run excessive fragmentation of spectrum in an auction may lead to exit or consolidation. Therefore, there are mechanisms for unsustainable market structures to adjust over the long run. Nevertheless, there may still be costs to society if new services are delayed as a result of excessive fragmentation of spectrum in the short run. Also, windfall gains may

[28] Note that while the number of networks being operated may in theory be less than the number of competitors, the number competitors that can be supported using the same network is constrained by network capacity. Therefore, while the number of networks and the number of competitors may not increase in a strict one-to-one ratio, an increase in competitors is linked to an increase in number of networks. Therefore, the same general arguments apply to increased numbers of competitors and increased numbers of networks.

be enjoyed if competition for spectrum in the auction is muted, with these gains realised on market consolidation (i.e. by a purchaser of spectrum pooling its interests with another party, whether through explicit spectrum trading or through other mechanisms). Therefore, there are clear costs from forcing an auction to produce a more fragmented outcome (for example through excessively tight floors or caps) when less fragmented outcomes would allow an acceptable level of competition in downstream mobile services markets and would in any case likely be allowed by competition and regulatory authorities if they arose subsequently. Such approach would simply reduce competition within an auction and restrict potentially efficient outcomes for no long-term benefit.

154. Leaving these issues to one side, we consider in detail below VP-RRA's third point, that is, that Ofcom's assessment that in order to safeguard competition in the UK mobile market it would need to ensure that there are at least four network operators post-auction implies that this same number of operators would also be required to safeguard mobile competition in Ireland.

4.4.3 Impetus for conducting a competition assessment

155. Ofcom's conclusion that it would need to ensure that there are at least four national wholesale providers in the UK was the result of a comprehensive competition assessment. This assessment was carried out by Ofcom in response to a Direction to do so by the Government and approved by Parliament. This Direction was imposed upon Ofcom along with other Directions in an Order relating to the award process for 800MHz and 2.6GHz spectrum and implementation of a broader spectrum strategy including 900MHz and 1800MHz spectrum liberalisation, spectrum trading, indefinite licence duration and licence fee setting to reflect full market value.

156. The competition assessment conducted by Ofcom therefore considers the effect on competition of the planned auction in the context of many other factors, which will together largely govern the use of mobile spectrum. In addition, the proposed safeguards of competition will be implemented in a market with characteristics that are uncommon in other countries. Therefore, the approach adopted in the context of the very particular circumstances in the UK at present should not be treated as a generally applicable approach to spectrum management or spectrum awards.

157. In particular, relative to the Irish case:

1) There is less spectrum becoming available in the UK than in Ireland over the period of the competition assessment (5-10 years from the end of the auction). This means that the competitive landscape after the auction is unlikely to change in the UK over the duration of the competitive assessment unless there is secondary trading (and indeed that might be handicapped if uncompetitive service markets were allowed to emerge). This is not necessarily the case in Ireland.

    - In the UK, owing to the move to indefinite licensing (900MHz and 1800MHz licences are already indefinite subject to the payment of annual fees, 2.1GHz licences were awarded initially for 20 years, and will then moving to a rolling licence term subject to annual fee payments) there will be no harmonised spectrum becoming

available through primary allocation for the provision of advanced mobile services in the 10 years after the auction with any degree of certainty.

- In Ireland, at minimum, the 2.1GHz and 2.6GHz bands will become available for award over the same time period, making available up to 2x135MHz of high frequency spectrum.

2) A significant asymmetry of spectrum holdings exists amongst existing UK operators before the auction, generating a potential concern that this is not exacerbated as a result of the planned award. In contrast, the situation in Ireland going into the auction is much more symmetric.

   - In the UK, while each operator has at least 2x10MHz of 2.1GHz spectrum, the 900MHz band is shared in its entirety by two operators, and at present 2x60MHz of the 1800MHz band is held by another operator (though this will be reduced to 2x45MHz before the auction).

   - In Ireland, the spectrum usage rights being auctioned in the relevant bands constitute all usage rights for the spectrum in these bands (with the exception of a number of blocks for a short time period (2013-2015)). Further, all spectrum under 1GHz will be available for award amongst bidders in the auction. Spectrum in the 2.1GHz band is allocated symmetrically across existing mobile operators, with each operator holding usage rights for 2x15MHz. The proposed 2x10MHz cap on 900MHz spectrum in the short term (2013-2015) should also prevent significantly asymmetric outcomes during this period that may damage competition by affecting business continuity of existing GSM services or limiting early access to sub-1GHz spectrum for advanced data services if equipment for such services is slow to emerge in the 800MHz band.

3) The competition assessment carried out in the UK, and the related assessment that measures to promote competition were necessary, was in the context of spectrum caps that would by themselves allow significantly asymmetric outcomes and substantial spectrum holdings amongst a small number of operators. This same correction is not necessary given the tighter spectrum caps proposed in Ireland and the proposal to award all spectrum in the relevant bands.

   - In the UK, a sub-1GHz cap of 2x27.5MHz is proposed. The most asymmetric outcome that this sub-1GHz cap would permit would be where two operators, O2 and Vodafone, maintain their existing sub-1GHz holdings and win a further 2x10MHz each, one existing mobile operator wins 2x10MHz of sub-1GHz spectrum and the fourth existing operator wins no sub-1GHz spectrum. This scenario is not that unlikely, as O2 and Vodafone would not have to compete for the full 2x27.5MHz each; they would simply have to compete for 2x10MHz each of the 800MHz spectrum available. In this scenario, without any sub-1GHz spectrum, this fourth operator would likely not be able to compete with its rivals over the time horizon considered in the competition assessment. Intervention is therefore

necessary to ensure competition where these spectrum caps are used and where a four-player market is deemed necessary.

- In Ireland, a sub-1GHz cap of 2x20MHz is proposed. The most asymmetric outcome that this would permit would be where three existing mobile operators win 2x20MHz and one operator wins 2x5MHz. This outcome is unlikely, as the value of a second block to the fourth bidder as expressed in its bids in the auction would need to be lower that the value of a fourth block to all three other bidders. In any case, in this scenario, all four bidders would have at least 2x5MHz of sub-1GHz spectrum, and where these were the existing mobile operators, all four would have high frequency spectrum even if they did not win any 1800MHz spectrum in the auction. Therefore, the case, if any, for intervention to ensure that this outcome does not occur is at best unclear and at worst unfounded.

4.4.4 Finding that Ofcom should ensure a market with four national wholesale operators

158. In its competition assessment, Ofcom considered the case for ensuring 3, 4 or 5 national wholesale providers,[29] and concluded that ensuring 4 such providers should safeguard competition over the period considered in the assessment (5-10 years). This assessment was based on an evaluation of competition, efficiency and broader social value (which it equated to widespread coverage). Each of these factors varies significantly in the case of Ireland relative to the UK, and as such, the conclusion of the UK competition assessment does not translate into a suitable prescription for the planned award in Ireland.

159. The competition assessment carried out by Ofcom considered the following issues (discussed in turn below).

Competition

160. The main thrust of Ofcom's assessment of relative attractiveness of a market with 3, 4 or 5 national wholesale providers is that more providers leads to more competitive intensity which ensures low prices and high quality and innovation. As such, relative to the option of ensuring four such providers, a market with three national wholesale competitors would have less competitive intensity.

1. An assumption underlying this conclusion is that the market can support four effective competitors in the future, that is, that the potential demand by consumers will make the roll-out and maintenance of up to four national high-speed data networks financially viable given geography and demographics. This assessment was made by Ofcom based on a potential market for services more than 13 times greater than that in Ireland based on relative populations.

[29] Ofcom defined a national wholesale operator as a company that provides wholesale access for the supply of mobile services. It noted that national wholesalers need access to spectrum and access to a network in order to wholesale mobile services. It noted further that while national wholesalers clearly need access to a national radio access network, they do not necessarily need to own it.

Imposing restrictions on auction outcomes that are not sustainable in the long run give up competition for spectrum within the auction and efficiency of the outcome without generating more intense service market competition.

161. Ireland is also very different from the UK in its demography, with a higher than average number of consumers living in very low population density areas. Indeed, schemes deemed necessary to tackle the issue of ensuring availability of broadband services to customers that are considered economically unviable to serve in Ireland (National Broadband Scheme, Rural Broadband Scheme) have not been necessary to adopt in the UK or indeed in other EU Member States. Therefore, Ofcom's assessment in the UK that this is economically feasible for four operators to be profitable in the long term does not necessarily carry across to the Irish case. This is good reason to be somewhat less restrictive in terms of the potential outcomes that the Irish auction might achieve to reflect these different circumstances.

Efficiency

162. Ofcom's assessment considers the efficient use of spectrum, spectrum fragmentation, economies of scale in networks and efficient investment and innovation. It noted that:

1. The greater number of operators Ofcom ensures, the greater the probability that spectrum will be used inefficiently;
2. Blocks of 2x20MHz of sub-1GHz are most efficient for providing services, but it may be possible for a national wholesaler to largely match the benefits of a 2x20MHz block of contiguous sub-1GHz spectrum with a combination of a smaller block of sub-1GHz spectrum and 2x15MHz or 2x20MHz of contiguous high frequency spectrum;
3. Network sharing could allow three, four and possibly five wholesale providers to operate a smaller number of networks (perhaps two or three) effectively, which if possible may mitigate or eliminate the risk of higher overall fixed costs; and
4. There is little compelling evidence that the differences in the number of national wholesale competitors (between 3, 4 and 5) would have a significant difference on investment incentives.

163. These points are relatively generic and as such likely carry over to the Irish case. However, they do not provide any evidence that four national wholesale operators might be desirable in Ireland on efficiency grounds; on the contrary, point 3 suggests that if operators were forced to become more efficient, the way to do this would be to operate two or three networks between them.

Broader social value

164. Ofcom considered that the main way that national wholesale operators might contribute to promoting broader social value would be through providing widespread coverage for mobile broadband services. It noted that while competitive intensity is likely to be higher with a larger number of national wholesale competitors, this effect is not certain, partly because there are fixed costs involved in networks, and this might tend to reduce coverage when there are more competitors. Incentives to roll out advanced data services might be reduced as well. These concerns are more acute in the case of Ireland due to the different demographics and geography.

2. Given the uncertainty underlying the effect of more competitors on coverage, we do not consider that the assessment of broader social value by Ofcom leads automatically to the conclusion that the optimal number of operators required in the Irish market is the same as in the UK. In particular, Ofcom's assessment clearly does not rule out the possibility that three competitors might be sufficient to protect competition in Ireland, or four competitors in which only three are reasonably symmetric national network operators with additional network operators having a more limited geographical focus.

4.4.5 Conclusion

165. In summary, the auction rules proposed for the planned multi-band award in Ireland have been set in the context of the conditions in Ireland to ensure that the market structure going forward will be determined not by ComReg but by the competitive rivalry amongst the mobile operators themselves. The proposed spectrum caps provide protections for downstream competition in mobile services.

166. It would be counterproductive to apply restrictions on the auction outcome, such as tighter caps or spectrum floors that lead to fragmentation of spectrum. In particular, caps and floors are only restrictions on auction outcomes and not long run market structure. Imposing unnecessary restrictions would not create a gain in long-run competitive intensity in service markets if it simply created unsustainable outcomes.

167. Ofcom's proposals for use of spectrum floors in addition to spectrum caps to safeguard competition in the UK vary significantly from the spectrum caps proposed in Ireland, and indeed appear to be fit for purpose in the UK case. However, Ofcom's proposals do not affect our view on the appropriateness of the auction format and rules proposed for a multi-band auction in Ireland.

5 Contingencies within the award process

5.1 Unsold spectrum at the end of the auction

168. There may be unsold spectrum at the end of the auction for a number of different reasons. These include:

- *Bidding behaviour during the auction:* Where demand is not granular, or where bidders transfer demand for multiple blocks of spectrum from one lot category to another, lots in a category may go from a situation of excess demand to excess supply in a round, and such lots may not be otherwise allocated later in the auction unless bidders bid for a sufficient range of packages to allow winning bids to be packed together without unallocated lots.
- *Winner determination:* In some cases, it may simply be that the highest value combination of lots being awarded to bidders based on their bids in the auction leaves lots unsold. In this case it is efficient that these lots go unsold. (Note that given the winning combination of bids will be that which generates the maximum revenue based on the sum of bid amounts associated with each bid within that combination subject to the auction rules set out from paragraph 192, it is highly likely that, were this to occur, the amount of unsold spectrum would be small.[30])

169. The suitability of a particular approach to dealing with unsold spectrum will depend on the amount and type of spectrum that is unsold at the end of the auction. Given the contingent nature of the issue of unsold spectrum, and the uncertainty attached to the amount and type of spectrum that might go unsold, we would recommend that ComReg retain the discretion to decide on how it wishes to proceed if and when the issue of unsold spectrum becomes a reality.

170. We do, however, recommend that while the suitability of an approach to spectrum left unsold in the proposed auction process be evaluated on the merits of the particular case, unless there are circumstances that merit a divergence from the general policy, a principle should be set that spectrum left unsold at the end of the auction would not be otherwise allocated for a period after the auction of at least 1-2 years. This is to avoid providing a negative incentive to bidders to "wait and see", that is, strategically withhold demand during the auction in the hope of being allocated this spectrum on the same terms as those offered in the auction in a follow-up process.

[30] The process for determining the winning combination of bids from all bids submitted in the auction is discussed in detail in Section 10.

5.2 Spectrum liberalisation prior to 2013: Preparatory licences and advanced commencement

Background

171. In DotEcon report 10/71a we considered two options available for the packaging of 800MHz spectrum in a 'big auction' with 900MHz spectrum:

- *Option 1: Auction spectrum when it is available*. In this case the first time slice for 900MHz spectrum would cover the period from May 2011 to July 2015, and the first time slice for 800MHz spectrum would cover the period from January 2013 to July 2015.
- *Option 2: Auction spectrum from a common start date*. In this case, the first time slice for both 800MHz and 900MHz spectrum would cover the period from January 2013 to July 2015.

172. We noted that option 2 had the following advantages relative to option 1:

- It avoids the risk of distortions within the auction which may arise under option 1 as a result of the differing licence lengths in the first time period, which would reduce the substitutability of the two bands;
- It has the potential to create a more level playing field amongst entrants and incumbents relative to the case where option 1 is implemented. Under option 1 incumbents would be likely to bid aggressively for 900MHz spectrum in the first period (starting from 2011), therefore, entrants may not be able to win sub-1GHz spectrum until 2013. By this time, incumbent operators may have a head start vis-à-vis deployment of high-speed networks and marketing services on any operator using 800MHz spectrum to compete in the market for provision of high-speed data services.

173. We acknowledged that the main disadvantage of option 2 relative to option 1 is the delay of the availability of such high-speed, low-cost services by preventing deployment of 3G services in 900MHz spectrum, and this could lead to the opportunity cost of foregone benefits for consumers. However, we assessed that the magnitude of this effect may in practice not be large, because:

- Only some blocks of spectrum in the 900MHz band are likely to be available for early liberalisation in practice due to the requirement to operate legacy GSM services using this spectrum for some time; and
- Any incumbent wanting to deploy 3G and 2G services simultaneously would face some delay in reducing the amount of 900MHz spectrum in use by GSM; a study by Red-M/Vilicom commissioned by ComReg estimated that in the worst case scenario it would take operators two years to do this.

174. Furthermore, we noted that under option 2 there is the possibility to adopt a number of measures that benefit from the auction outcome being known prior to the licences starting in 2013. For example, given that the assignment of 800MHz licences beginning from 2013 would be known, it would be possible to allow roll-out of infrastructure with testing prior to services being offered. Such measures would therefore mitigate much of the cost associated with the delay that arises from the second option.

175. To this end, in order to facilitate the earliest service provision, ComReg proposed in its consultation (10/71) to:

> *"issue to all winners of liberalised-use spectrum a 'preparatory' licence under the Wireless Telegraphy Act that would enable recipients to install networks and associated equipment in the 800MHz and 900MHz bands (but would not allow any wireless telegraphy transmissions) and that would commence from shortly after the conclusion of the licence award process and operate until the commencement date of new liberalised-use licences.*
>
> *In addition, during this period ComReg will consider and grant wherever possible 'test licences' to facilitate the testing of these networks and equipment."*[31]

176. Subsequently, in our report on the inclusion of 1800MHz spectrum in the proposed sub-1GHz auction (10/105a), we considered the two options for packaging spectrum in the 1800MHz band into time slices depending on whether or not we take into account the differing expiry dates of the incumbents' licences:

- Two time slices covering: 1 February 2013 – 12 July 2015 and 13 July 2015 – 12 July 2030.
- Three time slices covering: 1 February 2013 – 31 December 2014; 1 January 2015 – 12 July 2015 and 13 July 2015 – 12 July 2030.

177. Having considered the advantages and disadvantages of both we concluded that the 2-time slice option is desirable.[32]

178. However, this proposal again raised transitional issues, but we noted that these are fairly modest compared with the benefits of using the simpler approach. Further, we noted that ComReg proposed to issue preparatory licences in order to facilitate the earliest service-provision.[33] ComReg consulted on this point in its related consultation (10/105).

179. There were two further developments since responses to this consultation. First, in its interim licence proposal (11/11 and 11/29), ComReg proposed that liberalised use of spectrum may be permitted after completion of the auction and transition to locations in the band linked to the outcome of the assignment round for the first time slice, and with consent of all spectrum winners.

180. Further to this proposal, on the issue of advanced commencement of liberalised usage of spectrum allocated in the auction, in its current consultation (published as document 11/60) ComReg:

[31] Page 58 of ComReg consultation 10/71.

[32] Section 2.3 of DotEcon report 10/105a.

[33] Section 2.3.1 of DotEcon report 10/105a.

- States its commitment to commencement of liberalised licences prior to February 2013 where possible;
- Sets out a number of specific scenarios and frequencies where the feasibility of advanced commencement of liberalised usage rights is known; and
- Commits to consider the possibility of advanced commencement of liberalised usage rights for all other spectrum allocated in the auction after the auction outcome is known.

Respondents' views

181. All respondents' except H3GI agreed they would support ComReg's proposal in consultation 10/71 to issue preparatory licences in order to facilitate the earliest provision of services and test equipment (view expressed by RTÉ and ÉNL).[34]

182. In H3GI's opinion, ComReg's solution to the problem of potential inefficiencies arising from the delay in issuing licences, i.e. by issuing 'preparatory licences', is incorrect because ComReg's justification is based on the factually incorrect assessment that winners of these blocks would in any case be required to spend considerable time planning and deploying networks. H3GI states that this is incorrect because network equipment currently deployed by existing operators is UMT900MHz-ready and network equipment is currently available to support 3G services in the 900MHz band. Furthermore H3GI asserts that almost all handsets sold now support 3G in the 900MHz band. Therefore, H3GI believes that ComReg's objectives regarding mobile broadband would be best achieved by the immediate release and liberalisation of 900MHz spectrum. [35]

183. However, following from ComReg's interim licence proposal and Decision (11/29 and D03/11 respectively) indicating the possibility that licences would be liberalised prior to 2013 subject to certain conditions, and follow-up written discussion with ComReg on the issue (as published in ComReg document 11/37) H3GI noted the need for a robust and transparent process to ensure prompt completion of transitional activities by the existing mobile operators.

184. In their responses to ComReg consultation 10/105, all three of the respondents to ComReg consultation 10/105 on this issue expressed their agreement with the proposal to provide preparatory licences for the period up to 2013, with two of these respondents citing the earliest possible benefits of liberalisation for consumers as a benefit of this approach.[36]

[34] See Annex C for each respondents view on preparatory licences.

[35] Pages 14-15 of H3GI's response to ComReg consultation 10/71.

[36] Note that test licences might also be applied for and granted by ComReg for the period up to January 2013, whereby holders of such test licences may conduct tests of equipment for providing advanced data services, so that the provision of these services could commence as soon as possible given licence commencement dates and transitional issues.

DotEcon commentary

185. In respect of the current proposals, we consider that a number of issues are noteworthy.

186. First, as noted by respondents to ComReg consultation 10/105, where the proposal for preparatory licences and advanced commencement of licences awarded in the auction is implemented within the award process, this would mean, all other things equal, that advanced data services would be made available in Ireland earlier than might otherwise be the case. This is a potentially significant benefit of this proposal.

187. Second, and on a related note, the implementation of preparatory licences and adoption of a principle of advanced commencement of liberalised licences where possible before 2013 insures against delays of availability of 800MHz spectrum. In this respect, we note that while there is no reason to consider at this point that availability of 800MHz spectrum will be delayed, due to circumstances beyond its control ComReg is not in a position to guarantee its availability by January 2013. Therefore, there is value in ensuring that advanced data services will be provided in Ireland as soon as possible and regardless of availability of 800MHz spectrum.

188. Third, there is no reason to consider that there would be a significant negative effect on competition where these proposals were implemented. In this respect, we consider how this proposal might adversely effect competition.

189. Turning first to competition amongst operators within the 900MHz band, given the 2x10MHz cap on 900MHz spectrum in the first time slice and the fact that some spectrum is available in this band, there will be at least four bidders that will have the potential to benefit from the advanced commencement proposals (where the exact number will be determined in the auction). Where one or more bidders are not able to benefit from the advanced commencement option, this will not necessarily have a negative effect on competition and where it may affect competition this effect is likely to be small. This is because:

- All bidders that win spectrum in the 900MHz band in the first time slice will have the opportunity to bid for the locations in the band that will guarantee advanced commencement and those that may or may not benefit from this option.
- The maximum time lag that may exist between 900MHz licences that benefit from advanced commencement and those that do not will in any case be relatively short. In this respect, we highlight the following features of the current environment:
    - Under the current proposal, liberalised spectrum in both the 800MHz and 900MHz bands is due to be available for liberalised use from February 2013. At present, this is less than 18 months away.
    - Before spectrum in either the 800MHz or 900MHz band will become available for liberalised use, an award process has to be planned and implemented. In Ireland, this will involve, at minimum:
        - The publishing of a draft Decision by ComReg;

- A period of industry consultation;
- The publishing of a final Decision by ComReg having considered issues raised by respondents to the consultation;
- The publishing of an Information Memorandum containing details of the award process, the licences to be awarded and minimum prices for licences and associated consultation;
- The development of software for bid verification and submission, and an algorithm for determining winners and prices for both the main stage of the auction and the assignment stage based on the auction rules;
- The implementation of the auction process – submission of applications, running of the auction (where necessary), lodgement of upfront payments and award of licences.

As such, the award process itself will reduce significantly the time remaining between now and February 2013 when 800MHz spectrum is expected to become available.

- Preparatory licences mean that where a bidder were to win 900MHz spectrum in the first time slice and not be able to avail of advanced commencement, it would be able to be ready to provide services from the beginning of its licence in February 2013.

190. Considering, then, the potential effect on competition for sub-1GHz spectrum we consider that while one might argue that this earlier availability of sub-1GHz spectrum might prejudice the choice of operators between acquiring 800MHz and 900MHz spectrum, there are reasons to believe that the effect of this, if any, would be small:

- As noted above, given the expected availability of 800MHz spectrum from the end of January 2013, the time required to complete the award process and the time required for operators to re-tune their networks, the maximum amount of lead time between the liberalisation of 900MHz spectrum and the availability of liberalised 800MHz spectrum will in any case be a number of months. Given that licences awarded in the planned auction will run until 2030, this difference in availability is unlikely to have a significant effect on the long-term spectrum planning of bidders to meet their network requirements.
- The benefits of the allocation of substitutable spectrum in a unified award process would still be achieved with a high level of certainty given the similar nature of aspects of the licences other than date of availability:
  - Licence duration
  - Usage rights
  - Spectrum packaging

191. Overall, we consider that the benefits of the combination of preparatory licences and advanced commencement as proposed by ComReg may have significant benefits to consumers and little if any cost to competition. On the basis of the factors outlined above, then, we consider that there is merit in the inclusion of the proposed combination of preparatory licences and advanced commencement proposals in the planned award process relative to the

alternative option of permitting use of all spectrum allocated in the auction from February 2013.

PART B: DETAILS OF THE AWARD

6 Award format

6.1 Background

192. Several alternative options for the auction format currently envisaged have been proposed over the course of the consultation process. In this section we summarise the debate regarding the auction format, but we focus on stakeholder responses concerning detailed rules implementing the format. No respondent has raised fundamental objections to the use of the proposed auction format, and many of the points raised are now redundant in that respondent views are incorporated or addressed by the auction format currently proposed.

193. Following a description of the process behind the selection of the combinatorial clock auction format, in the following sections we consider a number of particular refinements made to the CCA format to ensure its fitness for purpose for a multi-band auction in Ireland. In the case of each of these refinements, we consider the extent to which the views of stakeholders have been addressed.

194. We first considered the issue of a suitable auction format in DotEcon report 09/99c, which was published alongside ComReg's related response to consultation and further consultation (09/99). The analysis presented in our 09/99c report and the resulting recommendation for an auction format was based on market conditions at the time (December 2009) and the assumption that the award process would include liberalised 900MHz spectrum only.

195. Two auction formats that we considered in detail in our December 2009 report were the combinatorial clock auction and the sealed-bid combinatorial auction formats. In both cases, proposals sought to first allocate spectrum to individual bidders, with specific frequencies to be assigned to spectrum winners in a follow-up process (an 'assignment stage', considered separately in Section 11.1). In the case of all formats considered, bidding would be subject to spectrum caps.

196. The combinatorial clock auction (CCA) format consists of two separate stages to allocate 'generic' or 'non frequency-specific' spectrum lots across bidders before specific frequencies are assigned in the assignment stage. The first stage of the generic lot allocation process (the 'main stage') consists of a number of open rounds ('primary bid rounds'). In advance of the start of a round, the auctioneer declares a price per lot for each lot category (where lots considered to be relatively similar are aggregated into categories). During the round, each bidder submits a single bid reflecting its demand for lots in each lot category. Bids in this stage will be subject to activity rules (discussed subsequently). A bid submitted during a round in the first stage is a bid for a package of lots across all lot categories (where the bid may contain no lots in some categories) for an amount equal to the sum of the lot price linked to each lot within the package in the round. At the end of a round, the auctioneer will assess the level of demand based on all bids submitted in the round and set a price for lots in each lot category for the following round; the price per lot for lot categories with excess demand will be increased relative to the last round, while the price per lot for lot categories with no excess demand will remain

unchanged. Rounds in this stage will continue until there is a round in which there is no excess demand for lots in any lot category based on lot prices in the round. After such a round has finished, the auction will progress to the second stage of the generic lot allocation process.

197. This second stage is a single round process ('supplementary bids round'). During this round, bidders can submit multiple bids. In this round, a bid consists of a package of lots across all lot categories (where the bid may contain no lots in some categories) for an amount specified by the bidder. Bid amounts for packages of lots are constrained by minimum prices and by bidding activity in the first stage of the generic lot allocation process.[37]

198. Following the first and second stage of the generic lot allocation process, winners and prices for spectrum are determined. Winners in the auction are determined based on all bids submitted by bidders in the first and second stage and their associated bid amounts. The winning combination of bids will be that which generates the maximum revenue based on the sum of bid amounts associated with each bid subject to the following rules:

- Where multiple bids are submitted by a bidder for the same package (e.g. where a bidder submits a bid for the same package of lots in multiple rounds), only the highest bid amount will be considered for that package in the determination of winners;
- Bids will only be considered in their entirety, that is, the winning combination of bids will not award to any bidder a subset of one of its bids; and
- There can only be a maximum of one bid of any bidder within the winning combination of bids.

199. Following the determination of winners, the price to be paid by each winner is determined based on a 'second price' rule, which promotes truthful bidding by ensuring that winners pay an amount for the spectrum they are awarded based on the opportunity cost of their winning it. It also allows bidders to compete for larger packages of spectrum without necessarily increasing the price of smaller packages they might also be interested in winning depending on the relative price of small and large packages.[38]

200. The sealed-bid combinatorial auction (SBCA) format is identical to the second stage of the generic lot allocation process in the CCA, including the associated winner and price determination process, with the exception that owing to the single-round nature of the format, bid amounts linked to lot packages bid for

[37] The constraint proposed for the CCA, the 'relative cap activity rule', is described in detail in paragraphs 204 to 207.

[38] For a detailed description of second price rules in general, see http://www.dotecon.com/index.php?target=publications&subtarget=papers. For a description of the specifics of the winner and price determination specifically proposed for this award, see Section 10 of this report.

in an auction using a SBCA format will not be subject to constraints based on bidding in previous rounds, but will be constrained only by minimum prices.

201. In 09/99c, we assessed the relative merits and drawbacks of these two formats and recommended the use of a sealed-bid combinatorial auction format. Our resulting recommendation was based on an evaluation of the relative benefit of reducing common value uncertainty using an open auction versus the greater risks of strategic behaviour to weaken competition in such a format.

202. Our subsequent report on the auction process, which proposed to award spectrum including 900MHz frequencies, DotEcon report 10/71a, was published alongside ComReg's consultation (10/71) in September 2010. It revisited the relative merits and drawbacks of the CCA and the SBCA formats given a number of developments:

- In their responses to ComReg consultation 09/99, some existing 900MHz operators argued that there is considerable common value uncertainty, thus strengthening the case for an auction format with open rounds - the CCA in this case.
- In response to ComReg consultation 09/99, Vodafone and O2 objected to the proposed SBCA format on the basis that Vodafone itself, O2 or indeed both of these operators faced a risk that they would not be assigned any spectrum in the 900MHz award, and that were this to happen there would be unavoidable disruption to consumers. This argument centred on providing bidders with the opportunity to re-bid due to the difficulty of refining estimates of the value of business continuity. Further to this assertion, Vodafone presented detailed data as to the number of customers that would be affected were it not to secure at least 2x5MHz of 900MHz spectrum. Consequently, both operators favoured an open auction alternative.
- The proposed inclusion of spectrum in the 800MHz band in the auction as a result of a more certain timetable for release of this spectrum from its existing use for broadcasting (the 'digital dividend'), and the consequent increase of supply of sub-1GHz spectrum and related spectrum caps that this would represent, means that the need to protect competition against collusive behaviour is weakened, as the benefit of strategic demand reduction, by one or more operators, is less clear.[39] Further, other measures such as a market value-based minimum price, a CCA format used in combination with a second price rule and limited transparency during the auction were proposed in combination with the increased supply of sub-1GHz spectrum to address this issue.

[39] Note that while the issue of strategic behavior on the part of bidders became a less important issue as a result of increased supply of spectrum, this is still an issue that needs to considered in light of proposals for the award process. In addition, current proposals introduce a cap on 900MHz spectrum in the first time slice. Therefore, issues of strategic behavior should be considered in particular for this time period in this band.

203. Taking the first two issues into account, the perceived balance of the CCA and the SBCA shifted somewhat, as we considered that the issue of business continuity risks might be significant enough to tip our recommendation from a SBCA to a CCA for an award of spectrum usage rights in the 900MHz band. Further to this recommendation, given that the propagation characteristics, technical restrictions and packaging of spectrum in the 800MHz band[40] are essentially the same as those of 900MHz spectrum, we considered that 800MHz and 900MHz spectrum would be substitutable in the long run, and as such it would be beneficial to include spectrum available in both bands in the same award process.

204. In order to further address the issue of business continuity, in addition to proposing the shift to a multi-round combinatorial auction format, the CCA, in DotEcon report 10/71a we also recommended the use of a particular rule for constraining the bids of bidders in the second stage based on their bidding behavior during the first stage of bidding - the relative cap activity rule.

205. As described in 10/71a, under this approach, a standard eligibility-points rule is used to determine activity and eligibility to bid in the first stage of the generic lot allocation process.[41] In the second stage of this process, the supplementary bids round, the following rules would apply to bids made in this round:

- There is no limit on the supplementary bid that can be made for the package of lots bid for in the final primary bid round (provided that the bidder is still bidding for some non-zero package).
- The supplementary bid for *any other package A* is subject to a cap determined in the following way:
    1. First, determine the last primary bid round in which the bidder would have been eligible to bid for package *A*. Call this round *n*. This will either be the final round or some round in which the bidder dropped its eligibility to bid (by reducing the number of blocks bid for in one or both categories) and so gave up the opportunity to bid for package *A* in later rounds.
    2. Suppose that the bidder bid for package *B* in round *n*;
    3. The supplementary bid for package *A* cannot exceed the bid for package *B* (i.e. the supplementary bid for this package, if one is made, or otherwise the primary round bid) plus the price difference between packages *A* and *B* that applied in round *n* (i.e. the packages are priced at the round *n* prices).

[40] European Commission Decisions 2010/267/EU and 2011/251/EU on the harmonisation of the 800MHz band and the 900MHz and 1800MHz band respectively. European Commission Proposal 2010/471 for European radio spectrum policy programme.

[41] The proposed eligibility points system proposed as part of the design for this auction is discussed in detail in Section 7.

206. The intuition behind this rule is that having already been given the opportunity to decide between *A* and *B* in round *n* and choosing *B*, this reveals the premium that the bidder is prepared to pay for *B* relative to *A*. In making supplementary bids, the bidder cannot then dramatically increase its bid for *A* relative to that for *B* and overturn the preference it has already revealed.

207. The caps in effect chain back to the supplementary bid made for the final package (i.e. the package bid for in the final primary bid round). This means that if the supplementary bid on the final package is increased, then all other supplementary bids can be increased. It is only the *relative* amounts bid for different packages that are constrained by the relative cap activity rule.

6.2 Respondents' views

208. Notwithstanding the general disagreement of some respondents with the use of an auction, or with the proposal to award all spectrum in the bands available, the use of the combinatorial clock auction format for the proposed award has received a high level of support in stakeholders' most recent responses to ComReg consultations on the proposed award process.[42]

209. The use of the relative cap activity rule as part of the CCA proposals described in 10/71 was welcomed by respondents to this consultation. Indeed, two existing mobile operators explicitly mentioned the benefit of the CCA used in combination with the relative cap activity rule:

- One respondent, Meteor, stated that together the use of the CCA and relative caps provide greater safeguards against unintentional loss of business continuity; and
- The other respondent, Vodafone, went further to state that the proposal to use the CCA and relative caps together must be retained in any final decision if the concerns around risks of service disruption are to be effectively addressed.

6.3 DotEcon commentary

210. Based on our own assessment and on the view of respondents, we consider that the use of the CCA format, and the use of relative caps for constraining supplementary bids, are uncontested aspects of the proposed award process.[43]

211. In DotEcon report 10/105a, following an assessment that there would be value in including 1800MHz spectrum in the proposed sub-1GHz award, we considered the adjustments that would need to be made to the auction design

[42] For a description of views expressed on the subject, see Annex D.

[43] O2 raised the issue that the auction rules should guarantee that provisional winners in the final primary bid round are allocated their final primary package or more, and that this 'knock-out' strategy should be stated by the auctioneer at the appropriate time. We note that the precise details regarding information that will be available to bidders to aid them in deciding on the value of supplementary bids they wish to place will be provided in the Information Memorandum.

in order to incorporate spectrum in the 1800MHz band within the proposed sub-1GHz auction. Given that the factors influencing the choice of auction format were not considered to change significantly with the addition of 1800MHz frequencies to the planned auction process, we did not fundamentally revisit the choice of auction format with the addition of the 1800MHz band in our report.

6.4 Aspects of the award considered further

212. While some aspects of the award process received widespread support, respondents to the various ComReg consultations have raised issues or objections, or have sought more information, with regard to other aspects of the award process. In the following sub-sections, we provide background, present stakeholder views and provide our own views on these responses with regard to a number of aspects of the proposed auction:

- Use of eligibility points and activity rules;
- Use of two time slices with transferability of eligibility points across bands and non-transferability of eligibility across time slices;
- Provision of an early liberalisation option for operators with existing holdings in the 900MHz and 1800MHz bands; and
- Use of a full assignment round and other transitional issues.

213. Note that in the following sections, a number of aspects discussed deal with the detail of an auction. These aspects are discussed to this level of detail for information purposes at the request of stakeholders in their responses to ComReg's consultations on the planned auction. Appropriate elements of the detail of these aspects of the award process will be finalised in the Information Memorandum.

7 Eligibility points and activity rules

7.1.1 Background

214. We consider the issue of a unified award process for spectrum in these bands in Section 2. In this section, we assume the use of a unified award process for this award and set out how a system of eligibility would work in this case using eligibility points. First, however, we summarise our proposals thus far in this sub-section, and consider the comments on this made by respondents to ComReg's various consultations on this issue in the following sub-section.

215. Considering, then, our proposals thus far, in our first report for ComReg on aspects of an award process to allocate 900MHz spectrum (09/99c), given the proposal at the time to have a sealed-bid combinatorial auction, we did not consider the issues of eligibility points or activity rules during the auction.

216. As noted in the previous section, in our second report in September 2010 (10/71a), we took account of bidder responses to 09/99 in favour of a multi-round rather than a single-round combinatorial process and the availability of 800MHz spectrum, and proposed a combinatorial clock auction format for award of 800MHz and 900MHz spectrum. This format is equivalent to the previously proposed sealed-bid combinatorial auction preceded by a number of open rounds.

217. In order to take account of the fact that Meteor has spectrum usage rights for 900MHz frequencies until July 2015, in 09/99c we proposed that spectrum usage rights until 2030 be packaged in two different blocks of time ('time slices') – up to 2015 and 2015-2030.[44] We considered that this did not raise issues for bidders in terms of bidding risks, as package bidding provides the facility for bidders to avoid the risk of only being awarded spectrum in one time slice and not the other. This proposal was preserved in concept in our 10/71a report.

218. Given the existence of two time slices not equal in duration and spectrum in two different bands, we needed to consider where the value of lots in the auction are likely to differ substantially and, where this is the case, augment our modified proposals with rules that put in place and maintain an 'exchange rate' for transferring bidding behaviour during the auction.

219. In this (10/71a) report, we concluded that given the substitutability of 800MHz and 900MHz spectrum, bidders should be permitted to transfer their bidding from lots in one band to lots in the other freely. However, we did not consider that bidders would benefit from being able to transfer their eligibility to bid from one time slice to the other.

220. Therefore, for an auction of spectrum in the 800MHz and 900MHz bands, we proposed that there would be four distinct lot categories:

- 800MHz lots in time slice 1 (6 lots);

[44] The time-slice proposal is considered in detail in Section 8.

- 800MHz in time slice 2 (6 lots);
- 900MHz lots in time slice 1 (5 lots, where Meteor's frequencies would remain with it for this period); and
- 900MHz in time slice 2 (7 lots).

221. As part of this proposal, bidders would have a total amount of eligibility to bid in each time slice, and would not be able to increase bidding in one time slice as a result of reducing bidding activity in the other. However, within a time slice, a bidder would be able to switch its bidding between 800MHz and 900MHz lots subject to a cap on total bidding activity within that time slice. Given the similarities of 800MHz and 900MHz spectrum, we proposed that eligibility within a time slice would be counted simply as the number of 2x5MHz lots bid for (i.e. equal weight would be given to 800MHz and 900MHz categories). The number of lots bid for in each time slice could not be increased from one primary bid round to the next, but within a time slice bids could be switched between the 800MHz and 900MHz bands. That is, in the first primary bid round, the choice facing a bidder would be how many lots in each spectrum band in each time category it wishes to be assigned at the unit prices for lots in a category at the relevant reserve prices applicable at the application stage plus one price increment. The level of price increments would be set by the auctioneer based on the level of excess demand for different types of spectrum.

222. In our third report in December 2010 (10/105a) we assessed the modifications of the award process necessary to include 1800MHz spectrum in the planned sub-1GHz spectrum auction, including the extension or modification of eligibility and activity rules. We considered that given our belief regarding complementarity of sub-1GHz spectrum and 1800MHz spectrum, and their substitutability at the margin, we would want to allow the transfer of bidding eligibility from sub-1GHz spectrum to 1800MHz spectrum and vice versa. We also considered that there would likely be value differences between sub-1GHz spectrum and 1800MHz spectrum on account of differing levels of supply and differing intrinsic value (in terms of differing propagation characteristics) that would need to be addressed in the proposed auction rules on eligibility and activity. In particular, we would need to make an adjustment that would preserve the incentive for bidders to state their demand for lots in different bands truthfully so as to preserve the integrity of the information coming from bids in the primary bid rounds.

223. In estimating an adequate exchange rate, then, we would wish to allocate a number of eligibility points to each lot so that they reflect to some degree the relative value differences between bands. (Note that we do not need the eligibility weights to be an exact reflection of the relative values of different bands; a loose approximation to these relative values should be sufficient to neutralize the effect that one-to-one transferability of bidding across lots of different value may have on bidding behaviour in the primary bid rounds).

224. The findings in our benchmarking report (10/105a) suggested that the value of a 2x5MHz lot of 1800MHz spectrum is approximately half that of a 2x5MHz sub-1GHz lot. Therefore, we proposed that sub-1GHz lots would have twice as many eligibility points associated with them as 1800MHz lots:

Band	Number of eligibility points attributed to a 2x5MHz lot in a given time slice
800MHz band	2
900MHz band	2
1800MHz band	1

225. We considered that based on these eligibility points, bidders would be able to reduce their demand or transfer demand across categories of lots within a time slice in response to price developments in a way that is sensible in the context of the types of combinations of spectrum that an operator could reasonably use to provide services.

7.1.2 Respondents' views

226. Only the four existing operators responded to consultation 10/105 which presented our full proposals on eligibility and activity rules.[45] Of these, three operators expressed a view on the proposal:

- Two operators, O2 and Vodafone, agreed that different weightings for eligibility points between 1800MHz and sub-1GHz spectrum is a reasonable approach in principle.
- One operator, Meteor, noted that the ratio of eligibility between the sub-1GHz and 1800 MHz bands should reflect the underlying value of these spectrum bands.

However, none of these commented on the appropriateness of the 2:1 ratio in particular.

7.1.3 DotEcon commentary

227. Given the positive views expressed on this issue, and the relatively uncontroversial nature of the proposal based on the number of responses to the relevant part of the related ComReg consultation (Q11 of 10/105), we view that the proposed 2:1 ratio should be adopted for sub-1GHz and 1800MHz spectrum.

[45] Responses on this issue are illustrated in Annex E.

8 Spectrum packaging

8.1 Background

228. The key features of the proposed auction design are as follows:

- **Lot size:** Spectrum in all three bands will be awarded in lots of 2x5MHz.
- **Licence duration:** All licences awarded in the auction will be of finite duration.
- **Two time-slice proposal:** Spectrum in these bands will be awarded from January 2013 to July 2030 in two distinct licence periods ('time slices'), which, although separate, can be bid for together in the award process:
  - 1st time slice: Spectrum rights of use covering February 2013 to 12 July 2015; and
  - 2nd time slice: Spectrum rights of use covering 13 July 2015 to 12 July 2030.

  The two time-slice are needed to take account of the fact that, for a small part of the licensing period, there will continue to be existing licence holders in the 900MHz and 1800MHz bands:
  - In the 900MHz band, Meteor, whose licence expires in July 2015.
  - In the 1800MHz band, O2 and Vodafone, whose licences expire in December 2014, and Meteor, whose licence expires on 12 July 2015.
- **The possibility of interim licences from December 2014 to July 2015 (1800MHz band):** In the case where O2 or Vodafone were not to avail of the early liberalisation option for its spectrum in the first time slice, and did not win sufficient liberalised spectrum in the first time slice but won liberalised spectrum in the second time slice, there would be a period of about six months between the expiry of their existing licences and the commencement of new liberalised licences, raising the issue of whether ComReg would need to provide licences for the interim period to ensure continuity of GSM services. Given the contingent nature of this potential requirement and the reasons stated by ComReg in consultation 10/105, ComReg did not propose to issue interim licences for this period at this point in time, while at the same time not discounting the consideration of future applications for GSM 1800MHz interim rights for the relevant period if the need arises.
- **Early liberalisation option (first time slice):** In DotEcon's report on the future use of spectrum in the 900MHz and 1800MHz bands in December 2009 (09/99c) and in ComReg's associated response to consultation and further consultation (ComReg document 09/99), it was proposed that the existing operator Meteor, which held a GSM-only licence in the 900 MHz band for the first time slice, could bid in the auction for liberalised spectrum in this time slice. Where such spectrum for the first time slice was awarded, Meteor would be given a rebate for the terminal value of its GSM-only licence relinquished in exchange for the award of liberalised licences. In consultation 10/105 on the inclusion of 1800MHz spectrum in the planned sub-1GHz award, this proposed approach was extended to include the GSM-only licences for the first time slice held by O2, Vodafone and Meteor in the 1800MHz band.

- **Preparatory and test licences until 2013:** ComReg proposed in consultation 10/71 that where liberalised spectrum licences are awarded from January 2013, holders of such licences will be eligible for preparatory and test licences (where possible) covering the period from the end of the auction up to January 2013 which will enable them to roll out network infrastructure using GSM and/or other approved technologies and to run tests using this infrastructure.
- **Interim licences to January 2013 (900MHz band):** Given the short amount of time between now and the expiry of O2 and Vodafone's existing 900MHz licences in May 2011, ComReg decided in a separate response to consultation and draft Decision (ComReg document 11/11) to provide interim licences to these operators from May 2011 to January 2013 on an unliberalised basis to preserve the status quo until liberalised spectrum can be made available in an appropriate award process. (Note that as this issue was taken out of this consultation process and dealt with in ComReg 11/29 and Decision 03/11, views on these proposals are not considered here.)
- **Advanced commencement of liberalised 900MHz contingency:** ComReg proposed (in ComReg document 11/11 and 11/29) that where all holders of spectrum licences relating to frequencies in any of the 800MHz, 900MHz and/or 1800MHz bands agree, liberalised usage rights of spectrum in the 900MHz band could be conferred upon all holders of this spectrum from the point when all re-tuning and relocation within the band is complete, on or before January 2013.

229. In the following sub-sections, we discuss in turn a number of aspects of spectrum packaging in the proposed award that about which there has been comment amongst respondents. Equally, there are other features of the spectrum packaging which are uncontroversial and have not been the subject of response which we do not consider further here.

8.2 Two time-slice proposal

8.2.1 Background

230. The spectrum offered in the proposed award process will become available at different dates between early 2013 and mid 2015 due to the different expiry dates of existing licences in different bands. In our report on the future of spectrum in the 900MHz and 1800MHz band in December 2009 (09/99c), we proposed that the award of 900MHz spectrum would be on the basis of two consecutive licensing periods, 2011-2015 and 2015-2030 to take account of Meteor's existing licence. Then, in considering the inclusion of 800MHz and 900MHz in a joint award (10/71a), we proposed that 800MHz spectrum would be awarded in two distinct time slices concurrent to those proposed for 900MHz spectrum given the substitutable nature of spectrum in these bands.

231. Following this, in our report considering the necessary modifications to the auction design proposals to incorporate spectrum in the 1800MHz band (10/105a), we considered two alternative options for the extension of the temporal lots concept to incorporate 1800MHz spectrum. This inclusion

created the issue that while the expiry of one existing licence in the band, that held by Meteor, coincides with the date of expiry of Meteor's existing 900MHz licence (and the end of the proposed first time slice) in July 2015, the two other licences in the band, those held by O2 and Vodafone, expire about six months beforehand in December 2014.

232. One main advantage of a unified award process is to allow for the switching of bids for spectrum in different bands in an auction as relative prices develop. To reap the full benefits of providing such flexibility, it is important to apply the same temporal lot structure across all substitutable bands. If time periods for different bands do not match up, this inhibits the ability of bidders to switch between bands, especially if there is a cap on the overall amount of spectrum they can hold at any one time.

233. The first of the alternative options considered applied the two time-slice approach adopted in the 800MHz and 900MHz bands to the 1800MHz band. The second alternative option applied three time-slices to all bands, which would allow the movement of O2 and Vodafone to liberalised licences from January 2015 if they wished to bid for these licences. The alternative time-slice proposals are presented below:

- Alternative 1: Two time-slice option
    - January 2013 – July 2015
    - July 2015 – July 2030
- Alternative 2: Three time-slice option
    - January 2013 – December 2014
    - January 2015 – July 2015
    - July 2015 – July 2030

234. On the one hand, the two time-slice option is a straightforward modification of earlier proposals for the sub-1GHz band, but allows for certain auction outcomes that might require ComReg to consider issuing interim licences to O2 and/or Vodafone to ensure continuity of GSM services. On the other hand, the three time-slice option would avoid the need for such interim measures, but only at the cost of substantially higher complexity in terms of bidding in the auction and the risk of increased re-tuning costs for one or more operators as a result of the auction outcome.

235. It was considered that, on balance of these effects, the two time-slice option applied in all bands in the auction represented the best packaging option across time.

8.2.2 Respondent's views

236. Of the respondents to ComReg consultations 10/71 and 10/105 that expressed an opinion on the issue of time slices, none were in favour of the three-time slice option.

- Some respondents objected to the whole award process or the temporal packaging in general but, while upholding their general objections, preferred the two-time-slice option over the three-time-slice option.
- Some respondents argued that 800MHz spectrum should be awarded in a single temporal lot, as there are no existing licences in that band.

- Two respondents argued against temporal packaging in general and suggested the award of indefinite licences with five years termination clause, or licences with pre-defined renewal rights.
- As an alternative to multiple temporal lots, one respondent, Vodafone, proposed a buy-out option where ComReg would buy back existing licences in both the 900MHz and 1800MHz bands (at prices based on those determined within the auction) to make all spectrum in the proposed award available from the same date (January 2013).

8.2.3 DotEcon commentary

237. We consider that the three-time slice option is unnecessarily complex and that the additional flexibility it provides relative to the two-time slice approach is not sufficient to justify taking such a complex approach. As respondents are in unanimous agreement that the three time-slice option is not desirable, this option is not considered further.

238. As summarised above, two distinct variants of the two time-slice option were proposed by respondents for the award of 800MHz, 900MHz and 1800MHz spectrum:

- One time slice for spectrum in the 800MHz band, two time slices for the 900MHz and 1800MHz bands; and
- One time slice for spectrum in all bands, as provided for by a buy-out of existing 900MHz and 1800MHz spectrum licences by ComReg.

We consider each of these alternatives below.

Single time slice in the 800MHz band

239. The main advantage of awarding lots of 800MHz spectrum in one time slice only for 2013 to 2030 as compared with two time-slices for all bands is that bidding in the auction would be somewhat simpler. However, this benefit is limited for a number of reasons:

- If a bidder were to bid on 800MHz spectrum only, it would benefit from only making bids for lots in one time slice. However, in the alternative scenario where there were two time slices in this band, to place the same bids as in the one time-slice case it would simply need to include in its bids two time slices rather than one for the number of lots it wished to bid for. Therefore, provided the auction format allows for package bidding, this is more a benefit of convenience than simplicity.
- If a bidder were to bid on spectrum in bands other than the 800MHz band, it would need to express its demand for these lots across the two proposed time slices anyway.

240. In contrast, if it is considered that 800MHz and 900MHz spectrum are substitutes (a point on which there is general agreement),[46] compared with

[46] We note a qualification in this respect as raised by H3GI and Qualcomm that 800MHz and 900MHz spectrum are not always substitutes.

the two time-slice option for all bands, bidders will be significantly limited in the bids they can place for sub-1GHz spectrum. To see the effect that this may have on bidders and their ability to express their demand for different combinations of spectrum, consider for example the case of the existing 900MHz operators. Such operators are likely to have three factors driving their valuations for sub-1GHz spectrum:

- Demand for 900MHz spectrum to maintain GSM services;
- Demand for 900MHz spectrum to provide high-speed data services; and
- Demand for 800MHz spectrum to provide advanced data services.

241. It is reasonable to assume that such a bidder's 900MHz spectrum requirement for continuing to provide GSM services will be reducing over time and become relatively small. Therefore, a reasonable follow-on assumption is that there will be demand by existing 900MHz operators for at least some 900MHz spectrum in at least the first time slice.

242. However, it is also reasonable to assume that the other two drivers of demand for sub-1GHz spectrum, the acquisition of spectrum usage rights for 800MHz and/or 900MHz spectrum for providing advanced data services, is somewhat flexible and the choice of preferred band may depend on the relative prices of spectrum in these two bands. Therefore, it is possible that a bidder may be prepared to switch some of its demand from 900MHz spectrum in the first time slice to 800MHz spectrum in the second time slice where its GSM spectrum requirements have decreased and if the relative prices of the two bands make this a profitable option. However, in the case where 800MHz spectrum is only available in a single time slice, flexibility to shift from 900MHz to 800MHz (or a mixture of spectrum across both bands) is much curtailed. The value of an incumbent's bids for 800MHz spectrum would be depressed by the fact that it also needed 900MHz spectrum for business continuity reasons, but was forced to buy 800MHz also for that period.

243. This is just one illustration of how the expression of demand for sub-1GHz spectrum might be limited by the packaging of 800MHz spectrum in one time-slice alongside the 900MHz and 1800MHz bands packaged in two time-slices. As a general principle, all substitutable bands should be provided using the same time-slices if flexibility is to be maximised and the auction process allowed to explore a full range of potential alternative outcomes.

244. Note that the additional complexity of two-time slices for 800MHz can be entirely avoided by a bidder who only cares about winning 800MHz spectrum for the whole period 2013-2030. Such a bidder can simply always bid for both time-slices and would only need to take a view about the value of spectrum over the whole period 2013-2030. In effect, such a bidder could entirely ignore the additional bidding options that the two time slices allowed.

245. While we do not know with any degree of certainty the extent of the actual cost of limiting auction outcomes across substitutable 800MHz and 900MHz spectrum, given the limited benefit of packaging 800MHz spectrum in one time slice we consider that, on balance, the two time-slice option across all time slices offers a better and lower risk option relative to the one 800MHz time-slice alternative. Such an approach would treat all bands similarly, maximize flexibility for bidders (which they need not use if they did not want

to) and avoid distortions to the auction outcome that might result from an asymmetric treatment of the bands.

One time slice for all bands with spectrum buy-out

246. In relation to this option as proposed by one consultation respondent, Vodafone, we note two significant issues:

- Firstly, while this proposal does indeed simplify the auction design, it is not clear that this leads to any significant benefits relative to the current proposals.
- Secondly, there are a number of requirements within this proposal that mean that it is likely to be unviable within a reasonable timescale.

247. Considering this first point, we note Vodafone's assertion that this proposal will provide major benefits relative to the current auction proposal because of there being:

- No need for temporal lots
- No need for licences for the period between December 2014 and July 2015
- No need for an early liberalisation option

248. Considering first the issue of temporal lots, given the package bidding facility inherent in the auction format selected for the award, the combinatorial clock auction, the advantage of there being no temporal lots is very limited. If a bidder has value only for lots from as soon as possible to 2030, the temporal lot structure would have the effect only of requiring the bidder to include in its bids during the auction, for each lot it wishes to bid on, the relevant lots in the first and second time slice instead of just one time period. Where all bidders do this, package bidding will ensure that for a given number of lots in a given category, the bidder will either win these lots in both time periods or in neither. This issue is entirely one of convenience, and as such should not be considered as a significant factor in deciding between alternative auction design proposals.

249. Considering then the issue of licences for the period between December 2014 and July 2015, we note that:

- Depending on the outcome of the auction, these may or may not be required; and
- ComReg has stated that given this issue will only arise where existing operators are presented with the option of liberalising their existing licences and choose not to, where they are necessary such licences will cover current use only.

Given these factors, we do not consider that the potential issuance of short-term licences for 6 months on terms that would be similar to those linked to existing GSM licences represents a significant complexity that existing operators would benefit greatly from avoiding.

250. Turning then to the issue of early liberalisation, this is not a feature generating substantial complexity:

- As aforementioned, the two time slices required for this option do not introduce complexity and can be reduced to an inconvenience factor for bidders not holding existing spectrum licences for the first time period;
- The main tenets for calculating any rebates required – the purchase price and the time left until expiry of the licence – are straightforward and have been set out in public since December 2009. Further, it has always been intended that the exact value of rebates, where relevant, would be set out in advance of the auction.
- Bidders with existing spectrum holdings will know throughout the auction process the 'upgrade price' of licences for existing 900MHz and 1800MHz spectrum - the round price of the relevant spectrum in the first time slice minus the related rebates.

251. To re-iterate, then, overall we do not consider that the complexity of the auction process as a result of the early liberalisation option and associated two time slice proposal is significant, and we do not believe that the benefit of removing this complexity is sufficiently great as to merit the adjustment of the auction design as currently proposed.

252. Moving then to the second point, we note that simplicity within the auction mechanism itself is not the only consideration in assessing the relative merits of alternative auction proposals. In particular, we need to consider the requirements of a "buy-out" mechanism that would allow a single common time period for all licences.

253. The simplicity benefit of this proposal (in the limited sense of simplifying the auction design) can only be realised where all operators in the 900MHz and 1800MHz bands opt to 'sell' their existing licences notionally to ComReg, so that this returned spectrum can be awarded as liberalised spectrum from 2013. This possibility raises the issue of the ability of such bidders to vacate their existing licensed spectrum or, more realistically, to reduce their spectrum holdings in these bands prior to January 2013 were this required on the basis of the auction outcome. Considering this possibility, it is clear that amongst the existing GSM operators, there are two very different situations:

- Over the relevant period (2013-2030), O2 and Vodafone have existing licences for 1800MHz spectrum only for part of this period. This band has 2x75MHz of spectrum, 2x31.8MHz of which is currently unassigned. Further, during the consultation period, ComReg has highlighted that existing 1800MHz operators are not making widespread use of their existing spectrum holdings. In addition, both O2 and Vodafone have alternative high frequency spectrum that could be used for serving customers if necessary. Taking each of these factors into account, it is clear that:
    - The probability of these operators not winning 1800MHz spectrum, or winning sufficiently less than their existing holdings to call into question its ability to serve its customers, is low; and
    - Were at least one of these operators to be awarded less than their existing spectrum holdings, they would have sufficient notice and alternative means of serving customers by the relevant time to ensure service continuity to these customers (using either sub-

1GHz spectrum allocated to it in the auction or using its existing 2.1GHz spectrum holdings).

- In contrast, over the relevant period, Meteor has existing licences for both 900MHz and 1800MHz spectrum (until July 2015). While the situation with respect to its 1800MHz spectrum licence is likely to be similar to that of O2 and Vodafone, it is likely to view its licence in the 900MHz band very differently. The 900MHz band (2x35MHz) is significantly smaller than the 1800MHz band (2x75MHz), and the fact that there is 2x13.4MHz of spectrum currently unassigned in this band conceals the potential for strong demand for this spectrum. ComReg has itself deduced that there is likely to be excess demand for spectrum in the 900MHz band. Spectrum holdings will need to transition into blocks of multiples of 5MHz and all existing 900MHz operators have made their cases to ComReg for at least 2x10MHz and, in addition, H3GI has over the duration of the consultation process made the case for immediate award of 900MHz spectrum. Various trials carried out in the 900MHz band made public during the consultation process have shown that existing 900MHz operators will need at least 2x5MHz to maintain GSM services.[47] A technical study commissioned by ComReg has shown that the cost in time and money to a 900MHz operator of reducing its 900MHz spectrum usage from 2x7.2MHz to 2x5MHz would be substantial,[48] and operators themselves have provided evidence that the implications of ending up with no 900MHz spectrum within a short timescale would be detrimental to their ability to provide continuity of service to their customers.[49] Therefore, it is clear that:
    - Meteor has a strong incentive to win a sufficient amount of 900MHz spectrum, an amount similar to its existing spectrum holdings, in order to serve its customers; and
    - Were Meteor to be awarded less than its existing spectrum holdings, it could struggle to provide service of a similar quality to its customers.

254. Given the position of each of these operators then, while Vodafone and O2 may be willing to accept the risks involved in selling its existing 1800MHz licences, Meteor is in a different position. This is because in order to benefit from a simpler lot structure Meteor would have to agree to ComReg buying back its 900MHz licences as well as its 1800MHz licences. This 'buy-back' option therefore represents a much greater risk to Meteor than it does to O2 or Vodafone. It is unlikely that a 'buy-back' solution, the terms of which are acceptable to Meteor, could be agreed with ComReg within a timeframe that is

[47] Responses of Vodafone and Meteor to ComReg consultation 09/14 – see ComReg document 09/51s.

[48] Vilicom and Red-M (September 2010), "Retuning and relocating GSM900 spectrum assignments in Ireland", ComReg document 10/71c.

[49] In their responses to ComReg consultation 09/99, Vodafone and O2 have presented information on the magnitude of the likely effect to their customers of winning only 2x5MHz of 900MHz spectrum or no 900MHz spectrum at all.

in keeping with an auction that ensures an acceptable amount of time prior to new licence commencement in January 2013. Put simply, setting terms for a buy-back arrangement is problematic and if disputed would lead to significant delay.

255. Moving on then to the price that ComReg would pay, or offset against payments for spectrum allocated in the auction, for the licences returned to it, it has been proposed by Vodafone that this price 'be derived from the final prices realised from the auction' derived using a methodology 'similar to that proposed for parties availing of the early liberalisation option under ComReg's current proposals'. This comment does not properly reflect ComReg's proposals, as calculation of the terminal value of Meteor's 900MHz licence in current proposals is calculated in advance of the auction and is based on its existing value as a GSM licence, which is completely decoupled from its value if awarded in the auction as a liberalised licence; it is the terminal period of an unliberalised licence that may be relinquished, not a liberalised one. Leaving this point to one side, we note that the methodology for calculating the terminal value of Meteor's 900MHz licence, and indeed the rebate concept, has generated significant debate within the consultation process thus far. This highlights the fact that it is unlikely a price linked to the spectrum buy-back option, or indeed a methodology for calculating such a price, could be agreed in a relatively short timeframe.

256. In short, we consider that two important conditions to be met in order to consider the one time-slice option with spectrum buy-back – unanimous agreement to return existing licences in the 900MHz and 1800MHz band to ComReg and the price to be paid by ComReg for these licences – cannot be met in a timeframe that is in keeping with a timely award process. Therefore, apart from the fact that the only significant benefit of this approach is a somewhat simpler auction, we do not consider that this is a realistic option open to ComReg for this award.

257. Taking into account these two issues – lack of significant benefit from simplifying the auction process and lack of feasibility in implementing the alternative proposal in a timely fashion – we consider that this alternative option does not present an option whose value is greater than that of current proposals.

8.3 Other aspects of packaging

8.3.1 Background

258. As discussed in Section 8.1, ComReg has made a number of proposals regarding the packaging and licensing of spectrum from now until 2030. In Table 1 below, we summarise these proposals and comment on the state of debate surrounding each aspect of the proposals:

Table 1: Aspects of packaging and licensing and corresponding status

Aspect of packaging/licensing	Status of issue
Lot size	There is general agreement on this issue.
Licence duration	While a number of operators are still stating their desire for indefinite licences, ComReg has been consistent in its view that licences awarded in the planned process should be for a fixed term.
Two time-slice proposal	Responses addressed in Section 8.2.
Interim licences from December 2014 to July 2015 (1800MHz band)	This issue was raised in the most recent consultation on the award and respondents have raised issues with the proposed approach.
Early liberalisation option (first time slice)	There is general agreement on this issue.
Preparatory and test licences until 2013	These are generally uncontroversial. However, they are in any case considered further in Section 5.2.
Interim licences to January 2013 (900MHz band)	This issue has been taken outside the consultation on the award process and has been addressed by ComReg in its response to consultation (11/29) and Decision (D03/11).
Advanced commencement of liberalised 900MHz contingency	Responses addressed in Section 11.

259. It is clear from the table above that many of the responses to these proposals have been positive, dealt with previously or dealt with elsewhere in the current report. One outstanding issue considered briefly below is that surrounding interim licences in the 1800MHz band from the period from December 2014 to July 2015.

260. In its consultation on the inclusion of 1800MHz spectrum in the planned sub-1GHz award (10/105), ComReg has made a number of reasonable points in support of its view that interim licences for the six-month period from the end of 2014 to July 2015 need not be set out formally in detail at this point. In summary, ComReg has first pointed out that such licences are only required under certain circumstances. Given that these operators will have had the opportunity to liberalise their existing GSM licences, and as such hold liberalised licences covering the relevant period, the issue of a break between licence periods arises only where these operators have opted not to liberalise their GSM licences running up to December 2014 and have acquired liberalised licences in the same band commencing in July 2015. As such, ComReg

assumes that where such licences were to be issued, they would cover current use only.

261. As set out in 10/105, ComReg considers for a number of reasons that licences covering this period in between licences may not be required, including the likely migration of customers to 3G over the relevant time horizon and the ability to make alternative arrangements for the serving of customers between the auction and the date of licence expiry.

262. It is on the basis of this low probability nature of an interim licence requirement that ComReg has not sought to specify the exact nature of such licences, whilst assuring operators that if the need arose interim licence applications would be considered.

8.3.2 Respondent's views

263. While the need for interim licences in the 1800MHz band is contingent on the auction outcome, respondents generally agree that there is a need for clarity and certainty about the award of such interim licences prior to the beginning of the award process.

8.3.3 DotEcon commentary

264. Given the contingent nature of such licences and the statements made by ComReg regarding the envisaged scope of any such licences where required (current use only), it appears that this provides adequate certainty to existing operators regarding such licences. It therefore appears reasonable to treat the issuance of short-term licences, where necessary, as a side issue to the main proposals that is usefully considered further if and when the need arises to issue such licences.

9 Early liberalisation option for existing licence holders

265. As detailed in Section 8, we have suggested breaking the licensing period for new liberalised licences in the 800MHz, 900MHz and 1800MHz bands into two distinct time periods, where one existing operator, Meteor, holds spectrum in the first time slice in the 900MHz band, and three existing operators, O2, Vodafone and Meteor, hold spectrum in the first time slice in the 1800MHz band.

266. In itself, however, this two time-slice option simply makes clear the supply of spectrum in each time period. In this section, we consider the option put forward in our December 2009 report (09/99c) that Meteor should be permitted to liberalise its spectrum in the 900MHz band. Following the inclusion of spectrum in the 800MHz and 1800MHz bands, any conclusion on this option would be applicable to the three existing operators in the 1800MHz band.

9.1 Background

267. In that report on the liberalisation of spectrum in the 900MHz band (09/99c) in December 2009, we considered that Meteor's access to liberalised spectrum should not be limited relative to other existing operators as a result of its licence running until 2015 while other operators, at the time of the auction, will not have licences for the period over which spectrum is being awarded.

268. In this (09/99c) report, we noted that an option to release existing spectrum that is not contingent on winning liberalised spectrum would be unlikely to be taken up by operators, given the need for an existing GSM operator to have continued access to 900MHz spectrum to provide GSM services in the short-term. Therefore, for an early liberalisation option to represent an opportunity for an existing licence holder in practice, the relinquishment of existing licence rights to 900MHz spectrum for GSM use only would have to be linked to the winning of liberalised spectrum in the same time period.

269. This is relatively straightforward in practice within the current auction design, as illustrated in detail in Section 10**.**

270. While this option could be implemented without reimbursing Meteor for its licence with GSM usage rights that would be relinquished in line with its winning of liberalised spectrum, we noted that this approach might provide too little incentive for operators to acquire liberalised usage rights relative to the situation where it did not currently hold any spectrum usage rights for the period in question. This is because its bid would be based on the upgrade value of its existing holdings from GSM only to liberalised usage rights, while other bidder's bids would be based on the full value of the licence.

271. We considered that the most straightforward option to reimburse for relinquishing spectrum usage rights would be that where existing 900MHz licence holder Meteor won liberalised usage rights for its existing spectrum in the first time slice in the 900MHz band, it would receive a rebate for its existing licence. Specifically, where it were to be allocated liberalised usage rights for its existing spectrum holdings in the auction then it would:

- Pay the price of a liberalised licence relating to the amount of spectrum liberalised; and
- Receive a rebate for the spectrum usage rights relinquished in exchange for the liberalised usage rights won in the same band.

272. We considered that the rebate should reflect the terminal value of the spectrum licence relinquished. We asserted that this should be calculated by ComReg and made public prior to the start of the auction. We recommended that this approach to reimbursing Meteor for the relinquishing of its GSM900 licence be adopted due to its simplicity. To clarify, where such a rebate were due, this would be offset against the upfront payment for spectrum due at the end of the auction.

273. As part of ComReg's related response to consultation and further consultation (ComReg document 09/99), it consulted upon the proposed option to provide the opportunity to allow Meteor to liberalise its existing spectrum licence within the auction and, where it was successful, receive a rebate for the remaining term of its relinquished licence. Stakeholders subsequently provided their views on whether such a rebate should be provided in their responses to this consultation. These responses are presented in Annex G**,** and summarised in the following sub-section.

274. In our report on the inclusion of the 1800MHz band in the proposed sub-1GHz award (10/105a) published in December 2010, we recommended that the same approach to Meteor's existing licence in the 900MHz band be adopted to the three mobile operators holding existing spectrum licences in the 1800MHz band – O2, Vodafone and Meteor. In this (10/105a) report, we state that a liberalisation option available to existing operators in the 900MHz and 1800MHz bands must respect two broad principles.

275. First, release of existing spectrum must be linked with re-award of liberalised spectrum. Existing licensees have usage rights linked to the relevant spectrum until the expiry of their licences. This principle should be maintained whatever the auction outcome. That is, for the relevant time period and frequencies, existing licence holding can either:

- Win liberalisation of these licences, in which case they relinquish their existing licences for the same spectrum; or
- Not win liberalisation of these licences, in which case they maintain their current usage rights for this spectrum for the relevant time period.
- There should be no possible outcome in which existing licence holders in these bands lose spectrum usage rights over the duration of their existing licences.

276. Second, existing licensees should not be given an unfair advantage in winning liberalised spectrum by virtue of holding their current licences. In particular, it is imperative that a current licensee pay the opportunity cost of awarding liberalised spectrum, otherwise there will be other, higher value users who will have been inefficiently excluded. Opportunity cost in this case is calculated based on the alternative users of this spectrum, ignoring the fact that the spectrum rights for the relevant frequencies must remain with existing licence holders until the expiry of their existing licences. In this way, the liberalised spectrum price to be paid by existing operators for liberalising existing

spectrum holdings should reflect true market value, even if there is not a real market for this spectrum.

277. As part of ComReg's related consultation (10/105), it consulted upon the proposed option to extend to the 1800MHz band the proposal to allow early liberalisation of existing spectrum holdings and, where this occurs, provide a rebate for existing licences relinquished. Stakeholders subsequently provided their views on this in their responses to this consultation. These responses are presented in Table 17**,** and summarised in the following sub-section.

9.2 Respondents' views

278. There were mixed views expressed by operators on the subject of a rebate in response to ComReg consultation 09/99. In summary:

- No operator objected to the provision of an early liberalisation option
- Proponents of the rebate proposal cited the avoidance of distortion of competition and incentivising of early liberalisation and associated benefits for consumers in support of this option.
- Opponents of the proposal cited a number of factors, which are addressed in turn in the following sub-section:
    1. This proposal confers an unfair commercial advantage on Meteor
    2. If ComReg grants Meteor a rebate, it will be providing it with funds to: (i) acquire liberalised spectrum below its full value (if Meteor uses the liberalised spectrum for 3G purposes); and/or (ii) use liberalised spectrum for GSM purposes, which Meteor would have done anyway.
    3. Meteor has sufficient incentive to liberalise early
    4. Meteor would have an unfair advantage over other bidders if they could choose during the auction whether they wish to liberalise its spectrum or not based on the price bid by competitors.
    5. It would be fundamentally unfair and a distortion of competition to allow Meteor this option.
    6. Meteor should have to make its liberalisation decision prior to the auction as bidders will need to know the number of lots available for the period where Meteor has existing frequencies as this could impact on their valuations and bids.
    7. A rebate under the proposed circumstances is not objectively justified or necessary
    8. Arguments that the value of the liberalisation option to Meteor would be the upgrade value plus the availability of more spectrum to it, which would be important to it in its ability to deploy advanced technologies in addition to maintaining GSM services. In this respect, the proposed rebate would be superfluous.

279. One of the respondents, O2, despite raising objections as to the advantage that this rebate option would have for Meteor, expressed that in general where an existing licence is to be foreshortened, it is correct to allow a rebate based on the original purchase terms.

280. In response to the proposed extension of the early liberalisation option and rebate proposal to the 1800MHz band, respondents expressed their view on this in their responses to ComReg consultation 10/105.

281. All four respondents were broadly in favour of ComReg's proposed approach providing for early liberalisation of spectrum in the 900MHz and 1800MHz band. Three of the four respondents to this consultation agreed with ComReg's proposal regarding rebates for 900MHz and 1800MHz licences. The fourth respondent, H3GI, re-iterated its views on rebates as expressed in its response to 09/99. These views are incorporated in the list of objections above.

282. One respondent, Vodafone, disagreed with the rebate proposal in the 900MHz band in its response to 09/99 on grounds including that there would be sufficient incentive to liberalise, maintained this view in its response to 10/105 but asserted that a rebate would be objectively justified and necessary to effectively encourage take-up of the early liberalisation option by current 1800MHz operators.

9.3 DotEcon commentary

283. Addressing first the issue of conferring an advantage upon Meteor in some way (as expressed in 1, 2 and 7 in paragraph 278), an important issue that is neglected in these arguments is that Meteor is the holder of usage rights for the relevant spectrum for the time period in question, usage rights paid for by Meteor both in upfront and annual fees. The proposed rebate aims to confer upon Meteor a rebate based on the original purchase price and the remaining term of this licence given some amortisation schedule. As such, Meteor does not benefit in the price it pays for liberalised spectrum relative to other bidders, and it receives a rebate only for the asset that it has returned to ComReg in exchange.

284. Conversely, were ComReg not to acknowledge the asset that Meteor would be relinquishing in exchange for liberalised spectrum in the form of reimbursement, this could undermine any future spectrum licensing 'exchanges'.

285. Therefore, we do not believe that this option confers any advantage within the auction, as it would reimburse Meteor only for the asset that it were to relinquish as part of the process of exchanging spectrum with GSM-only usage rights for liberalised spectrum usage rights in the 900MHz band in the first time slice, and not doing so could have negative consequences for future spectrum licensing 'exchanges'.

286. Considering then, Meteor's incentive to liberalise early (as raised in 3 and 8 of paragraph 278 above), there are a number of factors that would need to be evaluated in attempting to assess the actual magnitude of the incentive for Meteor to liberalise its existing spectrum usage rights in the 900MHz band, including:

- The value of existing GSM services that can only be provided by 900MHz spectrum in the short-term and without significant further investment and the associated amount of 900MHz spectrum required by Meteor to service the GSM customers in the short-term; and
- The value of holding liberalised 900MHz spectrum over GSM-only spectrum in this band over the duration of the first time slice.

287. There is considerable uncertainty surrounding these factors at present. For example:

- The amount of 900MHz spectrum required to maintain existing GSM services is different for each operator, and is changing all the time as existing operators replace old GSM-only handsets with handsets capable of operating using different technologies; and
- The first time period is shorter than that originally proposed, and so the absolute benefit of liberalising early is reduced. There is also more sub-1GHz spectrum that is now available, so that liberalisation of its existing 900MHz spectrum holdings is no longer the only way to begin providing advanced data services in the first time slice.

In addition, it is possible that the shorter first time period may reduce the incentive for Meteor to liberalise its existing 900MHz spectrum.

288. In short, the argument that Meteor would have sufficient incentive to liberalise its existing 900MHz holdings in the absence of a rebate for its existing spectrum usage rights in the band is far from clear.

289. Addressing lastly then the issue of how the auction process might be affected by Meteor's rebate option (as raised in 4, 5 and 6 of paragraph 278), it will be clear to all bidders prior to the auction how many lots are available in the 900MHz band for the period over which Meteor currently holds a licence:

- There will be five 2x5MHz lots – Meteor will occupy the further lots, regardless of whether it wins liberalised usage rights for this spectrum or not; and
- Meteor's spectrum cap will reflect that it is occupying two 2x5MHz lots for the relevant period.

This information should provide sufficient certainty for bidders in assessing potential demand and actual supply of spectrum for calculating their valuations for the spectrum available.

290. Further, Meteor will face the same conditions in terms of bidding and in terms of potentially winning as other bidders:

- Using a combinatorial clock auction format, both Meteor and all other bidders will be presented with a price per lot of liberalised spectrum in each of the open rounds. During each round, all bidders including Meteor will have to state their demand for liberalised spectrum given these stated prices. These statements of demand, in combination with the round prices for the associated lots, constitute bids that are binding. This process is considered in detail in Section 6.
- While Meteor will be guaranteed to have some spectrum at the end of the auction in the 900MHz band in the first time slice, its bids to liberalise this spectrum will be combined with all other bidders as part of the winner determination process. Therefore, whether Meteor is awarded liberalised spectrum rights for its existing spectrum holdings will be determined on the same basis as whether these rights are awarded to other bidders.

291. Overall, and applying the same principles set out above to the 1800MHz band, therefore, our view on this issue is unchanged; that is, existing operators in the 900MHz and 1800MHz bands should be permitted to liberalise existing

spectrum holdings, and where this option is taken up, receive a rebate based on purchase price and time remaining on the licences for the spectrum usage rights relinquished in return.

9.4 Further issue: Calculation of rebates

Background

292. We recommended as part of our auction proposals in 09/99c that, were Meteor to relinquish all or part of its current 900MHz licence in exchange for a liberalised 900MHz licence for the same period, then it should receive a rebate based on the purchase price of its 900MHz licence and the remaining term of this licence. In considering the extension of the sub-1GHz auction proposals to include 1800MHz spectrum, we further recommended that this rebate policy be extended to existing 1800MHz licensees.

293. We understand that ComReg proposes to adopt DotEcon's proposal that the rebate for the residual term of a licence should be related to the price originally paid for a licence. That is, the intention of the rebate is solely to place an existing licensee who gives up the residual term of a licence in a comparable situation to that it *would have* faced had it originally bought a licence of shorter duration. This places bidders with and without existing licences in comparable positions to allow fair competition.

294. This method is solely based on the actual price paid for the licence, not the profits that the current user can generate from the licence. In the proposed auction mechanism, any bidder making use of the option to liberalise an existing licence would only be curtailing its existing licence in the event that it obtained a corresponding right to use liberalised spectrum for the period corresponding exactly to the curtailment of the previous licence. Therefore, there are no circumstances whatsoever in which such a bidder would lose the benefit of access to spectrum during this period of its current licence.

295. One issue not considered in our first report considering rebates (09/99c) or indeed in our subsequent reports is that of setting out a detailed methodology for calculating such rebates. In this respect, in its response to ComReg consultation 10/71, Meteor made a specific proposal for how a rebate related to the residual term of an existing licence should be calculated. Meteor re-iterates this methodology in its response to ComReg consultation 10/105, and illustrates how this methodology should be used to derive a value for the appropriate rebate. In outline, the proposed method is as follows:

- Suppose that a licence was awarded originally award at a price, but this would have been reduced in part by some amount P in recognition of the shorter licence period had this been known at the time;
- This reduction is assumed to be a proportion of the original price equal to the length of the residual term relative to the overall length of the licence. This estimate of reduced price is not grounded in form of discounted cash flow analysis.
- To calculate a present day impact, Meteor claims that the reduction in the price of the licence should grow at the allowed rate of return assumed to be Eircom's current WACC of 10.21%, so now should have value $P(1+r)^N$

where *N* is the number of years between when the licence was originally awarded and the date of its relinquishment and *r* is the cost of capital;

296. Effectively, this approach identifies a part of the licence price associated with the final two years of a licence and then adds in the capital costs that would have been incurred had that lower price been paid. The result of Meteor's approach is that an uplift of 270.6% would be applied to the price reduction proposed by ComReg in its December 2010 consultation (10/105). This comprised the compounded effect of Eircom's current WACC of 10.21% between when the first Meteor licence was issued in July 2000 and November 2010, when Meteor submitted its response to ComReg consultation 10/105.

297. Meteor's calculation in its 10/105 response does not correct for inflation, but rather leaves prices in July 2000 nominal terms. A proper treatment of inflation would further increase this uplift.

298. As we discuss below, there is a fundamental inconsistency in Meteor's proposals. It is reasonable to add in the costs of funding a licence that could have been avoided if a licence were shorter and cheaper; this is effectively the undoing of discounting in order to consider the impact on the purchaser, as it would have applied at the time of licence award. However, if this approach is adopted it is then necessary to take account of the fact that the reduction in licence length, as viewed from the start of the licence, occurs at the end of the licence period and needs to be appropriately discounted to determine the impact on the initial purchase price.

299. Further to its representation on rebates in response to ComReg consultation 10/71, in its response to ComReg's subsequent consultation (10/105), Meteor asserted that its proposed methodology should be augmented to include an element of compensation for loss of profits upon relinquishment of GSM only licences should also be included in the calculation of rebates. This is incorrect, as the auction proposal involves a reduction in current licence term if and only if a liberalised licence is granted covering the corresponding period (and beyond). Therefore, the reduction in term of the current licence is purely notional and in effect the licensee is receiving access to liberalised spectrum.

300. Separately, in its December 2010 consultation (10/105), ComReg proposed rebates for 900MHz and 1800MHz licences based on:

- The proportion of the original licence prices relating to the time period for which licences might be relinquished; and
- Inflation over the period from the commencement of licences to the date of licence relinquishment.

DotEcon commentary

301. We can still think of the purchase price of the licence as being spread over time. In particular, the purchase price can be turned into annualised payments the sum of whose values discounted back to the time of purchase is the purchase price. In effect, these are equivalent annual "rental" payments.

302. For simplicity, we assume that these annualised payment are constant or grow at a particular constant rate *(g)*. Discounting is at the operator's real weighted cost of capital at the time of issue of the licence. Under these assumptions, the

equivalent annualised price π of a 15-year licence to an operator will be given by:

$$L_{15} = \sum_{t=0}^{14} \frac{\pi(1+g)^t}{(1+r)^t} \approx \sum_{t=0}^{14} \frac{\pi}{(1+r-g)^t}$$

(where the approximation is valid if *r* and *g* are small) and where:

- L_{15} is the purchase price of a 15-year licence;
- *r* is the real cost of capital faced by the operator at the time of issue of the licence; and
- *g* is the real growth rate of the annualised payments (which can be set to bring forward or retard the annualised payment stream).

303. This approach is consistent with the methods used in the benchmarking exercise for rebasing the prices of licences to account for differences in licence length. We assume a constant stream of annualised payment over the term of licence (i.e. *g*=0) as there is no strong rationale for increasing or decreasing rental values over period.

304. If the licence were curtailed to end in year *T*, then the terminal annualised payment that would lost due to curtailment would simply be

$$C_T = L_{15} - L_T = \sum_{t=T}^{14} \frac{\pi}{(1+r-g)^t}$$

However, notice that this impact is discounted back to year 0 (i.e. it is in year 0 present value terms) and so represents the change in the initial purchase price that would have occurred had the licence been shortened at that time.

305. In the situation that an existing licensee wins liberalised spectrum in the auction in place of an existing licence, then clearly the future curtailment of the existing licence occurs at some point midway through the life of the licence. In particular, we wish to determine how the future curtailment of a licence would affect the notional purchase price of the licence at the time that the auction was run.

306. Suppose that the auction were run in year *N*, resulting in the current licence terminating early in year *T* (where *T* is greater than *N*). In this case, the impact is only *T-N* years away rather than *T* years away as previously, so we need to adjust the discounting accordingly. In year *N* terms, the impact of curtailment is then

$$C_T^N = (1+r)^N \sum_{t=T}^{14} \frac{\pi}{(1+r-g)^t}$$

307. Notice that this formula takes account of the additional interest charges that the buyer would have paid up to year *N* when buying a 15-year licence initially. Compound interest is applied to the change in licence price in year 0.

308. Expressed as a proportion of the original 15-year licence price, the proportionate impact of the curtailment in year *N* terms is

$$\frac{C_T^N}{L_{15}} = \left[\sum_{t=T}^{14} \frac{1}{(1+r-g)^t} \Big/ \sum_{t=0}^{14} \frac{1}{(1+r-g)^t}\right] \times (1+r)^N$$

- Where L_{15} is the price of a 15-year licence;
- *T* is period in which the licence would be curtailed from until the end of the original licence term; and
- *N* is the present period up until which the rate of return on the cash flows would be compounded if the rebate for the terminal period of such a licence were offered now.

Notice that by expressing the curtailment as a proportion of the initial price, the annualised payment π is eliminated given the assumption of constant growth.

309. The calculation above does not correct for inflation. Therefore, the result is in nominal 2000 prices (the start date of the licence). Any inflation between the start of the licence and year *N* has to be applied *in addition* to the effects of compound interest.

310. Meteor is correct in applying an uplift for compound interest on the amount committed for funding GSM licences from the licence start date and relating to the curtailed period of the licence, as the funds for the purchase of spectrum usage rights for this curtailed period would not have been needed to be funded had a shorter licence been purchased in 2000. However, it has incorrectly applied the uplift factor to an *undiscounted* price. This incorrectly increases the result by between 2.5 to 4.6 times relative to properly discounting the price reduction (as it occurs at the end of the licence but we wish to determine the impact on the price at the start of the licence). Applying a compound interest uplift to the *undiscounted* price reduction, as Meteor has done, would yield a rebate that is much too high.

311. In addition, while we note that Meteor did not adjust for inflation in its response to ComReg consultation 10/71 in their calculations and so the results are in July 2000 prices. Applying an inflation correction would make their results even higher.

312. However in the Tables below, we adjust the rebate calculated for inflation using the Meteor methodology to present day prices for comparability with DotEcon and ComReg's methodologies. We also update the uplift factor of the compounded rate of return to between July 2000 and June 2011.

313. Our proposed methodology calculates the following rebates:

- O2 and Vodafone's 1800MHz licence (between Feb 2013 and Dec 2014) would be €0.81m; and
- Meteor's 900MHz and 1800MHz licences (between Feb 2013 and Jun 2015) would be €3.86m in June 2011 prices.

314. In comparison, Meteor's methodology yields equivalent rebates of:

- €3.74m for Vodafone and O2's 1800MHz licences; and
- €9.84m for Meteor's 900MHz and 1800MHz licences.

ComReg's methodology yields rebates of:

- €1.23m for Vodafone and O2's 1800MHz licences; and
- €3.42 for Meteor's 900MHz and 1800MHz licences.

Overall, ComReg's approach yields rebates close to the results from our proposed annualised of payments method.

315. In conclusion, we consider that our methodology for calculating rebates most adequately reflects the terminal value of licences that might be relinquished within the auction in exchange for liberalised licences for the same time period. However, we note that the value differences between the rebates calculated under our methodology and those calculated under ComReg's methodology are small. As such, it is unlikely that the use of ComReg's proposed rebates would have a materially different effect on the incentives of existing GSM operators in the auction (that is, which licences of existing GSM operators are liberalised and which are not) relative to using our proposed rebates. Therefore, we recommend that either the approach laid out above be used to set rebates, or that ComReg maintain their existing proposals for the rebates. Meteor's proposal should not be adopted.

Table 2: Rebate comparisons – Vodafone and O2 1800MHz licences valid between January 2000-December 2014

Vodafone and O2 2x14.4MHz of 1800MHz licence issued Jan 2000, valid until Dec 2014	Original licence price (Jan 2000 prices)	Inflation between Jan 2000 and June 2011	Reduction in price due to curtailed licence term as proportion of original 15-year licence price assuming g=0	Compounded WACC between Jan 2000 to June 2011 to account for the opportunity cost of cash flows foregone until now	Overall rebate in Jun 2011 prices
DotEcon Methodology	€7.12m	135.43%	$\frac{\sum_{t=T}^{14}\frac{1}{(1+r)^t}}{\sum_{t=0}^{14}\frac{1}{(1+r)^t}} = \frac{0.230}{8.28}$ $= 0.0278$	$(1+r)^N$ $= 303.4\%$	€7.12m ×135.43% ×**0.0278** ×**303.4**% = €0.81m
Meteor Methodology	€7.12m	135.43%	$\frac{23\ months}{180\ months} = 0.128$	$(1+r)^N$ $= 303.4\%$	€7.12m ×135.43% ×**0.128** ×**303.4**% = €3.74m
ComReg Methodology	€7.12m	135.43%	$\frac{23\ months}{180\ months} = 0.128$	Nil	€7.12m ×135.43% ×**0.128** = €1.23m

Table 3: Rebate comparisons – Meteor GSM licence valid between July 2000-June 2015

Meteor 2x4.8MHz of 900MHz and 2x14.4MHz of 1800MHz licence issued July 2000, valid until June 2015	Original licence price (July 2000 prices)	Inflation between July 2000 and June 2011	Reduction in price due to curtailed licence term as proportion of original 15-year licence price assuming g=0	Compounded WACC between Jul 2000 to June 2011 to account for opportunity cost of cash flows foregone until now	Overall rebate in June 2011 prices
DotEcon Methodology	€14.60m	130.95%	$\frac{\sum_{t=T}^{14}\frac{1}{(1+r)^t}}{\sum_{t=0}^{14}\frac{1}{(1+r)^t}} = \frac{0.526}{8.28} = 0.0635$	$(1+r)^N = 289.0\%$	$€14.6m \times 130.95\% \times \mathbf{0.0635} \times \mathbf{289.0}\% = 3.51m$
Meteor Methodology	€14.60m	130.95%	$\frac{29\ months}{180\ months} = 0.161$	$(1+r)^N = 289.0\%$	$€14.6m \times 130.95\% \times \mathbf{0.161} \times \mathbf{289.0}\% = €8.90m$
ComReg Methodology	€14.60m	130.95%	$\frac{29\ months}{180\ months} = 0.161$	Nil	$€14.6m \times 130.95\% \times \mathbf{0.161} = €3.08m$

Table 4: Rebate comparisons – Meteor 900MHz licence valid between January 2001-June 2015

Meteor 2x2.4MHz of 900MHz licence issued Jan 2001, valid until June 2015	Original licence price(Jan 2001 prices)	Inflation between Jan 2001 and June 2011	Reduction in price due to curtailed licence term as proportion of original 15-year licence price assuming g=0	Compounded WACC between Jan 2001 to June 2011 to account for opportunity cost of cash flows foregone until now	Overall rebate in June 2011 prices
DotEcon Methodology	€1.59m	127.95%	$\frac{\sum_{t=T}^{14}\frac{1}{(1+r)^t}}{\sum_{t=0}^{14}\frac{1}{(1+r)^t}} = \frac{0.523}{8.30} = 0.0630$	$(1+r)^N = 275.3\%$	$€1.59m \times 127.95\% \times \mathbf{0.0630} \times \mathbf{275.3}\% = 0.35m$
Meteor Methodology	€1.59m	127.95%	$\frac{29\ months}{174\ months} = 0.167$	$(1+r)^N = 275.3\%$	$€1.59m \times 127.95\% \times \mathbf{0.167} \times \mathbf{275.3}\% = 0.93m$
ComReg Methodology	€1.59m	127.95%	$\frac{29\ months}{174\ months} = 0.167$	Nil	$€1.59m \times 127.95\% \times \mathbf{0.167} = 0.34m$

10 Implementation of the early liberalisation option

316. In their responses to ComReg consultation 10/105, two operators, Meteor and O2, have raised queries about the bidding process in the case that a bidder holds a licence for spectrum in the first time slice and the mechanics of how such a bidder would have the option to bid to liberalise this spectrum within the auction.

317. Given that information on how this would work in practice has not yet been covered in detail and the relevant information is spread across a number of documents, in this section, therefore, we describe the proposed auction process with regard to this issue. In the interest of clarity, we do not refer back to our previous reports on this issue. We first state in detail the proposed bidding procedure in the case where a bidder does not hold any existing spectrum holdings. We then detail the proposed bidding procedure where a bidder has existing spectrum in a band or bands, making clear how this differs from the first case.

10.1 Bidding procedure for a bidder with no existing licences in the relevant bands in the first time slice

10.1.1 Prior to the auction

318. At the application stage, bidders will be requested to submit as part of their application:

- the number of lots in each time slice and in each band it would wish to be awarded at the respective minimum prices; and
- a deposit in the amount of the sum of upfront element of the minimum price associated with all lots it is applying for.

319. Note that the number of lots available in each band in each time period for potential award to a bidder with no existing spectrum holdings does not include lots of spectrum for which existing operators hold usage rights.

320. As part of its application, a bidder would specify how many lots it wished to be awarded in the following six categories:

- 800/1: 2x5MHz lots in the 800MHz band in time slice 1 (6 available);
- 800/2: 2x5MHz lots in the 800MHz band in time slice 2 (6 available);
- 900/1: 2x5MHz lots in the 900MHz band in time slice 1 (5 available);
- 900/2: 2x5MHz lots in the 900MHz band in time slice 2 (7 available);
- 1800/1: 2x5MHz lots in the 1800MHz band in time slice 1 (6 available); and
- 1800/2: 2x5MHz lots in the 1800MHz band in time slice 2 (15 available).

321. Note that this combination of lots and associated total price constitutes a bid and, as such, a binding obligation on the part of the bidder to pay the sum of the minimum prices of the relevant lots and fulfil all other associated licence conditions over the duration of the resulting licences and based on a pre-specified payment schedule were this bid to be successful.

322. Where a bidder does not enter a number of lots in its application relating to a given frequency band and time period, it will be assumed that the related application does not include any lots for that frequency band and time period.

323. The number of lots applied for in a bidder's application will be subject to spectrum caps. In the case of a bidder with no existing spectrum holdings and applicable spectrum caps of 2x10MHz of 900MHz spectrum in the first time slice, 2x20MHz of sub-1GHz spectrum and 2x50MHz of total spectrum in the auction, this would mean that in its application:

- The sum of lots bid for in categories 900/1 cannot exceed 2;
- The sum of lots bid for in categories 800/1 and 900/1 cannot exceed 4;
- The sum of lots bid for in categories 800/2 and 900/2 cannot exceed 4;
- The sum of lots bid for in categories 800/1, 900/1 and 1800/1 cannot exceed 10; and
- The sum of lots bid for in categories 800/2, 900/1 and 1800/1 cannot exceed 10.

324. In the case where there is excess demand for lots in at least one band in any time period, the award process will progress to the auction stage. [50]

10.1.2 During the auction

325. Upon scheduling of the first primary bid round, using the electronic auction system to be used for the entering and processing of bids, bidders will be able to view the same six categories of lots (800/1, 800/2, 900/1, 900/2, 1800/1, 1800/2) and the prices per lot that will apply to each of these categories in the first primary bid round. This will equal the minimum price per lot plus one price increment, where the size of the increment will be set by ComReg separately for each lot category based on the level of excess demand in that lot category at the application stage.

326. During the first primary bid round, bidders will need to state their demand for lots in each of the six lot categories based on the price per lot in each lot category. This will constitute a single bid for a package of lots at a bid amount equal to the sum of the lot prices linked to the lots included in the package. In assessing the validity of a bid, the number of eligibility points associated with the bid will be evaluated separately for each time period. The eligibility points associated with a bid for a time period is the sum of the eligibility points linked to the lots bid for in that time period during a primary bid round.

327. The package of lots that a bidder can bid for during the first primary bid round will be constrained by the relevant spectrum caps. Further, for each time period, the total number of eligibility points associated with the lots in a bidder's bid package in the first primary bid round cannot exceed the total

[50] Where there is no excess demand for lots in any lot category, bidders will be allocated the amount of spectrum specified in their respective applications, subject to the payment of the sum of upfront payments linked to lots within these applications, and the auction will progress to the assignment stage.

number of eligibility points linked to the lots in each time period specified in that bidder's application.

328. Following the end of the first primary bid round, the level of excess demand will be assessed and a price increment set separately for each band in each time period. Upon scheduling of the second primary bid round, bidders will be able to view information on each of the six categories of lots including the price per lot that will apply in each of these categories in the second primary bid round.

329. In the second and all subsequent primary bid rounds, the package of lots that a bidder can bid for during the round will be constrained by the relevant spectrum caps and eligibility points. Specifically:

- for each time period, the amount of spectrum bid for in a primary bid round must not be more than the spectrum caps, as set out prior to the start of the auction; and
- the number of eligibility points associated with the lots bid for in each time period in a primary bid round cannot exceed the number of eligibility points linked to the lots included in the bidder's bid in the previous primary bid round in each time period.

330. Primary bid rounds will continue until there is a primary bid round during which, considering all valid bids submitted during the round, there is no excess demand for lots in any lot category.

331. The primary bids stage will be followed by the supplementary bids stage, which will consist of a single round of bidding. During this round, bidders will be able make multiple bids for packages of lots in this round. A supplementary bid in this round will consist of the number of lots in each of lot categories 800/1, 800/2, 900/1, 900/2,1800/1 and 1800/2 and a bid amount. Where a bidder does not submit a specific number of lots in a lot category as part of a supplementary bid, the supplementary bid is assumed to include no lots from the relevant lot category. Bidders will be able to make bids on packages not bid for in the primary bid rounds and increase the bid amount for packages bid on in the primary bid rounds. Bidders will not be able to reduce the value of bids for packages submitted during the primary bid rounds or delete packages bid on in the primary bid rounds from its list of supplementary bids. All bids submitted in this round will be subject to constraints including minimum prices, spectrum caps, eligibility to bid linked to the relevant bidder's application at the application stage and relative caps on individual bids based on its bidding behaviour in the primary bid rounds (see section 6 for a description of relative caps).

332. After the scheduled end of the supplementary bids round, winners and prices will be determined based on all bids submitted using the procedure detailed in sub-section 10.3.

10.2 Bidding procedure for bidders with existing licences in the relevant bands in the first time slice

333. Three of the four existing mobile operators in Ireland hold usage rights for spectrum in bands to be made available in the auction in the first time period:

- Meteor holds a licence permitting it to use 2x7.2MHz of spectrum in the 900MHz band and 2x14.4MHz of spectrum in the 1800MHz band for GSM services only; and
- O2 and Vodafone each hold a licence permitting the use of 2x14.4MHz of spectrum in the 1800MHz band for GSM services only.

334. It has previously been clarified that holders of existing spectrum rights in the bands to be auctioned would have the opportunity within the award process to 'liberalise' their existing licences. In practice, this means that existing licence holders would have the opportunity to 'win' liberalised licences in exchange for their existing GSM only licences. To be clear, for the first time slice and for the amount of frequencies relevant (existing holdings and the number of 2x5MHz blocks to which these spectrum holdings approximate), this spectrum will remain in the hands of its current holders for this first time slice; these existing licence holders will however have the opportunity to relinquish existing licences and simultaneously receive a liberalised licence for the same spectrum (or part thereof) if this exchange is included in their winning bid.

335. If an existing licence holder of spectrum in the relevant bands wants to have as part of its winning bid the liberalisation of its existing spectrum holdings (or part thereof) then it would be required to pay a price for this spectrum determined in the auction less a rebate for the existing licences the relinquishment of which is implicit in its bid.

336. If an existing licence holder were not to have the liberalisation of all of its existing spectrum within a winning bid in the auction, this bidder would retain its existing GSM only licence relating to frequencies outside its winning bid for the first time slice. Existing spectrum holdings in the first time slice will count towards an existing licence holder's spectrum caps for that time period regardless of whether this spectrum is liberalised within the award process.

337. In order to implement this mechanism on a practical level, bidders with existing holdings of spectrum in the relevant bands will be able to bid to liberalise its existing spectrum within the auction in separate bidder-specific lot categories.

338. Bidding on the part of existing licence holders for partial liberalisation of spectrum in a given band will be on the basis that any spectrum retained for GSM purposes will have to comply with the separation rules of the relevant EC Decision and GSM raster plan. As discussed in Section 2.4 of ComReg document 10/71c, the available GSM channels in a 2x5MHz block can vary from 22 to 24/25 depending on co-ordination.

339. Note that any spectrum retained for GSM purposes and liberalised licences issued (as a result of exercising the early liberalisation option or otherwise) will be subject to the respect of the minimum carrier separation between GSM and other terrestrial systems as per the relevant EC Decision.[51] Note also that the

[51] EC Decision 2009/766/EC setting out minimum carrier separation between GSM and UMTS and the draft Decision amending 2009/766/EC which sets out the minimum carrier separation between GSM, UMTS, LTE and WiMAX

location of spectrum assignments in the band will be determined via the 'full assignment round', as discussed in detail in Section 11.1.

10.2.1 Prior to the auction

340. Prior to the application stage, ComReg will set out the terms that will apply in the case where bidders with existing spectrum within at least one band opt to liberalise either:

- part of their existing spectrum holdings within a given spectrum band (and are allocated a small amount of additional liberalised spectrum in addition to the liberalisation of existing frequencies); or
- all of its existing holdings.

341. The terms set out by ComReg will include the amount of the rebate due to an existing operator.

342. At the application stage, bidders will be requested to submit as part of their application:

- the number of lots in each time slice and in each lot category it would wish to be awarded at the respective minimum prices;
- where relevant, for each band in which it holds a current GSM only licence, the number of lots of its existing spectrum in the first time slice it would wish to be awarded a liberalised licence for at the respective minimum prices for liberalised licences and associated rebates; and
- a deposit in the amount of the sum of upfront fees associated with all lots it is applying for.

343. The categories of lot that will be available for a bidder to register its interest in being awarded in the application process will depend on its existing spectrum holdings. That is, as part of their respective applications, were they to apply, in addition to lot categories listed in paragraph 320, Meteor, O2 and Vodafone would have the following bidder-specific categories:

- Meteor: One category for liberalisation of existing holdings in the 900MHz band in the first time slice (lot category 900/1/LIB containing 2 lots) and one category for liberalisation of existing holdings in the 1800MHz band in the first time slice (lot category 1800/1/LIB containing 3 lots); and
- Each of O2 and Vodafone: One category for liberalisation of existing holdings in the 1800MHz band in the first time slice (lot category 1800/1/LIB containing 3 lots).

344. Conditions surrounding the applications of bidders with existing spectrum holdings are largely the same as those for bidders with no existing spectrum holdings in the relevant bands:

- The combination of lots included in a bidder's application and associated prices constitutes a bid and, as such, a binding obligation on the part of the bidder to pay the sum of the minimum prices of the relevant lots (minus rebates where relevant) and fulfil all other associated licence conditions over the duration of the resulting licences were this bid to be successful; and

- Where a bidder does not enter a number of lots in its application relating to a given frequency band and time period, it will be assumed that the related application does not include any lots for that frequency band and time period. In the case of bidder-specific lot categories relating to existing spectrum holdings (900/1/LIB and 1800/1/LIB), where such a bidder does not enter a number of lots in its application relating to these lot categories, it will be assumed that the related application does not include the liberalisation of any lots for the relevant frequency band in the first time period.

345. The number of lots applied for in a bidder's application will be subject to spectrum caps. As noted in paragraph 336, one difference in a bidder's application where it has existing spectrum holdings is that these holdings will count towards the spectrum cap regardless of whether this spectrum is liberalised or not. Therefore, were all existing operators in the relevant bands to bid in the auction, the following caps would apply to these bidders:

- For Meteor, in its application and in all rounds of the auction:
    - The sum of lots bid for in categories 900/1 cannot exceed 0;
    - The sum of lots bid for in categories 800/1 and 900/1 cannot exceed 2;
    - The sum of lots bid for in categories 800/2 and 900/2 cannot exceed 4;
    - The sum of lots bid for in categories 800/1, 900/1 and 1800/1 cannot exceed 5; and
    - The sum of lots bid for in categories 800/2, 900/1 and 1800/1 cannot exceed 10.
- For O2 and Vodafone, in their respective applications and for each operator in all rounds of the auction:
    - The sum of lots bid for in categories 900/1 cannot exceed 2;
    - The sum of lots bid for in categories 800/1 and 900/1 cannot exceed 4;
    - The sum of lots bid for in categories 800/2 and 900/2 cannot exceed 4;
    - The sum of lots bid for in categories 800/1, 900/1 and 1800/1 cannot exceed 7; and
    - The sum of lots bid for in categories 800/2, 900/1 and 1800/1 cannot exceed 10.

346. In the case where there is excess demand for spectrum in at least one of lot categories 800/1, 900/1, 1800/1, 800/2, 900/2 or 1800/2, that is, any lot category that can be bid on by multiple bidders, the award process will progress to the auction stage.

10.2.2 During the auction

347. Upon scheduling of the first primary bid round, using the electronic auction system to be used for the entering and processing of bids, bidders will be able

to view the same categories of lots available to them and the prices per lot that will apply in each of these categories in the first primary bid round.

- In the case of bidders with no existing spectrum holdings, this will be six categories: 800/1, 800/2, 900/1, 900/2,1800/1 and 1800/2.
- In the case of O2 and Vodafone, this will be seven categories: 800/1, 800/2, 900/1, 900/2, 1800/1/LIB, 1800/1 and 1800/2.
- In the case of Meteor, this will be eight categories: 800/1, 800/2, 900/1/LIB, 900/1, 900/2, 1800/1/LIB, 1800/1 and 1800/2.

348. The price per lot in each lot category that can be bid on by multiple bidders (800/1, 800/2, 900/1, 900/2,1800/1 and 1800/2) will equal the minimum price per lot plus one price increment, where the size of the increment will be set by ComReg separately for each lot category based on the level of excess demand in that lot category at the application stage.

349. The price per lot in lot categories 900/1/LIB and 1800/1/LIB will be equal to the price per lot in lot categories 900/1 and 1800/1 respectively.

350. During the first primary bid round, bidders will need to state their demand for lots in each of the lot categories available to them based on the price per lot in each lot category. This will constitute a single bid for the package of lots at a bid amount equal to the sum of the lot prices linked to the lots included in the package. In assessing the validity of a bid, the number of eligibility points associated with the bid will be evaluated separately for each time period. The eligibility points associated with a bid for a time period is the sum of the eligibility points linked to the lots bid for in that time period during a primary bid round.

351. The package of lots that a bidder can bid for during the first primary bid round will be constrained by the relevant spectrum caps. Further, for each time period, the total number of eligibility points associated with the lots in a bidder's bid package in the first primary bid round cannot exceed the total number of eligibility points linked to the lots in each time period specified in that bidder's application.

352. Following the end of the first primary bid round, and all subsequent primary bid rounds, the level of excess demand will be assessed and a price increment to apply in the following round will be set separately for each lot category that can be bid on by multiple bidders (800/1, 800/2, 900/1, 900/2,1800/1 and 1800/2). For the second and all subsequent primary bid rounds, the price per lot set for lot categories 900/1/LIB and 1800/1/LIB in a primary bid round will be equal to the price per lot set for the same primary bid round in lot categories 900/1 and 1800/1 respectively.

353. Upon scheduling of the second primary bid round, bidders will be able to view information on each of the six categories of lots including the price per lot that will apply in each of these categories in the second primary bid round.

354. In the second and all subsequent primary bid rounds, the package of lots that a bidder can bid for during the round will be constrained by the relevant spectrum caps and eligibility points. Specifically:

- for each time period, the amount of spectrum bid for in a primary bid round must not be more than the spectrum caps, as set out prior to the start of the auction; and
- the number of eligibility points associated with the lots bid for in each time period in a primary bid round cannot exceed the number of eligibility points linked to the lots included in the bidder's bid in the previous primary bid round in each time period.

355. Primary bid rounds will continue until there is a primary bid round during which, considering all valid bids submitted during the round, there is no excess demand for lots in any lot category that can be bid on by multiple bidders (800/1, 800/2, 900/1, 900/2,1800/1 and 1800/2).

356. The primary bids stage will be followed by the supplementary bids stage, which will consist of a single round of bidding. During this round, bidders will be able make multiple bids for packages of lots in this round. A bid submitted during this round will consist of a list of lots and a specific bid amount set by the bidder.

- A supplementary bid in this round submitted by a bidder with no existing spectrum holdings in the relevant bands will consist of the number of lots in each of lot categories 800/1, 800/2, 900/1, 900/2,1800/1 and 1800/2 and a bid amount.
- A supplementary bid in this round submitted by either O2 or Vodafone will consist of the number of lots in each of lot categories 800/1, 800/2, 900/1, 900/2, 1800/1/LIB, 1800/1 and 1800/2 and a bid amount.
- A supplementary bid in this round submitted by Meteor will consist of the number of lots in each of lot categories 800/1, 800/2, 900/1/LIB, 900/1, 900/2, 1800/1/LIB, 1800/1 and 1800/2 and a bid amount.

357. Where a bidder does not submit a specific number of lots in a lot category as part of a supplementary bid, the supplementary bid is assumed to include no lots from the relevant lot category. Bidders will be able to make bids on packages not bid for in the primary bid rounds and increase the bid amount for packages bid on in the primary bid rounds. Bidders will not be able to reduce the value of bids for packages submitted during the primary bid rounds or delete packages bid on in the primary bid rounds from its list of supplementary bids. All bids submitted in this round will be subject to constraints including minimum prices, spectrum caps, eligibility to bid linked to the relevant bidder's application at the application stage and relative caps on individual bids based on its bidding behaviour in the primary bid rounds (see section 6 for a detailed description of relative caps).

358. After the scheduled end of the supplementary bids round, winners and prices will be determined based on all bids submitted using the procedure detailed in Section 10.3.

10.3 Determining winners and prices

359. This section updates the procedures discussed in our most recent report (published as ComReg document 10/105a) for determining the winning bidders and winning prices.

360. The proposed winner determination and pricing methodology is similar to that used in ComReg's previous 26GHz auction and in combinatorial clock auctions run in the UK, Holland and Denmark. However, as compared with these auctions, there is the additional feature in that holders of existing licences may bid to win back spectrum on a liberalised basis. For the purposes of understanding the auction design, it is useful to think about a bid to liberalise existing spectrum as being a notional linked offer to both buy liberalised spectrum and to release the corresponding existing unliberalised spectrum held by the bidder.

361. It is possible that a bidder holding existing unliberalised spectrum at 900MHz or 1800MHz frequencies could:

a) bid for additional spectrum on top of its current holding;

b) bid to liberalise its existing spectrum in whole or part,

c) do all the above.

Therefore, a bid from such a bidder needs to specify:

d) how much existing unliberalised spectrum would be retained by the bidder and how many new lots available for re-award would be created from the corresponding released spectrum; and

e) the number of lots of liberalised spectrum demanded.

Such any offer to release existing spectrum and buy lots is subject to the provisions of the spectrum caps, which include any unliberalised spectrum retained by a bidder in the relevant bands as well as new lots.

362. When determining the winning bids, the link between corresponding buy and release offers will be respected: either both will be accepted or both rejected. When winning bidders are determined, there should be no possibility that an offer to release existing unliberalised spectrum could be accepted without the corresponding offer to buy liberalised spectrum also being accepted.

363. Therefore, bidders who hold existing unliberalised spectrum do not face risks of losing that spectrum, at the same time they should not unfairly benefit from their current position when competing for liberalised spectrum. Such bidders should compete with other potential users of liberalised spectrum on a neutral basis. In particular, a bidder winning back liberalised spectrum should pay the opportunity cost of that spectrum as determined by the bids of other *potential* users. To determine this opportunity cost, we should consider *hypothetically* the possibility that spectrum released by an existing licensee were awarded to someone else on a liberalised basis.

10.3.1 Determination of winners

364. In order to determine the winning bidders, all bids made in the auction throughout the primary bid rounds and the supplementary bids round are considered. In addition to those bids made in the auction, we add a notional "zero bid" for each bidder (i.e. a bid of zero for no lots) that represents the case of that bidder losing. For these purposes, bids from existing licensees that involve releasing existing spectrum and winning back of liberalised spectrum are treated as linked.

365. The algorithm for determining winner bidders will only accept linked offers from existing licensees to release some spectrum and win lots in the event that re-awarding liberalised spectrum to that bidder will not exclude some other bidder who might be prepared to pay more. In order to implement this requirement, the winner determination algorithm is based on the idea of looking across possible scenarios for release of spectrum and considering, within each scenario, the corresponding offers to buy lots. Only scenarios in which bidders releasing spectrum win their corresponding demands for liberalised lots will be considered.

366. The following procedure will be used to determine the winning outcome. First, all the possible scenarios for the release of existing spectrum by existing licensees in the 900MHz and 1800MHz will be identified from the bids received. By a release scenario, we mean a complete specification of the number of blocks released *by each bidder* in each band.

367. The release options available to existing licensees are limited such that the spectrum released first is that for which an existing licence holder has usage rights for only part of the lot:

a) Vodafone, Meteor and O2 all hold 2x14.4MHz in the 1800MHz band. Therefore, they have the option of releasing 0, 1, 2 or 3 blocks.

b) Meteor holds 2x7.2MHz in the 900MHz band. Therefore, it has the option of releasing 0, 1, or 2 blocks.

368. Associated with each of these release options is an associated rebate on the residual term of the existing licence being relinquished. This rebate depends on the band (900MHz vs. 1800MHz) and varies in proportion to the amount of spectrum being released.

369. The maximum number of scenarios that needs to be considered is 192 (=3x4x4x4), corresponding to all the possible combinations of release options for individual bidders. However, in practice, not all scenarios may be relevant, as a bidder may not have made bids for some of the release options available to it, reducing the number of scenarios that need be considered.

370. These scenarios identify all possible hypothetical patterns of release of existing spectrum given the bids received. Each scenario completely specifies what spectrum existing licensees release and retain. Purely for illustrative purposes, one particular scenario might specify that:

a) Meteor releases all its 900MHz spectrum;

b) Vodafone releases two wholly occupied blocks of 1800MHz spectrum; and

c) O2 does not release any spectrum at all.

371. For each such scenario, we go through the following steps:

a) Determine the total available spectrum for award (which will depend on the scenario) in the first time slice. The total supply of spectrum consists of lots unconditionally available for award (i.e. those released by ComReg) *plus* the released spectrum from existing licensees assumed by the scenario. For instance, suppose that the scenario specified that Meteor released both its 900MHz blocks; this would

increase the supply scenario of 900MHz lots for the first time period by two.

b) We then determine all the bids to buy lots that are *compatible with the scenario*. These are bids to buy lots that are linked to offers to release *exactly* the amount specified in the scenario for that particular bidder.[52] For example, if the scenario presumed that Meteor released both blocks in the 900MHz band, then we only consider Meteor's bids to buy lots that involved it releasing precisely this amount of spectrum. Notice that all bids of any bidder that is not an existing licensee will be compatible with any release scenario.

c) Within a scenario, we wish to consider the possibility that a releaser of existing spectrum has not bid a sufficient amount to justify winning back liberalised spectrum given other conflicting demands. To consider this possibility, we add in a zero bid for each releaser (in addition to all the bids to buy lots from that bidder compatible with the release scenario). This creates the possibility that the releaser might not be re-awarded its released spectrum unless it bids a sufficient amount.

d) Given the compatible bids (and zero bids), we determine the combination of bids, taking one bid from each bidder, of greatest total value subject to the total demand for spectrum in each band and for each time slice not exceeding the total lots available for award in that scenario.

e) In the event that any releaser of existing spectrum is assigned its zero bid (because that bidder has not bid a sufficient amount to win the lots demanded in the case that it releases the spectrum specified in the scenario) the supply scenario will be deemed infeasible and not considered further. This ensures that existing licensees only release existing spectrum as part of being re-awarded that spectrum on a liberalised basis.

372. Finally, amongst all feasible scenarios, we select the one with the greatest total value of winning bids. In the event of any tie across scenarios, the tied scenario with the greatest number of MHz of spectrum being released by incumbent bidders will be selected. If a tie amongst scenarios still remains, this will be resolved by random selection. This will be called the "winning scenario"[53].

373. This procedure ensures that if a release offer is accepted from a bidder, then its linked offer to buy lots is also accepted. This is achieved by only considering compatible bids at step b) above. Therefore, buying liberalised spectrum and released existing spectrum holdings are treated as linked. However, at the

[52] It is important that we consider only those bids that *exactly* match the release scenario, as this means that each supply scenario is mutually exclusive.

[53] Ties are unlikely to occur in the actual auction in practice as they require two feasible scenarios to have exactly the same value, which depends on the (sum of) individual bids including those made in the supplementary bids round where bids can be expressed in denominations of €1.

same time if a bidder does not bid the relevant opportunity cost to liberalise existing spectrum, then this outcome will not be selected.

10.3.2 Determination of prices

374. Winning prices must meet the requirement that each winning bidder and group of winner bidders pays at least its opportunity cost. Subject to this requirement, auction revenues are calculated so that bidders pay no more than necessary collectively to achieve this requirement.

375. The procedure described above for determining winners has an associated total value of winning bids, V. For the purposes of defining the winning prices, we need to re-evaluate the total value of winning bids on omitting a group of bidders. In particular, let $V(I \setminus C)$ denote the re-evaluated sum of winning bids if some set of bidders C is omitted from the set of all bidders I. This is evaluated in the following way:

a) For bidders not in C, all of their bids are included;

b) For bidders in C, all of their bids are excluded;

c) The supply of lots available for award is incremented by the lots released by bidders C in the winning scenario. This ensures that the opportunity cost of existing spectrum holdings liberalised is defined by the counterfactual that the existing licensee releases spectrum and does not win it back;

d) With this restricted set of bids and given the augmented supply of lots, supply scenarios are defined and winners determined in the same way as described above (for the case of all bidders). Notice that the winning supply scenario may change as a result of this re-evaluation on omitting some bidders.

376. The prices that winning bidders pay need to satisfy the constraints

$$\sum_{i \in C} (\beta_i - p_i) \leq V(I) - V(I \setminus C)$$

for every possible subset of winning bidders C. Here β_i is the winning bid of bidder i and p_i is the corresponding winning price. These constraints represent the requirements that each set of bidders C pay a sufficient amount that there would not be any other bidders (i.e. those not in C) who individually or collectively would be prepared to pay more.

377. Subject to these constraints and that the winning prices must be at least the reserve prices, total auction revenue is minimised. Winning prices must also be greater than or equal to reserve prices.

378. In the event that there are multiple sets of winning prices that satisfy these conditions, one set of winning prices will be selected in order to minimise the sum-of-square distance from the Vickrey prices p_i^V for each bidder. The VIckrey prices are defined by

$$p_i^V = \beta_i - V(I) + V(I \setminus \{i\}),$$

i.e. the opportunity cost created by bidder i winning its bid on an individual basis. The winning prices are then chosen to minimise

$$\sum_i \left(p_i - p_i^V\right)^2$$

which always results in a unique set of winning prices.[54]

[54] For a detailed explanation of Vickrey prices and Vickrey-nearest, see: http://works.bepress.com/cgi/viewcontent.cgi?article=1011&context=cramton

11 Assignment stage

11.1 Full assignment round

Background

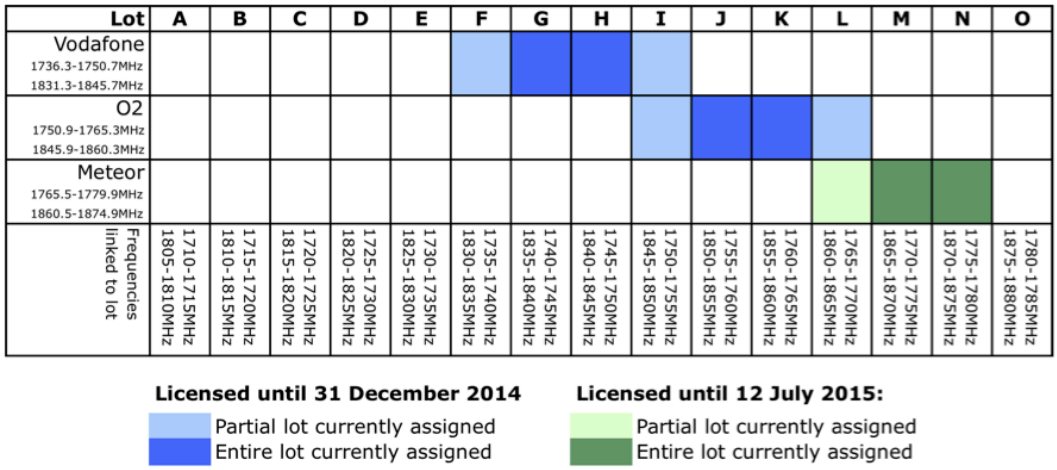
379. As described in Section 6, the combinatorial clock auction format is proposed for allocating spectrum to bidders. However, spectrum is allocated in the process described previously on a 'generic' basis; that is, lots are linked to a band and a time slice, but not to specific frequencies within the given band. There is therefore a requirement for a process through which lots won are assigned to specific frequency blocks.

380. One of the benefits of allocating generic lots and then assigning frequencies in a follow-up process is that constraints can be placed on the assignment options available to winners of spectrum within a given band. One such constraint that would be desirable to impose is that assignment options would be limited to those that allow contiguous assignment of frequencies.

381. The concept of an assignment round was first raised in the context of the 900MHz band in 09/99c. In this case, the location of Meteor in the band and the 2x10MHz spectrum cap considered at the time meant that all assignment options for other spectrum winners could be accommodated with contiguous frequency assignments. However, the issue of fragmented assignments became a serious concern when considering the inclusion of 1800MHz spectrum in the proposed sub-1GHz auction.

382. In section 4 of our December 2010 report on the inclusion of 1800MHz spectrum in the auction (10/105a), we noted that proposals for an early liberalisation option in the 900MHz band would have a low risk of fragmentation of frequency assignments as a result of Meteor retaining all or part of its existing holdings unliberalised for the first time slice. However, in considering the extension of these proposals to the 1800MHz band, we observed that given the exact frequencies held by existing operators in the 1800MHz band, as illustrated in Figure 4, it is likely that fragmentation would result from applying this same approach to early liberalisation in the 1800MHz band. Where the assignment options for one or more bidders are likely to be fragmented and such bidders place high value on contiguous spectrum, a risk arises that the auction outcome will be inefficient.

Figure 4: the 1800MHz band



383. In our report, we considered two alternative options for dealing with the issues arising from early liberalisation of spectrum in the 1800MHz band resulting from the specific frequencies held by existing operators within the band.

- 'All or nothing'; and
- 'Full assignment round'.

384. Under the 'all or nothing' approach operators with existing 1800MHz spectrum would not be permitted to liberalise a subset of their existing frequencies, but rather they would only have the option to liberalise the entirety of their existing holdings. In the case where the licensee wished to liberalise usage rights for all of its existing 1800MHz frequencies, these usage rights would need to be competed for, and the location of its liberalised frequencies within the band would be determined in an assignment stage. Therefore, the lots available in the assignment stage would be those that are currently unallocated plus any additional spectrum that the incumbent operators choose to liberalise.

385. We identified a number of drawbacks with the 'all or nothing' approach:

- It represents an incomplete solution to the problem of fragmented auction outcomes and auction inefficiency; and
- Whether a bidder would be able to win a contiguous block of spectrum would be determined by the actions of other bidders (i.e. incumbent operators).

386. A particular concern raised was that both O2 and Meteor's existing frequencies occupy blocks I and L, therefore both of these operators would have to opt in to early liberalisation in order to allow these operators to be ensured an award of a contiguous assignment of frequencies. Thus, if only one of these

operators opted in then at least one bidder would end up with a fragmented assignment and their assignment would also not be in full blocks of 2x5MHz.[55]

387. The alternative approach we considered was the 'full assignment round' which entails the inclusion of all spectrum in the band in a frequency assignment process, thus including existing licences whether or not licensees choose to avail of the early assignment option. Within this option, frequencies linked to existing 1800MHz licences from 2013 onwards would be determined within the auction.

388. We identified the following significant advantages with the 'full assignment round' approach:

- First, in the case where the entire band is available for award then the CCA format proposed for the auction it is possible to guarantee that only contiguous blocks of spectrum are awarded;
- Second, given the assurance of contiguous frequencies this approach alleviates the problem of an inefficient auction outcome resulting from bidders placing different values on contiguous and non-contiguous spectrum assignments.

389. The only downside we identified with this 'full assignment round' approach was that relative to the early liberalisation approach proposed for 900MHz spectrum in DotEcon report 09/99c, it requires existing licensees which choose not to liberalise to either bid to maintain their current locations within the band during the assignment stage or otherwise not state a preference over the frequencies that will be assigned, giving rise to the possibility that frequencies assigned are different to those currently occupied.

390. Therefore, in both scenarios there is the possibility that existing operators within a band may be assigned spectrum in another part of the band unless they outbid other bidders to maintain their current locations thus incurring an additional cost. In the case where an operator is assigned alternative frequencies then the operator will need to incur the cost of moving to another location within the band. We noted that given that different locations within the band should be roughly the same value, it seems unlikely that a bidder would bid much more than the cost of re-location to maintain its current frequencies.

391. However, we noted a number of reasons as to why we consider the impact of this approach to be small:

- Technical analysis by Red-M/Vilicom indicates that the monetary costs of relocation are small relative to the costs of running a mobile network[56];
- At some point all of the incumbent operators will need to incur the costs of relocating their frequencies if they win 1800MHz spectrum in the second time slice. This is because at present all of the existing 1800MHz operators

[55] Section 4.2.1 of DotEcon report 10/105a.

[56] See footnote 12 of DotEcon report 10/105a.

are spread over multiple 2x5Mhz blocks including in all cases partial blocks, and the relevant EC Decision requires a 2.8MHz separation between GSM and UMTS systems. Therefore, the only difference will be that the costs are to be incurred prior to the beginning of the first time slice rather than the beginning of the second time slice[57];

- The package-bidding feature inherent in the CCA format will allow bidders to make bids for the same frequencies in the two time periods. Therefore, given the reasonable assumption that bidders will want to minimise relocation costs, it is expected that where a bidder is to make a package bid it will be assigned the same spectrum for both time slices. Furthermore, we proposed a number of constraints on assignment options in order to further minimise the possible requirements to relocate frequencies within each band as a result of the assignment round.[58]

392. Given the above reasons, which suggest that the relocation costs are minimal, we concluded that, in our view, the 'full assignment round' approach is the best option available for the assignment of 1800MHz frequencies to bidders from the beginning of 2013.

393. Subsequently, we considered the suitability of this approach for the 900MHz band. We noted that while the benefits of ensuring a contiguous assignment of spectrum were likely to be smaller in the case of 900MHz spectrum, they are nonetheless material. In addition, we considered that there is an additional benefit to imposing a consistent approach across spectrum bands. Furthermore, we noted that the drawback of potentially imposing a cost on Meteor of moving earlier than it might otherwise have done would be a re-timing of this cost rather than a pure cost imposition, and in any case estimates of this cost provided by Red-M/Vilicom and Meteor suggests that the cost would be small.[59]

394. Taking into account these considerations we recommended that the 'full assignment round' approach be implemented for both the 900MHz and 1800MHz bands.

395. In ComReg consultation10/105, ComReg proposed to introduce a 'full assignment round' into the first time slice of the 900MHz and 1800MHz bands.[60]

396. Although we noted that any relocation costs that may occur as a result of this approach were likely to be small, ComReg proposed to provide reimbursement to a GSM licensee, in either band, for relocation costs that would otherwise have been avoided, but not where the costs were simply brought forward. For example, if an existing GSM licensee did not win spectrum in the second time

[57] See paragraph 77 and footnote 13 of DotEcon report 10/105a.

[58] See section 4.3 of DotEcon report 10/105a for recommendations made for further assignment constraints to ensure continuous assignments.

[59] See footnote 15 of DotEcon report 10/105a.

[60] Pages 28-29 of ComReg consultation 10/105.

slice and did not avail of the early liberalisation option in the first time slice then such a licensee should be reimbursed. ComReg stated that any such reimbursement would only be based on relocation costs which were objectively justified, proportionate and independently verified.[61]

Respondents' views

397. All of the respondents to ComReg Consultation 10/105 have agreed that the 'full assignment round' approach is beneficial and preferable in order to ensure that contiguous blocks of spectrum are awarded. Furthermore, they agreed with ComReg's suggestion to provide reimbursement to operators that incur relocation costs that would otherwise have been avoided.[62]

DotEcon commentary

398. Respondents to this proposal have not raised any real objections to the use of a 'full assignment round' in order to transition to locations in the band. Therefore, we recommend the adoption of this assignment round option as described in DotEcon report 10/105 and herein.

399. As an aside, we note that ComReg has proposed as part of its proposals for allowing the advanced commencement of liberalised licences for at least some 900MHz spectrum that where Meteor were not to liberalise any of its existing 900MHz spectrum holdings in the first time slice, it would not be permitted to bid on the two lowermost lots in the band, that is, those lots currently unassigned, as it would not have a liberalised licence in the 900MHz band. If this proposal is adopted, this (and any similar) constraints on assignment options would be implemented through the winner and price determination algorithm for determining the outcome run after bids have been submitted and the assignment round has closed.

11.2 Constraints to ensure continuous assignments

Background

400. In our December 2010 report considering the details of including the 1800MHz band in the proposed sub-1GHz auction (10/105a), we noted that it is possible to decrease the probability of a spectrum assignment in which a number of bidders will have to relocate from one time slice to the next.

401. We considered a number of possible ways to decrease this probability, and only one such constraint appeared to offer the benefit of decreasing the probability of bidders of having to relocate between the first and second time slice without unduly limiting assignment options. In this (10/105a) report, we proposed to impose the constraint on assignment options that where a bidder is awarded the same number of blocks in a band in the first time slice and the second time slice, assignment options within the band would be limited so

[61] Pages 29-31 of ComReg consultation 10/105.

[62] See Annex H for further details on each respondents view on the 'full assignment round'.

that this bidder would be assigned the same frequencies within the band for the first and second time slice:

- In the case where all bidders were to win the same number of lots in a band in the first and second time slices, all assignment options would result in spectrum assignments that would be the same for the first and second time periods for all spectrum winners.
- In the case where one or more bidders were to win the same number of lots and other bidders were to win different numbers of lots across time slices, it is still possible that bidders with the same number of lots in the two time slices will have assignment options that are at the end of the band and in the middle of the band.

402. This constraint offers the benefit of guaranteeing assignment of the same frequencies wherever possible without unduly limiting the frequencies within the band that such bidders would be awarded.

403. Note that in our assessment we assumed that the cost to an operator of re-locating or re-tuning its frequencies within a band is constant, i.e. shifting frequencies by a few channels would cost the same as moving to a completely different location in the band. In particular, bidders that win different amounts of spectrum in the two time slices need to relocate or re-tune their equipment anyway, so that it should not make a difference whether their frequencies change only slightly (i.e. contract or expand in their position) or if they are relocated completely within the band. Given the technical work done on this issue, this appeared to be a reasonable assumption.[63]

404. We expressed the implications of this constraint with and illustration of its effect in the 900MHz band. This illustration is replicated here for the 800MHz band. Our example considers the case where the whole band is available in the assignment round, i.e. under the full assignment round approach described in Section 11.1.

405. We consider the case where there are three winners in the band, Bidders 1, 2 and 3, in each time slice. The number of lots allocated to each bidder in each time slice at the end of the main stage is presented in Table 5 overleaf:

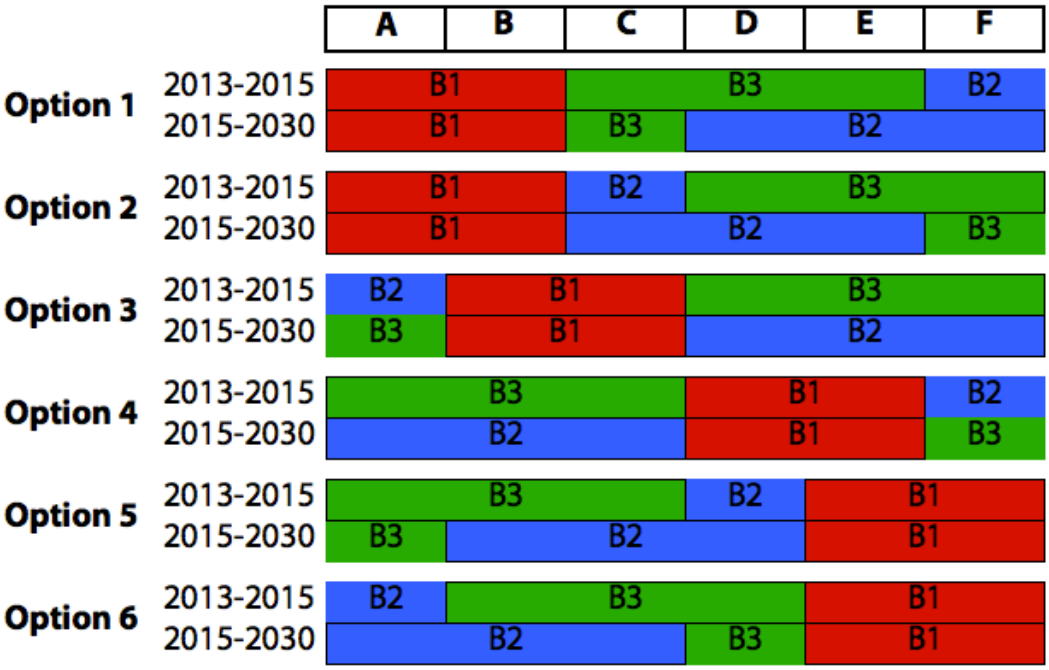
[63] In a report for ComReg (10/71c), Vilicom/Red-M estimated that the cost of Meteor re-tuning its frequencies by 200kHz, the smallest movement of frequencies that might possibly be contemplated, would be about €300,000 and in response Meteor estimated that such a move would cost less than this. In a further report for ComReg, Vilicom/Red-M estimated that the cost of re-locating a 'typically' sized Irish network of 2x15MHz within the 1800MHz band would be around €240,000. Therefore, it is reasonable to assume that the cost of moving is fixed, regardless of the magnitude of the move.

Table 5: Spectrum allocated to bidders in the main stage

	Number of lots allocated to this bidder in the first time slice	Number of lots allocated to this bidder in the second time slice
Bidder 1	2	2
Bidder 2	1	3
Bidder 3	3	1

406. Where we impose the above proposed constraint, Bidder 1 would be guaranteed contiguous spectrum across the two time slices. This would mean that the assignment options within this band are as follows:

Figure 5: Assignment options given the allocation in the main stage



407. As can be seen from Figure 5, the available assignment options include assignment of spectrum to each bidder at each end of the band and in the middle of the band, and for Bidder 2 and Bidder 3, options for full relocation and for partial relocation where one or the other might be preferred.

408. In report 10/105, we noted that this proposed constraint produces assignment options that minimise the number of bidders that would be required to relocate or re-tune frequencies between the first and second time slices. That is, in the example above, two bidders have been assigned different numbers of lots in the first and second time slice, and the potential assignment options as represented in Figure 5 expresses all assignment options where only two operators are required to re-tune between time slices.

409. We considered another constraint that reflected the situation where bidders winning different amounts of spectrum might have a preference to re-tune part of their assignments over relocating of their full assignments. This constraint might further reduce the extent of relocation by constraining assignment options such that the number of 'transition blocks', i.e. blocks which are assigned to different bidders in the two different time slices, should be minimised. However, we showed that the increased probability of continuity over time slices for bidders came at the cost of further restricting the assignment options for such bidders.

410. We considered that:

- There was no evidence that preferences for partial re-assignment over full re-assignment were strong, and therefore the benefit of imposing this additional constraint was limited;
- The assignment options that would be precluded by the addition of this constraint may have value to bidders that would not have the opportunity to express this preference; and
- Where bidders do have moderate preferences for partial rather than full re-assignment of frequencies across time slices they will be able to express their preference for assignment options resulting in only partial re-assignment of frequencies in the assignment round.

411. Therefore, based on the limited benefit and offsetting cost of imposing this additional constraint, we do not believe that this imposition offers unambiguous benefits, and recommended that only the first constraint considered be adopted.

412. In line with our recommendation, in its related consultation (10/105), ComReg proposed that a restriction on assignment options be imposed so that if a bidder were to win the same amount of spectrum in a band in the first and second time slice, a continuous assignment across time slices would be guaranteed.

Respondents' views

413. Of the four respondents to ComReg consultation 10/105, all four agreed with the proposal to impose continuity of spectrum assignments within a band where the same amount of spectrum is allocated to a given bidder in the first and second time slice. Reasons stated for support of this option were that:

- imposing this constraint is an economically efficient approach/gives the most efficient result overall;
- it will promote efficiency and investment and reduce complexity of options at the assignment stage and the potential for strategic bidding;
- it is objectively justified and proportionate; and
- where a bidder were to be allocated the same amount of frequencies in both time slices in a band, the option of choosing non-contiguous spectrum assignments across the two time periods would appear to have very little, if any, value, so the proposed constraint would be of unambiguous benefit to licensees.

414. Further, all four agreed with ComReg's assertion in its consultation that it is not appropriate that the assignment options presented to bidders are only limited to those options involving a partial relocation. One respondent, Vodafone, noted that there is unlikely to be a significant difference in the costs to licensees between partial and full relocation of frequencies. It noted further that the benefit of only partial relocation would be significantly outweighed by the cost of the reduction in the choices and flexibility available to bidders in the auction process, risking a sub-optimal outcome of the award process. Another respondent, Meteor, stated that while partial relocation could be possible, a rule to impose this would be complex to define and would reduce transparency of the auction process.

DotEcon commentary

415. Given the benefits of the proposed option, and the unanimous agreement by consultation respondents that a constraint imposing that spectrum assignments be continuous in the specified case should be implemented, our view that this should be implemented is unchanged.

PART C: DETAILS OF LICENCES

12 Spectrum sharing

416. As part of their responses to ComReg consultations on an award of spectrum including that in the 900MHz band, a number of respondents (Vodafone, O2, Meteor and Ericsson) have raised the issue of spectrum sharing, mainly whether this would be permitted and how this would be dealt with in the auction. In this section, we consider how entities with a view to potentially sharing spectrum in the future could bid in the auction if ComReg were to decide that spectrum sharing will be permitted.

Joint bidding in the auction

417. If parties were to commit to spectrum sharing prior to the auction, it would be possible for them to pool their bidding interests[64] and use a bid vehicle to bid on their collective behalf during the auction. Note that this would mean that parties cannot at the same time bid both as individuals and as part of a joint bid vehicle.

418. Eligibility and activity rules in force during the auction would be such that bidders bidding through a bid vehicle do not obtain unfair advantages by joint bidding.

419. One important issue for operators in respect of spectrum sharing agreements is how a spectrum cap on a bid vehicle would be treated within the auction. In this respect, we consider that where operators bid as a bid vehicle representing a spectrum sharing venture, the spectrum caps set for such a bid vehicle should be the same as those set for any other bidder i.e. a 2x10MHz cap on 900MHz spectrum in the first time slice, a 2x20MHz sub-1GHz cap and an overall cap of 2x50MHz.

[64] Note that the granting of permission for any such pooling of interests would be subject to appropriate competition scrutiny.

13 Licence conditions

13.1 Coverage and roll-out conditions

420. In this section, we summarise the issues surrounding the coverage and roll-out conditions which may be attached to new licences for 800MHz, 900MHz and 1800MHz spectrum. We first summarise the recommendations made in previous DotEcon reports on coverage and roll-out obligations. We then discuss a number of aspects of our coverage and roll-out recommendation, including respondents' views on these aspects and our current views. These issues are separated into the following areas:

- Heterogeneity of coverage obligations;
- Minimum roll-out and coverage level; and
- Measurement of coverage.

421. As for the main proposals on this aspect of licensing, in summary:

- In its first report in December 2009 (09/99c), DotEcon recommended a obligation on all 900MHz licensees to have coverage of:
  - Sufficient area to cover 25-35% of the population within 3 years; and
  - Sufficient area to cover 50-70% of the population within 5 years.

  with broadly similar requirements for 1800MHz-only licensees, highlighting that these should not be overly onerous to avoid inefficient duplication of networks.
- With coverage obligations at this level, there is a strong case for homogeneity of coverage obligations. Heterogeneity of coverage in new licensees may distort competition for licences in the auction and competition in the resulting market.
- ComReg is currently proposing a similar obligation on all sub-1GHz and 1800MHz licensees.

13.1.1 Background

Heterogeneity of coverage obligations

422. In DotEcon report 09/99c we considered the approach of differentiating coverage obligations according to the characteristics of the winning licensee i.e. whether they had 900MHz spectrum licensed to them prior to the planned auction.

423. In considering this approach the first point we evaluated was whether adopting this approach would lead to a material social benefit in comparison to the approach of setting a homogeneous coverage obligation. We considered that the case for setting a heterogeneous coverage obligation, which imposes tighter conditions on incumbent operators, hinges on the view taken of the high levels of GSM coverage in Ireland at present. If it were socially desirable to have high coverage and this would not be provided in the absence of a high coverage obligation then this might effectively be resolved by the imposition of a higher coverage obligation on existing operators, for

example at the level of GSM coverage, and a lower obligation imposed on entrants to encourage entry. Conversely, where coverage provided by operators based on commercial considerations were to be high, there would be no need to impose obligations on existing operators in excess of those imposed on potential entrants.

424. In assessing this issue, we noted that all three existing 900MHz operators have exceeded the minimum levels of coverage mandated in their respective licences. In addition, we noted that competition between operators provides an incentive to operators to provide coverage as an aspect of service quality differentiation. Further, we considered that moving to 3G services provided using sub-1GHz spectrum might even encourage further roll-out as areas on the margin may become economic to serve. Therefore, evidence suggested that the probability that the current coverage levels would reduce significantly in the absence of a high coverage obligation seemed likely to be low.

425. We then highlighted the following concerns and risks that could arise from heterogeneous coverage obligations:

- Cherry-picking: Less onerous coverage obligations could allow entrants to cherry pick the more profitable high density areas to serve, therefore cannibalising incumbents' existing customer bases in these areas. This could potentially cause difficulties for incumbents if they were to no longer be able to cross-subsidise provision of services in low-density areas with provision of services in high-density ones, therefore undermining rural coverage.
- Inconsistency of approach: ComReg has adopted the perspective on current 900MHz licences that these are different to the liberalised 900MHz licences that it is planning to award, and therefore operators with existing 900MHz licences should compete for new liberalised spectrum licences in open competition. Given that these existing 900MHz operators will not benefit from holding existing 900MHz licences, it would be difficult to then justify requiring these same operators to take on higher coverage obligations as a result of holding 900MHz licences previously.
- Complexity of the award process and distorted competition: An alternative approach of having different levels of coverage obligation linked to different lots of spectrum sold side by side in an auction would mean that the award process would become more complex and could lead to low competition for those licences with high coverage obligations (potentially even going unsold). This may result in the distortion of competition in the auction, leading to opportunities for incumbents to win licences at less than their true opportunity cost and potentially constraining the ability of entrants to compete for specific licences in the auction.

426. Considering these various issues, we recommended in 09/99c that any coverage obligation apply homogeneously to all licences.

Specification of coverage obligations

427. In DotEcon report 09/99c we made a number of recommendations for the specification of the minimum level at which roll-out and coverage obligations should be set by ComReg.

428. First, we considered the two possible options for setting coverage obligations: as a percentage of the population to be served or as a percentage of the area within the licensed area to be served i.e. a geographic obligation. We noted that where an operator rolls out its network with a strict priority given to higher population density areas, both approaches are effectively equivalent.

429. Nevertheless, despite the similarities between the two approaches we set out the following good reasons to favour a geographic, rather than population based, obligation:

- Population density measures where people live rather than where they are most likely to be. However, mobile operators tend to provide mobile phone coverage along major road and transport links even if population density is low. Hence, specifying a coverage obligation based on geography rather than population leaves it up to operators themselves to decide where subscribers are most likely to be and to provide coverage to meet customers' needs effectively;
- A population-based coverage obligation requires detailed data on the location of the population in order to determine whether or not the obligation has been met whereas a geographic coverage is much simpler to measure.

430. We considered the specifics of the requirements i.e. the level and the time frame under which it should be set.

Level of coverage and roll-out obligation

431. In 09/99c, we discussed the various issues that need to be considered when setting coverage and roll-out requirements for new 900MHz spectrum licences to be allocated within the planned auction. As part of this discussion, we considered international examples, the option of carrying over existing coverage obligations and service-specific coverage obligations on mobile broadband and voice services.

432. We noted that existing 900MHz licences imposed conditions specific to named services. However, given the liberalised nature of new 900MHz licences, licence conditions associated with new licences must be less linked to the provision of specific services. Although some conditions and minimum standards for calls could be carried over to new licences, a significant issue is the extent to which it is desirable to do so. This issue was linked with that of whether licence conditions should be the same for all licensees (homogeneous licences) or else differentiated according to some objective differences across licensees (such as whether they previously held 900MHz licences).

433. Whilst our observation of international practices did not in itself provide any clear guidance for potential coverage obligations for new liberalised licences in the 900MHz band we nevertheless observed that these were typically less

onerous than those commitments offered in a beauty contest by licensees when GSM or 2.1GHz spectrum was initially awarded.[65]

434. Where coverage obligations were to be imposed we considered that there was a good case for setting these at a medium level and in line with those appropriate for mobile broadband. We recommended that where a coverage obligation is linked to the assignment of a new 900MHz licence, this coverage level be set at the level of area coverage sufficient to serve 50-70% of the population. This range was chosen because it was believed to be sufficient to avoid cherry-picking, but low enough not to discriminate against and/or discourage new entrants.

435. We noted that where ComReg were to implement a coverage obligation it would need to be phased over a period of time otherwise it would create a large asymmetry between entrants and incumbents in their ability to meet the obligation. On the other hand, the phasing in should not create unnecessary delay as this would deny the benefit of the coverage obligation in achieving rural roll-out.

436. After considering the relevant issues we recommended a homogeneous coverage level of 50-70% of the population. Given the level of coverage recommended, we considered that the time horizon for all licensees to meet such obligations should be reasonably long in order to ensure that new entrants were not discriminated against. We proposed the following obligations:

- Operators must have coverage of a sufficient amount of the country so as to provide services to 25-35% of the population within 3 years of the date of the assignment of a liberalised licence; and
- Operators must have coverage of a sufficient amount of the country so as to provide services to 50-70% of the population within 5 years of the date of the assignment of a liberalised licence.

437. In our second report, 10/71a, published alongside ComReg's related consultation (10/71) in September 2010, we considered the option of including 800MHz spectrum in a joint award with 900MHz spectrum and the implications this may have on proposed licence conditions. In this (10/71a) report, we concluded that in order to maximise the substitutability of the spectrum bands and the opportunity for holding large blocks of spectrum within one band there would be benefit in ensuring that licence conditions be the same for licences for spectrum in the 800MHz and 900MHz bands. This should also avoid distorting bidders' choice to purchase spectrum in one band or another. For example, if licence conditions were heterogeneous then a higher coverage obligation on one band relative to the other may skew bidders' choices towards the band with the lower coverage obligation, or allow incumbent bidders to bid on the band with the higher obligation facing a lower level of

[65] Section 15.1.1 of DotEcon report 09/99c.

competition that might otherwise be the case, therefore winning spectrum at less than the true opportunity cost.[66]

438. In our third report, 10/105a, published alongside ComReg's related consultation (10/105) in December 2010, we considered the appropriate coverage levels to be linked to licences for 1800MHz frequencies where 1800MHz spectrum were to be auctioned alongside 800MHz and 900MHz spectrum. In considering this issue, we noted international practice in setting coverage obligations for 1800MHz licences, the specific conditions in Ireland and the implications for the upcoming auction.

439. In particular, we noted that it was international practice to specify some level of rollout or coverage obligation on mobile spectrum licences. In cases where incumbents' existing 900MHz and 1800MHz spectrum had been liberalised we observed that National Regulatory Authorities (NRAs) tended to apply non-onerous coverage obligations such as the requirement to maintain existing coverage levels. Of the countries we observed, only in France did the regulator, ARCEP, impose more demanding coverage obligations when liberalising spectrum, increasing the coverage requirements from 90 to 99% of population in metropolitan France.[67] Further, where incumbent operators held 900MHz and 1800MHz spectrum it was observed that the obligations imposed were homogenous and in most cases the coverage obligation was defined in terms of a service obligation. However, where obligations were specific to 1800MHz spectrum these were less onerous than those placed on sub-1 GHz licences.

440. After considering the international examples and the level of coverage obligations on 2.1GHz spectrum we recommended that the coverage obligation for 1800MHz spectrum should be:

- Less onerous than the 70% population coverage obligation linked to licences proposed for liberalised sub-1GHz spectrum;
- Comparable to those imposed on 2.1GHz spectrum licensed to a new entrant, particularly in terms of the time period within which coverage has to be met; and
- Band-neutral, consistent with the proposed approach for the coverage obligations on sub-1GHz licences.

441. Therefore, given these recommendations, a coverage obligation on a 1800MHz licensee would only be binding for a new entrant winning only 1800MHz spectrum, because:

- An entrant (or incumbent) winning 800MHz and/or 900MHz spectrum alongside 1800MHz spectrum in the auction would necessarily meet its

[66] Section 4.3.4 of DotEcon report 10/71a, "Award of liberalised spectrum in the 900MHz and other bands"

[67] Section 8.2 of DotEcon report 10/105a, "Inclusion of the 1800MHz band in a joint award of spectrum in the 800MHz and 900MHz bands"

1800MHz obligation when it meets its sub-1GHz licence obligations given that the latter should be more onerous; and

- An incumbent's rollout of 3G services as required by its 2.1GHz licence will more or less cover its obligations for the 1800MHz spectrum since the two have been proposed to be similar.

442. In ComReg consultation 09/99 it proposed setting the following minimum level of roll-out and coverage for new entrants (i.e. heterogenous):

- 30% geographic coverage within 4 years of the licence commencement date;
- 70% geographic coverage within 7 years of the licence commencement date; and
- 90% geographic coverage within 10 years of the licence commencement date.

443. After reviewing the responses to its 09/99 consultation ComReg proposed in its following consultation on the subject (10/71) to set a symmetric coverage obligation for 70% of the population of Ireland and an asymmetric roll-out time to meet this obligation. The proposed rollout time is 3 years for a licensee that has an existing mobile network and 7 years for a new entrant to the Irish mobile market. Subsequently, in ComReg consultation 10/105 on the inclusion of 1800MHz spectrum in the auction, ComReg expressed the view that there is no need to set a specific coverage obligation for 1800MHz spectrum as the coverage obligations set out in consultation 10/71 should apply to all spectrum bands in the joint award.

Measurement of coverage obligations

444. In report 09/99c we acknowledged that coverage at present is defined by reference to transmitter field strength and that the required field strength for coverage to be present is different for GSM and 3G services. We also noted that whilst the current definition could continue to be used for measuring coverage obligations we believed that it might not be future-proof given likely changes in radio technologies. For example, future receiver improvements may allow a service to be deployed successfully with lower field strength therefore using the current approach could lead to an inefficient network topology.

445. To this end, we considered that one possible solution to this problem would be to define coverage area for a particular service by reference to the probability of the service being available being sufficiently high. For example, for a particular 1km square area to be included as part of the coverage area for a particular service, that service must be available at a random time and at a random outdoor location within the square at 1.5m from the ground with at least a specified probability. The requirement could also include a requirement that this probability of availability is achieved with a certain level of network loading e.g. a certain percentage of people in the area simultaneously using the service. Therefore, this approach would define an outdoor coverage area without specifying any particular technology i.e. making it future-proof.

446. In terms of defining indoor coverage levels we identified that it was more difficult as there is no fixed notion of what "indoor" might mean. Given the

methodological and practical problems associated with defining indoor coverage levels in comparison to outdoor requirements we raised the question of whether it is necessary to impose an indoor coverage obligation in addition to an outdoor coverage obligation.

447. We considered that market forces are likely to be reasonably effective in providing incentives for indoor coverage especially in urban areas because 900MHz spectrum has superior propagation characteristics and could be used to provide mobile broadband more deeply into buildings. This service would likely be very attractive to valuable market segments such as mobile workers with laptops and therefore one would expect operators to compete strongly for such consumers.

448. Furthermore, we noted that the issue of indoor coverage may become less important as new technologies, such as "smart repeaters" which effectively extend the range of the existing radio network, and 3G femtocells, which do not need a radio connection to the public 3G network to provide localised 3G coverage, become widely available.

449. Given these considerations we concluded that there might be a good case for limiting any mobile broadband coverage requirements simply to an outdoor requirement if relevant services are offered using the band.

450. In 09/99 ComReg proposed to set different outdoor field strength levels for measurement purposes for each technology i.e. a field strength level for GSM, 3G and other technologies. For other technologies ComReg stated that the value of the field strength level will be set by ComReg to a level that is sufficient for the provision of such services with this technology in a manner that is objectively proportionate and non-discriminatory. This addresses our concern about the definition of coverage areas with different technologies being used.

13.1.2 Respondents' views

Homogeneity of coverage obligations

451. In response to ComReg consultation 09/99 Meteor, O2 and Vodafone agreed with the view that coverage obligations should be set homogeneously because of the little benefit arising from differentiated roll-out and coverage obligations that might not outweigh the potential risks. For example, Meteor stated that it supports our considerations in making our assessment on roll-out and coverage in 09/99c, and O2 stated that a differentiated approach conflicted with an auction award process because it distorted competition in the auction. In response to ComReg's consultation 10/71, ESBN agreed with the symmetric coverage obligation proposed by ComReg.[68]

452. On the other hand, in response to the same consultation, BT, Digiweb and H3GI stated that in their view roll-out and coverage obligations should be

[68] See Table 20 in Annex F for more information on respondents' views to setting heterogeneous coverage obligations.

asymmetric, imposing more onerous obligations on existing 900MHz operators. BT stated that coverage and roll-out requirements should take into consideration the advantage that some operators have by virtue of their existing networks and the significant financial cost and time taken to roll out a network for new entrants. Therefore, the conditions should not discriminate against new entrants or otherwise impede competition.

453. Following the review of responses to its 09/99 consultation ComReg proposed in consultation 10/71 to set a symmetric coverage obligation but providing a longer timescale for rollout by entrants relative to incumbents. In their respective responses to ComReg consultation 10/71, Digiweb and H3GI accepted this proposal to set a symmetric coverage obligation and an asymmetric roll-out time to meet this obligation.

Level of coverage and roll-out obligation (including specification)

454. Many respondents tended to agree with our recommendations on roll-out and coverage, albeit with a few asides in a small number of cases.[69]

455. The only respondents that strongly opposed our recommendations were H3GI and Ericsson. H3GI expressed its view that ComReg's proposal as set out in 09/99 was disproportionate and discriminatory. In particular, it stated that as a new entrant they were only given 5 years to achieve 85% demographic coverage in their 3G licence therefore they consider that a 90% demographic coverage should be achieved in the shorter period of 7 years rather than 10 years. Subsequently, however, in response to ComReg consultation 10/71 H3GI stated that it agreed with ComReg's proposed coverage and roll-out obligation.

456. In response to ComReg consultation 10/71, Ericsson expressed its concern that the proposed coverage obligations were too low and that ComReg ran the risk that over time incumbents would not invest in infrastructure in pockets of rural areas and therefore coverage in Ireland could fall back down to the 70% level. Furthermore, Ericsson observed that ComReg's proposals contrasted with the recent awards of and proposals for the award of 800MHz spectrum in Germany, the UK and Sweden. Therefore Ericsson considers that a more appropriate coverage obligation for services deployed using 800MHz and/or 900MHz spectrum would be the 90% geographic target that ComReg proposed in consultation 09/99.

457. On the other hand, in response to ComReg consultation 09/99, Meteor stated its support for DotEcon's roll-out and coverage recommendations and asserted that to the extent that coverage and rollout obligations can be objectively justified (which to date in their view they have not been) the targets should be set in accordance with our recommended coverage level, that is, in the region of 50-70% of the population. Meteor tended to agree with our recommendations in this respect, to the extent that coverage obligations can be demonstrated to be necessary.

[69] See Annex E for more information on respondents' views to the minimum coverage level for entrants proposed by ComReg in 09/99 and 10/71.

13.1.3 DotEcon commentary

Homogeneity of coverage obligations

458. After considering these responses, and given the high level of consensus on this issue, our view on the homogeneity of coverage obligations remains unchanged.

459. As an aside, in response to BT's view that an asymmetric coverage obligation should be set in order to ensure that new entrants are not discriminated against we note that a symmetric coverage obligation could also ensure new entrants are not discriminated against. As noted above, in 09/99c we stated that a homogenous coverage obligation should be set at a level suitable for a new entrant therefore ensuring that new entrants were not discriminated against in the auction. Furthermore, we asserted that one of the risks associated with differentiated coverage obligations was to impede competition in the auction. Therefore as long as a homogeneous coverage obligation was set at a level suitable for new entrants it is unclear how a heterogeneous coverage obligation would have any additional benefits to a homogenous obligation, furthermore it could lead to a number of potential risks.

Level of coverage and roll-out obligation (including specification)

460. We believe that the obligation for a symmetric 70% of population coverage requirement (though with differing roll-out periods (3 years for incumbents and 7 years for entrants)) proposed by ComReg is sufficient to ensure that cherry picking solely of high-density urban areas could not occur. It is also modest enough to avoid any risk of forcing the build-out of competing networks to low population density areas where cost efficiency would be best achieved by reducing network duplication.

461. We consider that the precise level of coverage is not especially critical, as a wide range of alternative levels would probably equally well achieve these two objectives (i.e. stopping cherry picking without forcing inefficient duplication).

462. In considering any more onerous coverage obligation than that proposed, it is helpful to distinguish the distinct issues of:

a) Whether measures are necessary to protect *existing* voice coverage as existing 900MHz licences expire; and

b) Whether there is any case for using the allocation of spectrum as an instrument in promoting coverage of *future* data services.

Roll back of existing voice coverage

463. In our view, the risk of roll-back of voice coverage appears quite limited:

a) In the short-run, existing 900MHz licensees will need to offer legacy GSM services using 900MHz spectrum until nearly all handsets are upgraded;

b) The costs of rolling out networks to rural areas are largely sunk and so the cost savings resulting from rolling back GSM coverage levels are correspondingly modest. In particular, there is no alternative use or second-hand demand for equipment;

c) Coverage has been an important competitive differentiator, and one that has been given prominence in advertising and marketing. The first MNO to roll back voice coverage would create significant opportunities for rivals to win its customers; and

d) In any case, the coverage obligations in 3G licences (and the greater coverage levels actually achieved under competition) underpin voice coverage levels.

Coverage obligations on future data services

464. For a coverage obligation to be at all useful in delivering services in rural areas where these would not otherwise be competitively provided, the obligation needs to be reasonably burdensome. In particular, it would need to significantly exceed present 3G coverage levels (say, a 98% population coverage level). However, at some point high population coverage levels become a blunt instrument, as they force coverage into areas where people live (and few people at that) rather than where people spend their time (e.g. along roads and at workplaces). Therefore, to achieve very high coverage levels, it is typical to use "not spot" obligations instead, which require service to be provided at specified locations.

465. In this respect, we note that Ireland has already taken measures to address the provision of rural broadband through the National Broadband Scheme, which is a "not spot" type obligation (i.e. to provide service where there is an absence of broadband services). The more recent Rural Broadband Scheme extends this.

466. In direct response to the view expressed by Ericsson that coverage obligations should be higher, otherwise coverage levels may fall, we note that actual coverage, if decided by operators in the absence of this type of obligation, would likely provide coverage levels beyond those proposed for new licences. We re-iterate the points made in the preceding paragraphs, noting in particular:

- The existing direct market intervention to boost rural data coverage to provide broadband services to those customers that are least desirable to serve otherwise through the National Broadband Scheme;
- The Rural Broadband Scheme, which has been set up with the aim of identifying the remaining individual premises in rural Ireland that are unable to obtain a broadband service and providing a service to those premises where requested;[70]
- The fact that at present existing operators are exceeding coverage levels set out in their licences;
- Coverage has been an important competitive differentiator to date, and this is likely to continue to be the case;

[70] http://www.dcenr.gov.ie/Press+Releases/Rural+Broadband+Scheme+Announced+by+Minister+Rabbitte.htm

- With the liberalisation of sub-1GHz spectrum, the provision of coverage in low density areas will become more financially feasible, so the marginal cost of extending coverage should fall, encouraging greater coverage; and
- Roll-back of existing 2G/3G coverage appears implausible, as the costs incurred in building sites are at least partially irrecoverable, whereas demand in contrast is growing.

467. As such, there is a good case for not setting coverage obligations at very high levels and addressing coverage issues if and when they arise. In particular, if there turns out to be a rural data coverage issue it is difficult to know in advance what the root cause of the problem might be and, therefore, what the best corrective intervention should be. Under this approach, where such a coverage issue were to arise, policy makers in Ireland and/or ComReg would be able to tailor the remedy taking into account the factors underlying the problem.

Measurement of coverage obligations

468. Given the divergence of our recommendation and ComReg's proposal, and given that there is widespread agreement on the condition proposed by ComReg, we have not considered this issue any further.

13.2 Other licence conditions

13.2.1 Background

469. In our first report (09/99c), in addition to a detailed consideration of coverage and roll-out conditions to be linked to liberalised licences in the 900MHz band, we set out our views on other licence conditions that might be linked to such liberalised licences.

Use-it-or-lose-it condition

470. We noted a number of drawbacks to the inclusion of such a licence condition – it would be difficult to implement in a technology and service-neutral way, there may be reasonable commercial reasons for not using particular frequencies temporarily and such a condition may be easy to circumvent. We considered that such a condition is in essence a weak form of coverage obligation, and that imposition of spectrum caps diminishes the case for such an obligation. We therefore recommended that a use-it-or-lose-it condition not be included in licence conditions for the relevant licences.

Service quality and performance standards

471. We noted that is it possible to impose general obligations regarding quality and performance whilst maintaining service and technology neutrality. For example, we considered that one way to safeguard quality standards for voice in a technology and service neutral way would be to impose that licensees had to meet certain standards for voice if voice services were provided. We recommended that the following obligations be imposed on licensees:

- Licensees should maintain a coverage map accessible to both ComReg and consumers;
- If voice calls are provided using the licensed spectrum, quality standards within the licensee's coverage area should be at least as good as those

required by the tighter of 900MHz and 2.1GHz licences in terms of blocked and dropped calls;
- System availability should be logged, and average availability should then be calculable on an annual basis; and
- Licensees should promote transparent disaggregated bills that allow consumers to determine the costs of individual services used.

Emergency services

472. We noted that the proposed licences are long and that these requirements should be redefined as necessary. In this respect, one significant development since our report in December 2009 is the coming into force on 26 May 2011 of revisions to the Electronic Communications Framework as implemented by the Amending Directives (2009/140/EC and 2009/136/EC). This framework now mandates a number of further requirements in terms of providing emergency services, including:

- The provision of a location-based services in addition to the traditional voice service provision requirement (raised as a possible augmentation to the licence requirement in 09/99c);
- Requirements on operators using new technologies such as VOIP to provide access to the emergency services; and
- Provision of emergency service access to those with disabilities (such as the provision of a text-based service).

These obligations will need to be imposed on all licensees, though through general authorisation instead of through specific licence conditions (in line with changes to EU telecoms regulations).[71] We do not recommend that obligations be put in place with regard to emergency service access over and above those set out in the revised Framework.

Penalties and performance bonds

473. We considered that ComReg needs a variety of penalties of different sizes so that where a penalty is required, it can take into account the severity of the infraction. ComReg has a number of powers in this regard – it can refuse to grant a licence, revoke or suspend a licence or amend a provision of a licence.[72] In addition, existing GSM licences specify financial penalties for failing to meet licence conditions, but these penalties are in the order of €1-3 million.

474. Reduction in licence term represents a material penalty and also a credible threat for dealing with a range of moderate to serious violations of licence conditions. However, it may be valuable to have alternative penalties such as performance bonds, for use towards the end of the licence period when

[71] DIRECTIVE 2009/140/EC of the European Parliament and of the Council of 25 November 2009 amending Directives 2002/21/EC on a common regulatory framework for electronic communications networks and services, 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities, and 2002/20/EC on the authorisation of electronic communications networks and services

[72] These powers stem from Statutory Instrument No.s 468/1997, 422/1999 and 339/2003.

curtailment may not be a credible threat. An operator penalised in this way may be offered the opportunity to re-purchase this last part of its licence, perhaps within 24 months of the imposition of the penalty, in terms that take account of the infringement.

475. As a rule of thumb, we considered that a curtailment of less than 2-3 years would probably not be worth imposing, and that it would be better to have an alternative such as performance bonds to deal with such situations.

476. Overall, then, we recommended the use of a performance bond of €2-3 million, to be used to impose penalties for minor breaches, and the use of licence curtailment as a penalty for serious breaches of licence conditions.

Reporting and compliance

477. We noted that reporting and monitoring is required to ensure compliance with licence conditions. We considered that current conditions do not place an onerous cost burden on operators while providing ComReg with the tools to ensure compliance. We recommended that the current condition (for 900MHz spectrum licences) be maintained, and that the type of information to be reviewed by ComReg is revised at intervals deemed appropriate by ComReg in light of technological developments and the use of these technologies at the relevant frequencies.

13.2.2 Respondents' views

478. Based on responses to ComReg consultation 09/99, stakeholders were broadly in agreement with the licence conditions proposed. The more significant points of debate were:

- *Minimum Quality of Service (QoS):* This issue received a mix of responses. Proponents of minimum QoS standards argued that these should be set to ensure that consumers have a reasonable service. Opponents argued that the robust competition in the market is sufficient to ensure that acceptable QoS standards will be maintained, and that such standards would be unnecessary, highly disproportionate and not objectively justified. Where there was agreement between respondents on the issue of QoS standards was that where such conditions were to be imposed, these should apply to all licensees equally.
- *Performance bond:* Of the stakeholders that expressed a view on this, opinions were mixed on the requirement and value of such a performance bond. Proponents did not give any reason for their agreement. Opponents argued that this was not necessary, that competition would ensure compliance and that there were less costly ways to ensuring compliance.

13.2.3 DotEcon commentary

479. In the context of this first issue, arguments from both sides reflect divergent views on the certainty that service provision by licensees based on their own business considerations would result in levels of service that would be considered reasonable; that is, proponents argue that this should be ensured, while opponents argue that this level of service would be provided anyway and thus obligating operators to provide this is unnecessary.

480. In the context of this second issue, we refer back to the requirement that ComReg should have a range of measures to enforce licence conditions so that it can set the magnitude of the penalty to be in line with the magnitude of the infringement. We also re-iterate the issue that given the cost to an operator of licence curtailment, this should be reserved for major licence infringements, and as such, the proposed performance bond relates to more minor infringements.

14 Issues related to spectrum fees

481. This section addresses issues surrounding the payment of fees for licences awarded in the planned auction. Specifically, it considers:

- The split between an upfront payment and subsequent payments; and
- The possibility of a deferral option relating to the upfront payment.

All issues relating to the value of the recommended minimum price ranges provided in previous reports and the associated methodology have been addressed in our related benchmarking report (published as ComReg document 11/59). A summary of the issues raised and our responses can be found in Annex C of that report.

14.1 Split between upfront and subsequent payments

Background

482. In terms of the structure of payments, we asserted at the outset that licences awarded in the auction would have two payment components: a upfront payment, due within a short time after the release of the results of the auction, and a series of subsequent payments, spectrum usage fees, due annually for the duration of the associated licence.

483. In our December 2009 report on aspects of a 900MHz award (09/99c), we highlighted the trade-off faced in considering the break-down of auction fees into an upfront fee and subsequent annual licence fees:

- On the one hand, paying significant fees on an ongoing basis during the licence period would ensure that licence holders consider the opportunity cost of their licensing; while
- On the other hand, allowing bidders to be awarded spectrum immediately after the auction based on fees predominantly due in the future risks the possibility of default, where a spectrum winner's inability to pay for its licence only becomes apparent some time after the auction.

484. We recommended that at least 50% of the minimum price be paid through annual spectrum usage fees.

485. In considering a discount factor to be applied in order to set the actual amounts of annual fees given a specific value for licence prices and a fixed discount factor, we noted two potential values:

- 10.21%, the weighted average cost of capital of Eircom set by ComReg in 2008; and
- A higher discount factor of 15%.

486. We assumed that the cash flows generated from a licence are flat over time and used the appropriate discount rate assumption to convert the value of a 15-year licence into that for a shorter licence.

Respondents' views

487. Only a small number of respondents to ComReg consultation 09/99 stated their views on this issue. Respondents included three of the four existing mobile operators. Two of these operators have argued that:

- This strikes a balance between discouraging frivolous or non-constructive speculative participation in an auction and facilitating near term investment in infrastructure development; and
- The overall price being divided between an annual fee and an upfront element gives an ongoing incentive to use any allocated spectrum.

488. The operator not in favour of the proposed break-down of fees argued that:

- it is both proportionate and justified that most of the licence price of the spectrum should be captured in the up-front payment;
- charging most of the licence price in the up-front payment would serve to limit the risk of bidders overpaying for spectrum; and
- ComReg's proposals differ significantly from common practice in other European countries, which is to have low or no annual fees, and ComReg's decision to diverge from this practice is not adequately justified.

489. These same views are re-iterated by operators in their responses to ComReg consultations 10/71 and 10/105, with the addition of an aside noted by one operator that the approach to the structure of payments must be adopted for the spectrum in each of the bands to be included in the joint award process.

DotEcon commentary

490. Based on these responses, our view on the issue of the structure of payments is unchanged. As an aside, we note a number of issues regarding the case against the proposed break-down of fees:

491. There is no basis for the assertion that there is more of a risk that bidders would overpay in the case of significant annual fees. There should be no incentive for bidders to pay more than their respective valuations for spectrum, and this incentive should not be affected by the structure of payments.

492. The level of fees, and the structure of those fees, for licensing spectrum varies from country to country depending on the objectives in setting such fees, whether spectrum is scarce, whether spectrum has been awarded administratively or via a competitive process and factors that are country- and licence-specific. Therefore, the relevant issue is whether this feature of the award is consistent with ComReg's objectives, specifically the efficient allocation and use of spectrum and the promotion of competition. In our view, the proposed approach is indeed in line with these factors.

14.2 Deferral option

Background

493. In our December 2009 report on aspects of a 900MHz award (09/99c), we note that given the current financial and economic climate, it would be prudent to

have safeguards, such as a deferral option, against financing constraints that might negatively affect the auction.

494. We noted that offering the option of deferring only a portion of the required upfront payment would strike a balance between providing a degree of flexibility for operators whose borrowing capacity may be adversely affected by the economic crisis and promoting the award of spectrum to credible bidders only.

495. We considered that ensuring that bidders pay the upfront payment element of the minimum price linked to licences awarded plus at least 50% of the excess of their winning bid above the minimum price within a set period of the announcement of winning bids by the auctioneer to ensure that their bids are credible.

496. We stated that there is always a risk of default with deferred payment schemes, and that an interest rate should be applied that reflects this risk. We considered that the interest rate applied should be higher than the cost of commercial funding.

497. We also stated that given the long time scale over which spectrum would be licensed, it might be prudent for the interest rate applying to the deferred payment option to take into account reasonable expectations about inflation.

Respondents view

498. Over the consultation period thus far, only a small number of respondents have expressed views on this issue, three in favour of this option and two opposed to it. Of the four existing mobile operators in Ireland, two have expressed their support for this option, raising the points that:

- This provision of such an option strikes a necessary balance in the near term between the payment of spectrum fees and the necessary investment that must be made by network operators;
- Where offering a deferral option raises default concerns, these can be abated with the use of a pre-qualification stage of the award process to assess the financial standing of applicants;
- The deferral period should be extended beyond three years; and
- The inclusion of 1800MHz spectrum in the auction increases the rationale for including a deferral option as the capital required to purchase spectrum has increased.

499. Conversely, the two operators opposed to the provision of a deferred payment option argued that such a deferral option increases the likelihood that a bidder can bid an excessive price in order to win but then default on their payments, thus depriving other bidders access to the spectrum. Further, one operator argued that it should be a requirement that for applicants to qualify to participate in the award process, they would need to demonstrate their ability to meet reasonable criteria in relation to financial strength and access to capital.

DotEcon commentary

500. Responses from stakeholders underscore the trade-off between the benefit of providing flexibility for bidders, given the economic crisis and the requirements invest heavily in networks after the auction, and the risk of default that such an option might generate.

501. Both respondents for and against the provision of a deferral option raised the issue of a pre-qualification stage to ensure that the risk of the types of bidders likely to default is reduced.

502. Addressing first the issue of offering a deferral option, experience in recent spectrum auctions has been mixed:

- The multi-band auction in Germany (2010), the 800MHz auction in Sweden (2011) and the 850MHz and 900MHz auction in Hong Kong (2011) required full payment of the licence price shortly after the end of the auction; while
- The 900MHz (2010), 1800MHz (2010) and 2.5GHz auctions in Denmark, the 2.6GHz auction in Finland (2010) and the 2.1GHz auction in Belgium (2011) all permitted the payment of fees in installments.

Therefore, there does not appear to be any guidance on this issue based on auctions that have taken place in the recent past.

503. While the case for a deferral option has not changed significantly since our first report, we note that the preference to implement the deferral option as previously proposed (relating to 50% of the upfront fee required after the auction to be paid over a period of 3 years) is marginal. While such an option represents a degree of flexibility for bidders, the sums involved given the specification of the deferral option are small relative to the total financial commitment linked to both the purchase of spectrum usage rights in the auction, and the proposed timescale is reasonably short. It is therefore unclear whether the small amount of flexibility that this option would allow would offset the risk of default. Further, where the proposed default option were to be increased in scope (taking in a longer time period and/or increasing the amount of the total payment required from bidders), increased flexibility for bidders would be offset by increased risk of default and, accordingly, increased risk of inefficiencies stemming from misallocation of spectrum across bidders.

504. Separately, we note that a consequence of ComReg's proposal to require 50% of the licence fees established in the auction upfront means that 50% of the licence fees to be paid over the duration of the relevant licences in the form of annual fees. Such fees are themselves a form of deferred payment, and the level of this deferral is substantial.

505. Therefore, while we recognise the value of a deferral option in general, given the relatively large part of licence fees already deferred in the form of annual fees and the marginal benefit of the deferral option proposed, we do not consider that the provision of such an option is valuable in practice.

506. As for the possible implementation of a pre-qualification stage, there is no strong case that such a stage is required. The auction process already includes a number of safeguards against non-serious bidders, including:

- a non-trivial deposit requirement for participants linked to their eligibility to bid in the auction;
- a non-significant minimum price;
- the requirement of an upfront payment linked to spectrum allocation immediately after the auction, with assignment of frequencies contingent on the timely payment of these funds; and
- the potential for forfeiture of some of all of a bidder's deposit where it does not make the necessary payments after the auction.

We therefore consider that the inclusion of a pre-qualification stage would not add further knowledge of a bidder's financial strength beyond that elicited by elements of the auction process already proposed.

14.3 Indexation of SUFs

507. In our report in December 2009 (09/99c), we asserted that given the long time scale of proposed licences, it might be prudent to build in some indexation of SUFs against inflation and address inflation issues where deferred payments were to be offered. We noted that indexation should not create additional risks for bidders as a mobile network operator's revenues and costs would in any case be affected by inflation.

508. In its related consultation (09/99), ComReg agreed with the principle of indexation and proposed the incorporation of inflation in the calculation of the cost of deferring payments where this option were to be offered. The indexation of SUFs were not addressed in this consultation.

509. In ComReg consultation 10/71, ComReg proposed to set interim licence prices for O2 and Vodafone based on previous licence prices indexed for inflation using the CPI.[73] In response to ComReg consultation 10/71, the responses of three operators contained relevant comment on indexation based on the CPI (all relating to ComReg's proposal to adjust interim licence fees for O2 and Vodafone for inflation):

- Meteor agreed with ComReg's basic proposition that spectrum fees should be adjusted for changes over time, commenting further that the CPI inflation index is a generally accepted index; and
- Both O2 and Vodafone asserted that the CPI is not a relevant index to apply to spectrum licences, and that if any such indexation was applied at all, then it is the communications sub-component of the overall consumer price index that should be used instead of CPI.

510. ComReg considered the telecoms sub-component of the CPI as an alternative basis for indexation and concluded that the CPI was most appropriate. While the issue of indexation of fees based on the CPI is raised in responses to 11/11

[73] This is in line with its general view, as expressed in ComReg's proposed strategy for managing the radio spectrum up to 2013 (11/28), that in order for annual usage fees to keep their value constant in real terms and maintain proper incentives for firms to continually assess whether they should continue to hold particular spectrum usage rights, such fees will need to be updated on an annual basis in order to account for inflation.

(ComReg document 11/27), no alternative views or corroborating evidence is presented.

511. In ComReg's response to consultation and Decision (11/29 and D03/11), ComReg maintained its view that the communications sub- component of the CPI is inappropriate as it refers only to price trends in a very limited part of the economy and does not reflect overall price changes in the wider economy.

512. Taking into account our previous views, subsequent developments and arguments made by ComReg for and against indexation and the use of the CPI as a basis for this, our view that annual fees should be subject to indexation (where fees paid one year after the upfront payment is made, and all subsequent payments, are subject to adjustment for inflation, positive and negative) is unchanged. Further, whilst there are clearly many complex issues in the appropriate measurement of inflation, we maintain our view that the CPI is an appropriate basis for setting the level of fee inflation, as operators' revenues will depend on consumer inflation.

513. In this respect, we note that a similar view has been taken by other regulators, both in terms of adjusting annual fees to take account of inflation and the use of the CPI to do so. This has been documented in section 4.3.2 of ComReg document 11/29 which observes that licences are adjusted for inflation in the UK, the US, Australia and Sweden, and the CPI is used for updating licence fees in three of these four countries. This is significant precedent given the fact that the issue of potential indexation of annual fees does not arise in many awards as:

- Not all spectrum awards include a non-trivial annual fee element within licence fees; and
- For much licensed spectrum, demand can be met by the amount of a given type of spectrum available. Where this is the case, and the regulator prices licences using such spectrum to cover costs, inflation will be included implicitly in such licences, as increasing costs in the economy in general, and corresponding increases in cost of administration of licences, will be reflected in the in the price of licences.

514. We note also that ComReg has adopted this principle of updating licence fees to reflect inflation over a certain period via the indexation of fees using the Consumer Price Index (CPI) in the past,[74] most recently updating fees for O2 and Vodafone's GSM licences for the period from May 2011 up to January 2013 at the latest. Therefore, the use of the CPI for indexing annual fees would be consistent with its approach elsewhere.

515. This indexation of annual fees proposed would not have an effect on the principle of a 50/50 split of upfront and annual payments, as this calculation is

[74] For example, 26 GHz National Block licences - http://www.comreg.ie/_fileupload/publications/ComReg0793R.pdf, TETRA licence - http://www.comreg.ie/_fileupload/publications/ComReg0867.pdf, eircom line rental - http://www.askcomreg.ie/home_phone/Universal_Service.90.LE.asp, Emergency Services Digital Radio licence – http://www.irishstatutebook.ie/2008/en/si/0324.html

based on a split of licences fees in current prices; the indexation of annual fees to reflect inflation merely adjusts for the fact that the value of a given amount of money now may change over time as the general price level in the economy changes.

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Annex A Spectrum to be included in the auction

Table 6 summarises views on an integrated award of spectrum in the 800MHz and 900MHz bands as provided by respondents to ComReg consultations 10/71 and 10/105.

Note that while this and subsequent tables present summaries of the view of respondents as prepared by DotEcon, this report has been prepared taking into consideration the full text of responses provided in response to ComReg's consultations relating to this award.

Table 6: Stakeholder views on the award of 800MHz and 900MHz frequencies in a unified award process

Respondent	Views on whether the award of 800MHz and 900MHz frequencies should be combined (responses to 10/71 and 10/105)
Digiweb	Yes – this should in principle allow the best opportunity for entrants to access the market, 800MHz and 900MHz frequencies have similarities that cannot be ignored
Ericsson	Yes – spectrum in these bands have similar propagation characteristics, they are substitutes in the medium term, providing the opportunity to deploy more advance mobile broadband networks makes sense in terms of efficient network management
ESBN	Yes – this will allow effective and efficient spectrum management and provide certainty to operators as regards satisfying their spectrum requirements and allows for release of spectrum on a technology-neutral basis
H3GI	Yes in principle but: The proposed delay of availability and liberalization of 900MHz spectrum will result in the inefficient and ineffective use of 900MHz spectrum Postponing the availability of 900MHz spectrum on account of later availability of 800MHz spectrum confers a competitive advantage on the three existing 900MHz operators The delay is based on the substitutability of 800MHz and 900MHz frequencies which is factually incorrect (no availability (or roadmap for availability) of network equipment or devices available at 800MHz, no worldwide harmonization measures, standard (regarding potential uses) yet to be clarified, LTE to be come available earlier for 800MHz)
Imagine	Yes – both bands are substitutable and should be included in a joint award

Meteor	Yes, with the reservation that proposals for the joint award are deficient as there is no mention of spectrum sharing or spectrum pooling in the proposal However, bands are substitutable over the time period concerned, and a combined approach would lead to a more efficient outcome.
O2	Yes – O2 welcomes the holistic approach to spectrum management There is a strong case against consecutive award processes for this spectrum: (1) It would not be practically possible to have two awards in quick succession, therefore to do so would delay the availability of 800MHz spectrum, consequently delay consumer benefit of the digital dividend (2) It would create uncertainty for applicants and would hamper an efficient assignment outcome (3) It would create artificial scarcity of sub-1GHz spectrum
Qualcomm	Not directly answered 800MHz and 900MHz spectrum are not fully substitutable – there is different equipment availability and there is different ecosystem development (UMTS in 900MHzin short term, LTE in 800MHz in long term)
RTÉ	Yes, however technical work needs to be done to establish the necessary anti-interference measures
UPC	Yes
Vodafone	Yes – Vodafone advocates a holistic approach to allocating spectrum in frequency bands that are to significant but varying degrees substitutable for one another. This can best be achieved through the simultaneous award of spectrum across multiple bands to the greatest extent possible. However, even a joint award would not be sufficient to address the risks of losing existing 900MHz frequencies, though use of a relative cap, interim licences and flexible transition arrangements would address these concerns.

Table 7 summarises views on an integrated award of sub-1GHz and 1800MHz spectrum as provided by respondents to ComReg consultations 10/71 and 10/105:

Table 7: Stakeholder views on the award of sub-1GHz and 1800MHz spectrum in a unified process

Respondent	Viewpoint on whether the award of 800MHz and 900MHz frequencies should be combined with the award of 1800MHz frequencies (responses to 10/71 and 10/105)
Digiweb	Not directly answered, deduced 'no' The delay of the award as a result of doing so (24-30 months) would be unacceptable However, the inclusion of 2.3GHz frequencies would not cause delays and thus should be included
Ericsson	Yes – 1800MHz spectrum is a good complement to 800MHz and 900MHz spectrum for both operators and entrants. It is timely to provide 1800MHz spectrum for award now given the deployment of LTE in the band
ESBN	No view on this
H3GI	No – on the basis that interested parties have not shown sufficient demand for 1800MHz spectrum to merit its inclusion
Imagine	No view on this
Meteor	Yes – Its inclusion would lead to greater economic efficiency and would provide the best opportunity for entrants.
O2	No – ComReg should hold this back from the sub-1GHz spectrum auction and award it with 2.6GHz when there is clarity on its availability, as substitutability of the different bands is more important than the complementarities between them. Ideally, all relevant bands should have their availability made clear and the maximum number of bands be made available together in a unified award process. If this is not possible, bands should be grouped with substitute spectrum awarded simultaneously. Substitute bands are (1) those below 1GHz, and (2) those above 1GHz.
Qualcomm	Yes – 800MHz and 900MHz frequencies and 1800MHz frequencies are complements for providing coverage and capacity respectively LTE is becoming available at 1800MHz. Simultaneous availability of 800MHz, 900MHz and 1800MHz frequencies would enable operators to deploy acquisition strategies combining all three bands

RTÉ	Yes
UPC	Yes – provides certainty for spectrum planning
Vodafone	No, on the basis that it may delay the award of 900MHz In principle, the inclusion of 1800MHz spectrum could somewhat increase the efficiency of the auction outcome as there is a valuation link between sub-1GHz and 1800MHz spectrum, but in practice the benefits of its inclusion may be limited and outweighed by the costs and risks associated with delay of the award process itself given the near expiry of 900MHz licences Although 1800MHz spectrum is substitutable to some extent for sub-1GHz spectrum for wide area service provision, it is most suitable to provide additional capacity in areas of particularly high demand Award of 800MHz and 900MHz spectrum in 2011 and award of 1800MHz and 2.6GHz spectrum in a unified process at a later date would be a superior approach

Annex B Spectrum caps

The table below presents the views expressed by respondents to ComReg consultations on issues relating to the setting of spectrum caps and the appropriate level of such caps. Table 8 below summarises views expressed by respondents to ComReg consultation 10/71 in September 2010 on the imposition of a sub-1GHz cap in the auction:

Table 8: Views on a sub-1GHz spectrum cap

Respondent	Views expressed on a sub-1GHz cap (response to 10/71)
Digiweb	Yes – this is an acceptable and widespread practice, and should contribute to the likelihood of a new entrant in the market.
Ericsson	Yes – A sub-1GHz cap would prevent outcomes resulting in negative retail competition.
ESBN	Yes – this provides for competition in the market, prevents barriers to entry and allows for new entrants and new spectrum uses.
H3GI	Yes – this is necessary to promote competition and the interests of consumers.
Imagine	Yes – This will help to encourage market entry for the provision of mobile voice and broadband services.
Meteor	Yes
O2	Yes, if a spectrum cap has to be applied at all
Qualcomm	Yes – agree with ComReg's desire to ensure sufficiently competitive playing field by safe-guarding access to sub-1GHz spectrum.
RTÉ	No – This would prevent an operator from choosing the option to plan spectrum usage to mitigate interference to broadcasting services operated below the 800MHz band. Higher 800MHz frequencies should be auctioned first so that if demand is less than expected, broadcast services will not be adversely affected.
UPC	Yes – Agrees, but suggests set aside more effective in encouraging new entrants.
Vodafone	Yes – This is appropriate to ensure a reasonable distribution of spectrum between operators across the 800MHz and 900MHz bands while also providing flexibility to licensees in relation to how they combine spectrum across bands to optimise the delivery of services to their customers.

Table 9 below summarises views expressed by respondents to ComReg consultation 10/71 in September 2010 on the imposition of a sub-1GHz cap of 2x20MHz in the auction:

Table 9: Views on a 2x20MHz sub-1GHz cap

Respondent	Views expressed on sub-1GHz cap of 2x20MHz (responses in 10/71)
Digiweb	No – this would create the risk that there would be no new entrant after the auction. ComReg could consider instead an overall spectrum cap or a spectrum reservation for entrants.
Ericsson	Not fully in agreement The 800MHz band is unencumbered and there will be equipment for providing advanced services available sooner in the 800MHz band, therefore allowing one operator to secure usage rights to 2x20MHz of the 2x30MHz available in this band could allow it an unfair competitive advantage Setting a 2x10MHz cap per band while allowing and supporting spectrum sharing could result in a better outcome
ESBN	Yes – It provides for fair and adequate apportionment of spectrum amongst operators
H3GI	No – By setting this cap at 2x20MHz and not 2x15MHz ComReg is securing revenue in the award process at the expense of long-term competition in the market This risks the outcome that H3GI only wins 2x5MHz of sub-1GHz spectrum which in the long term will put H3GI at a significant competitive disadvantage to incumbent operators
Imagine	No – This will not result in new market entry, the proposed cap favours the incumbent mobile network operators A 2x15MHz cap should be used with one licence reserved for an entrant
Meteor	Yes Notwithstanding this, a disadvantage of a 2x20MHz sub-1GHz cap is that there is the possibility under this proposal that any of the existing 900MHz operators might not win any 900MHz spectrum in the second time slice. If this were to occur, such an operator would face substantial costs compared to operators with 900MHz spectrum. This will distort competition. ComReg should exclude 2x15MHz of 900MHz spectrum from the auction and assign 2x5MHz each directly to existing 900MHz operators at the reserve price.

O2	Yes – If a spectrum cap is to be imposed then it should be set as a simple cap of not less than 2x20MHz of sub-1GHz spectrum. Such a cap will provide a reasonable amount of capacity for when the ecosystem will be able to use the 800MHz and 900MHz bands together. However, O2 is of the view that no spectrum cap is required and if at all should only applied for the auction, i.e. there should be no general holding caps and no restriction on spectrum sharing
Qualcomm	No view on the level of a sub-1GHz cap.
RTÉ	No – if a spectrum cap is to be applied it should be higher than 2x20MHz or linked to the allocation of the lowest frequency lot such that the winner of this lot will have access to higher frequency lots also.
UPC	Yes – if there is 2x20MHz 800MHz spectrum set aside for new entrants.
Vodafone	Yes – A cap of 2x20MHz is reasonable in the context of the spectrum available as it strikes a balance between avoiding extremely asymmetric outcomes in spectrum allocations, minimising the risk of spectrum going unallocated in the award process and providing any efficient new entrants with the opportunity to obtain access to spectrum.

Table 10 below summarises views expressed by respondents to ComReg consultation 10/105 in December 2010 on the imposition of a sub-1GHz cap of 2x20MHz and a 2x50MHz overall cap in the auction:

Table 10: Views on a 2x20MHz sub-1GHz cap and a 2x50 MHz overall spectrum cap

Respondent	Views on a 2x20MHz sub-1GHz cap and a 2x 50MHz overall cap (responses to 10/105)
H3GI	2x20MHz sub-1GHz cap: Not the most appropriate cap ComReg should set a spectrum cap of 2x15MHz with the possibility of relaxing this cap in the event that supply exceeds demand 2x50MHz overall cap: No comment on this
Meteor	2x20MHz sub-1GHz cap: Agrees with this proposal to prevent high asymmetry in overall spectrum holdings

	2x50MHz overall cap: Rejects ComReg's proposal to set an overall cap of 2x50MHz, which would which would unfairly favour the large established operators O2 and Vodafone, affording them the opportunity to squeeze out the competitive tension created by smaller operators and potential new entrants Proposes an overall cap of 2x40MHz
O2	2x20MHz sub-1GHz cap, 2x50MHz overall cap: These caps are appropriate in principle
Vodafone	2x20MHz sub-1GHz cap, 2x50MHz overall cap: These caps would be reasonable to avoid the extreme asymmetries in distribution of spectrum

Table 11 below presents the view of one consultation respondent on the use of spectrum floors in addition to spectrum caps, as expressed in a letter provided to ComReg in July 20011 (to be published by ComReg shortly):

Table 11: View expressed on the use of spectrum floors in addition to spectrum caps

Respondent	Views on spectrum floors (to be published)
H3GI	In the UK, in order to ensure competition in the 5-10 years after the combined 800MHz-2.6GHz auction, Ofcom proposed in its consultation on the award process in March 2011 to impose spectrum floors in addition to spectrum caps, so as to ensure that there will be at least 4 national wholesale operators with at least the minimum amount of spectrum to compete effectively in the market. H3GI agrees with the approach adopted by Ofcom, and asserts that ComReg should impose spectrum floors in addition to spectrum caps to ensure that there are at least four holders of enough spectrum to effectively compete after the auction in Ireland.

Annex C Liberalisation prior to 2013

Table 12: Respondents' views on preparatory licences

Respondent	Views on the proposed preparatory licences (responses to 10/71)
Digiweb	No objection to ComReg's proposal to issue 'preparatory licences'.
Ericsson	Agrees with proposal to issue 'preparatory licences' because all successful bidders of liberalised spectrum will have to prepare for the commencement of services in 2013.
ESBN	Agrees with the proposal to issue 'preparatory licences'.
H3GI	Suggests that ComReg's objectives regarding mobile broadband would be best achieved by the immediate release and liberalisation of 900MHz spectrum. In H3GI's view ComReg's justification to the problem of delayed licences by issuing preparatory licences with the view that winners of these blocks would in any case be required to spend considerable time planning and deploying networks is factually incorrect. H3GI states that network equipment currently deployed by the existing operators is UMT900MHz ready and network equipment is currently available to support 3G 900MHz from their Vender Nokia siemens Networks and also from Ericssons. Furthermore asserts that almost all handsets sold now support 3G 900MHz.
Imagine	Agrees with the proposal.
Meteor	Agrees in principle with the proposal to issue 'preparatory licences' and would welcome the opportunity to review and comment on the draft terms of such licences.
O2	Supports the proposal to issue 'preparatory licences' as in O2's view it should mean that there will be no material impact caused by delaying the availability of the spectrum to a common commencement date. Preparatory licences should allow consumers to benefit from earliest possible liberalisation.
Qualcomm	Emphasises that, independently of 'preparatory licences', ComReg's proposals introduce a minimum two year delay in the introduction of mobile broadband in the 900MHz band and may delay the development

	until 2015 due to the spectrum allocation in time slices. However, Qualcomm welcomes ComReg's proposal to minimise the deployment delay beyond these self-imposed two years.
RTÉ and RTENL	Agrees with this proposal. Stresses that extensive testing would be required to ensure that mitigation techniques to protect broadcasting services are performing as expected, noting the existence of testing and field trials currently being undertaken in other European countries to help understand the extent of the impact on broadcast services.
UPC Ireland	No comment.
Vodafone	Agrees that the installation of equipment for use of these spectrum bands must be permitted prior to the commencement date and that preparatory licences should be issued, if this is necessary from a legal perspective (which Vodafone states it is not clear about), to achieve this. Preparatory licences should allow consumers to benefit from earliest possible liberalisation.

Annex D Use of the CCA format for the proposed auction

Table 13: Views on the CCA auction format expressed in responses to 10/71

Respondent	Views on the use of a CCA format for the proposed award (responses to 10/71)
Digiweb	Yes
Ericsson	No comment
ESB Networks	No comment
H3GI	Yes
Imagine	No comment
Meteor	Yes, notwithstanding its views on the need for a holistic award process Asserts that spectrum uses in multiple bands are substitutable and complementary and that it is important to have the opportunity to express all associated valuations in a combinatorial format Agrees that the CCA in combination with the relative cap activity rule provides greater safeguards against unintentional loss of business continuity Asserts that the CCA format also provides for bidders to make rational choices between potentially substitutable and complementary spectrum whilst discouraging strategic behaviour
O2	Yes – the auction mechanism proposed appears to address the main objectives of ensuring an efficient outcome whilst: • Facilitating continuity of operations of existing services so as to avoid consumer disruption; • Facilitating aggregation and avoiding aggregation of assignments; • Minimising common value uncertainty; and • Avoiding or minimising the possibility of manipulation of the auction result by non-genuine strategic bidding.
Qualcomm	No comment
RTÉ and RTENL	No comment
UPC	Yes, as long as there are two auctions, one for incumbents and one for entrants
Vodafone	Yes – Believes that the proposed auction format ensures that existing licensees will not lose access to the minimum amount of spectrum usage rights to maintain existing service provision in the

	900MHz band. • It is appropriate that the auction format used should allow package bidding • It welcomes the decision to take explicit account of business continuity risks and the difficulties of accurate valuation of business continuity • The use of a second price rule and separate stages for spectrum allocation and frequency assignment further increase the prospects for accurate valuation of the spectrum and therefore an efficient auction outcome Asserts that the use of a CCA format as proposed, in combination with the relative cap activity rule, must be retained in any final decision if the concerns around risks of service disruption are to be effectively addressed.

Annex E Eligibility and activity rules

In Table 14 below, we present the views expressed by stakeholders on the use of a 2:1 ratio of eligibility points to be associated with 2x5MHz lots of sub-1GHz and 1800MHz spectrum respectively.

Table 14: Views on a 2:1 ratio to be used for sub-1GHz and 1800MHz spectrum respectively

Respondent	Views on 2:1 eligibility ratio for sub-1GHz and 1800MHz spectrum (responses to 10/105)
H3GI	No view on this
Meteor	Asserts that where the underlying value substantially deviates from the eligibility ratio chosen, the activity rule is less effective and bidders have incentives to behave strategically. Believes that the ratio of eligibility between the sub-1GHz and 1800 MHz bands should reflect the underlying value of these spectrum bands. Makes no direct reference to the appropriateness of the proposed ratio of eligibility points for sub-1GHz and 1800MHz spectrum.
O2	Agrees with ratio of 1:1 between 800MHz and 900MHz frequencies and that the ratio of eligibility points for sub-1GHz and 1800MHz spectrum might well be correctly set at greater than 1: 1 as there will be a material difference in value No comment on whether 2:1 is the correct ratio Notes that Switzerland set this ratio at 3:1, Hong Kong set this at 2: 1 and Germany set the ratio at 1: 1.
Vodafone	Agrees that switching between 1800MHz and sub-1GHz spectrum must be allowed in the auction Considers that different weightings for eligibility points between 1800MHz and sub-1GHz spectrum is a reasonable approach in principle

Annex F Spectrum packaging

Table 15 summarises views on on spectrum packaging. This covers views, expressed in response to various ComReg consultations (including 09/99, 10/71 and 10/105), on how to deal with existing licences, views on the 'temporal lots' proposal, views on the duration and usage rights of licences and other packaging issues raised that have not previously been addressed:

Table 15: Views on spectrum packaging and follow-on licensing issues

Respondent	Viewpoint of aspects of spectrum packaging and follow-on licensing (responses to 09/99, 10/71 and 10/105)
H3GI	Disagrees with temporal lots. Suggests indefinite licences with 5 years notice for termination. Agrees that the two-time-slice option is preferable, under the disclaimer that it generally disagrees with the proposed award process.
Meteor	Suggests indefinite licences or clearly defined rights for periodical renewal. Agrees with two-time-slice option. Wants more clarity about interim licences for 1800MHz spectrum. Agrees with early liberalisation option for operators with existing licences in the first time slice.
Vodafone	Suggests a buy-out solution to end all licences in early 2013. Disagrees with two time-slices for the 800MHz band. Suggests a single time slice for the 800MHz band. Agrees with the two-time-slice option. Wants more clarity about interim licences for 1800MHz band. Wants earliest possible liberalisation of 1800MHz and 900MHz spectrum.
O2	Disagrees with the inclusion of 1800MHz spectrum in the award. Suggests that 1800MHz spectrum to be awarded together with 2.6GHz spectrum in a separate award process. Disagrees with two time-slices for the 800MHz band. Suggests a single time slice for the 800MHz band. Favours the two-time-slice option, subject to the general objections above. Wants more clarity about interim licences for 1800MHz spectrum.

Annex G Early liberalisation option

In this section, we present the views expressed by respondents to the relevant ComReg consultations on the use of an early liberalisation option and associated rebate for relinquishment of existing spectrum holdings. Table 16 presents views on this proposal as applied to Meteor in the 900MHz band, as expressed in responses to ComReg consultation 09/99. Table 17 presents views on the extension of the proposal to existing licence holders in the 1800MHz band, as expressed in responses to ComReg consultation 10/105.

Table 16: Respondent views on an early liberalisation option and associated rebate in the 900MHz band

Respondent	Views on the proposed Meteor rebate (responses to 09/99)
An Post	No comment
BT	No comment
Digiweb	Agrees that a rebate in respect of the remaining term of a licence should be provided for in ComReg's auction design
H3GI	Disagrees with the Meteor rebate proposal Asserts that the proposal confers an unfair commercial advantage on Meteor contrary to Article 107 TFEU Argues that in conjunction with its 1800MHz frequencies Meteor only needs at most 2x5MHz of 900MHz spectrum for the purposes of providing GSM services and is currently rolling out its 3G network. As a result, if ComReg grants Meteor a rebate, it will be providing it with funds to: (i) acquire liberalised spectrum below its full value (if Meteor uses the liberalised spectrum for 3G purposes); and/or (ii) use liberalised spectrum for GSM purposes, which Meteor would have done anyway. Asserts that Meteor has sufficient incentive to liberalise early.
Meteor	Agrees that a rebate should be provided for an operator choosing to release GSM spectrum before the licence expiry date Agrees with DotEcon's assessment that absent early liberalisation for Meteor in the 900MHz band, O2 and Vodafone could have access to 3G spectrum in the 900MHz band earlier than Meteor, which risks distorting competition in advanced wireless data services Asserts that the rebate proposal will help avoid competitive distortions and create incentives to bring liberalisation to the band earlier, conferring any associated benefits to consumers and operators and supporting the goals of the EC Decision and EC Amending Directive.
O2	States that Meteor would have an unfair advantage over other

	bidders if they could choose during the auction whether they wish to liberalise its spectrum or not based on the price bid by competitors. States that bidders will need to know the number of lots available [for the period where Meteor has existing frequencies] as this could impact on their valuations and bids. States that it would be fundamentally unfair and a distortion of competition to allow Meteor a one-way bet – where they knew that they could not lose any spectrum but only gain some if the bidding worked out to their advantage. Notwithstanding these comments, O2 asserts that in general where an existing licence is to be foreshortened O2 agrees that it is correct to allow a rebate based on the original purchase terms.
Vodafone	Argues that a rebate under the proposed circumstances is not objectively justified or necessary Asserts that the providing Meteor the option of liberalising its existing licences in the 900MHz band is on its own sufficient to incentivise this release and buy-back option. Therefore, the justification of a rebate to Meteor is insufficient. Argues that the concern around Meteor's bid potentially being based on the 'upgrade' value of a liberalised licence and that this would give too little incentive to Meteor to release its licence early does not provide an adequate rationale for a rebate. Argues that the value of the liberalisation option to Meteor would be the upgrade value plus the availability of more spectrum to it, which would be important to it in its ability to deploy advanced technologies in addition to maintaining GSM services. In this respect, the proposed rebate would be superfluous. Considers that it would be entirely unjustified, disproportionate and distortive if any rebate to Meteor were funded, either directly or indirectly, by other telecoms operators.

Table 17: Respondent views on the extension of the early liberalisation option and associated rebate to the 1800MHz band

Respondent	Views on the proposal to extend the rebate proposal in the 900MHz band to the 1800MHz band (responses to 10/105)
H3GI	Disagrees with the use of rebates Re-iterates its view on rebates expressed in response to 09/99
Meteor	Agrees that it is appropriate to issue a rebate for the residual time remaining on a GSM licence if an operator were to opt for early liberalisation, and this should apply to both 900MHz and 1800MHz licences.
O2	Agrees with the proposal for rebates on the remaining term of existing licences
Vodafone	Agrees with the proposal for rebates on the remaining term of existing licences Argues that while Meteor would likely have sufficient incentive to liberalise at least some of its 900MHz spectrum in the absence of a rebate, in order to effectively encourage take-up of the early liberalisation option by current 1800MHz operators in respect of most or all of their existing spectrum usage rights, a rebate on the basis of the remaining terms of the licences as currently proposed would be both objectively justified and necessary. Believes that rebates should take the form of a discount off any upfront fees and/or annual spectrum usage fees that would otherwise be payable by existing licensees.

Annex H Assignment stage

516. Respondent views on the 'full assignment round' proposal put forward in DotEcon report 10/105a and ComReg's related consultation and the 'continuous assignment' proposal put forward in the same consultation are described in the following Tables.

Table 18: Respondents' views on the full assignment round

Respondent	Views on the full assignment round (responses to 10/105)
H3GI	Agrees that there are important benefits to be gained from designing the auction such that all new licences will comprise of contiguous spectrum in the first time slice. Assert that this is a technologically and economically efficient approach. Believes that ComReg's proposal to introduce a "full assignment round" is sensible and is in agreement with this approach. Considers it appropriate for ComReg to provide compensation to a GSM licensee, in either the 900MHz or 1800MHz band, for required relocation costs that otherwise would have been avoided. An independent expert appointed by ComReg should approve compensation and the compensation should be fair and reasonable.
Meteor	Agrees that it may be beneficial to design the auction to promote contiguous assignments. Supports ComReg's proposal to apply the "full assignment round" approach provided that adequate compensation is given for all relocation costs associated with liberalised licences for the following reasons: Considers that the "All or nothing" may still lead to the problem of fragmented assignments, furthermore, partial liberalisation would not be allowed therefore distorting the outcome of the auction. Stresses that under the "Full assignment round" approach existing licence holders would potentially be required to incur relocation costs therefore this could reduce those bidders' primary bids thus other bidders without this problem would have a bidding advantage thus leading to an inefficient outcome in the auction. In order to alleviate this problem any compensation provided by ComReg would have to cover the full cost of relocation.
O2	Agrees that there are benefits in designing the auction such that licensees can obtain contiguous spectrum assignments. Considers that the "full assignment round" is preferable as it is the most effective way to all licensees to aggregate their assignments. However, considers that where an operator might be forced to modify their networks, where in absence of the "full assignment round" they would not have then they should be compensated.

Vodafone	Considers that it is of central importance that the finalised auction design ensures that new licences will comprise of contiguous blocks of spectrum in the first time slice. Affirms that in absence of this feature there would be significant risk that licensees will win fragmented spectrum therefore increasing the requirement to co-ordinate spectrum with neighbours and reduced flexibility to utilise spectrum to the benefit of customers. Vodafone considers that the benefits of a "full assignment round" considerably outweigh the costs and that it is clearly superior to the "All or nothing" approach. Considers that the "Full assignment round" effectively ensures that the assignment of new licences would be in contiguous blocks therefore leading to efficiency benefits. Agrees that an existing licensee should be appropriately compensated for the efficient costs that they would incur in being required to relocate in the case where it did not acquire spectrum in the second temporal lot and did not avail of the early liberalisation option in the first temporal lot. However, believes that it wouldn't be appropriate or justified to provide compensation in other circumstances. Expresses the view that the compensation should take the form of a discount off fees required to be paid by the licensee arising from any spectrum usage rights allocated to them as an outcome of the award process or alternatively their existing 900MHz and 1800MHz licences.

Table 19: Views of respondents on a continuous assignment constraint

Respondent	Views on a continuous assignment constraint in the case of equal spectrum allocations across time slices within a band (responses to 10/105)
H3GI	Agrees with the proposal to impose spectrum continuity States that this is an economically efficient approach Agrees that it is not appropriate that the assignment options presented to bidder be limited to those involving partial relocation
Meteor	Agrees with the proposal to impose spectrum continuity States that this will promote efficiency and investment are reduce complexity of options at the assignment stage and the potential for strategic bidding Agrees that it is not appropriate that the assignment options presented to bidder be limited to those involving partial relocation Notes that while partial relocation could be possible, a rule to impose this would be complex to define and would reduce transparency of the auction process
O2	Agrees with the proposal to impose spectrum continuity States that imposing this constraint would give the most efficient result overall
Vodafone	Agrees with the proposal to impose spectrum continuity Asserts that the proposed constraint is objectively justified and proportionate and must be incorporated in the auction design. Asserts that where a bidder were to be allocated the same amount of frequencies in both time slices in a band, the option of choosing non-contiguous spectrum assignments across the two time periods would appear to have very little, if any, value, and that the proposed constraint would be of unambiguous benefit to licensees. Notes that there is unlikely to be a significant difference in the costs to licensees between partial and full relocation of frequencies. It notes further that the benefit of only partial relocation would be significantly outweighed by the cost of the reduction in the choices and flexibility available to bidders in the auction process, risking a sub-optimal outcome of the award process.

Annex I Coverage and roll-out conditions

517. In this section, we present stakeholder views on the various aspects of the coverage and roll-out proposals put forward in ComReg consultation 09/99 and modified in 10/71. These views are presented in the Tables below.

Table 20: Respondents' views on heterogeneity/asymmetry of coverage and roll-out conditions

Respondent	Views on heterogeneity/asymmetry of coverage and roll-out conditions (responses to 09/99 and 10/71)
An Post	No comment
BT	Considers that the conditions should be asymmetric, taking full consideration of the advantage some operators have by virtue of their existing networks and the significant financial cost and time taken to roll-out a network for new entrants.
Digiweb	In its response to 09/99: Stated that asymmetric coverage and roll-out conditions should be applied for new entrants. Considered that where the use of extensively deployed bands might be counted towards the compliance conditions then a symmetric coverage and roll-out condition should be applied. In its response to 10/71: Considered the symmetric coverage obligation proposed by ComReg to be acceptable.
H3GI	Agrees with the symmetric coverage obligation proposed by ComReg in 10/71.
Meteor	Considers that if coverage obligations can be objectively justified these should be symmetric. Supports the considerations put forward by DotEcon in 09/99c that symmetrical licence conditions have the following benefits: • Avoid long term competitive distortions; • simplify the award process; and • reduce the risk of introducing bias in the auction design. States that symmetrical roll-out and coverage obligations are required to ensure that operators can ultimately move to a generic licensing regime and spectrum trading. Notes that it appears to be common and accepted practice to award spectrum licences with symmetrical coverage and roll-out conditions. Considers that the only concern raised by DotEcon in 09/99c, that a symmetric coverage obligation could compromise existing voice

	coverage and associated emergency call coverage offered by GSM, is unfounded because existing GSM operators have all well exceeded coverage obligations. Concludes that the risks associated with asymmetrical conditions are numerous, very real and must be avoided.
O2	Considers that there is fundamental difficulty for ComReg's proposal to assign the spectrum using an auction but to have asymmetrical conditions because the logic behind the use of an auction for the award is based on the fundamental premise that the lots for which the bidders are bidding are identical. However, if ComReg were to impose different licence conditions depending on who the winning bidder is, i.e. asymmetric conditions, then the lots on which bids are placed are not identical and the integrity of the auction is undermined. Considers that ComReg can only use an auction as the assignment mechanism if the licence conditions are symmetric.
Vodafone	Considers that symmetric coverage and roll-out conditions requiring all licensees to achieve a minimum geographic coverage level of 70% within 3 years of licence award must be adopted. States that in its view ComReg has not provided adequate justification for declining to accept the recommendation of DotEcon for the inclusion of symmetric and moderate coverage obligations in licences.
Tesco Mobile	No comment
Ericsson	Does not support ComReg's proposal for a symmetric coverage obligation and asymmetric roll-out timeframes depending on whether or not the licensee is an existing operator or a new entrant. Asserts that with the mobile operators not obliged to provide any coverage in excess of, what is in its view, the extremely modest coverage target, it is unlikely that the operators will make any effort to go beyond this target. Therefore Ericsson warns that this exposes Ireland to, in its view, the credible risk that over time, coverage could shrink back down to the required coverage level which would result in broad swathes of the country being deprived not only of advanced mobile but also potentially of basic mobile voice and text as well. In its view this scenario is entirely credible as mobile operators will weigh up the cost of replacing their existing 2G infrastructure with the likely revenues to be gained from traffic generated in rural and remote areas over the replacement equipment. In Ericsson's view it is easy to imagine a situation whereby the operators will take the view that investment in such replacement infrastructure does not make economic sense for them.
ESBN	Agrees with the symmetric coverage obligation proposed by ComReg

	in 10/71.

Table 21: Respondents' views on the minimum coverage level for entrants proposed by ComReg in 09/99

Respondent	Views on the minimum coverage levels for entrants proposed in ComReg in 09/99 (responses to 09/99)
An Post	No comment
BT	No comment
Digiweb	Disagrees with ComReg's timelines for new entrants because in determining suitable rollout and coverage conditions ComReg refers to the existing 3G networks rollout (over 90% in 7 years), however, Digiweb notes that the market has now changed and therefore such an aggressive rollout is not necessary or practical in today's market. Based on this and DotEcon's analysis Digiweb recommends that new entrants should meet 35% population coverage within 3 years, 70% within 7 years and 90% within 10 years of licence commencement.
H3GI	Disagrees with ComReg's proposal as it believes that these are disproportionate and discriminatory. In particular, it states that as a new entrant it was only given 5 years to achieve 85% demographic coverage in their 3G licence. Proposes that a 30% geographic coverage should be achieved within 3 years, 70% within 5 years and 90% within 7 years from the licence commencement date.
Meteor	Disagrees with ComReg's proposal to establish an ultimate minimum coverage obligation of 90% geographic coverage because it gives rise to fundamental questions of discrimination and inequity if applied asymmetrically. Even if applied symmetrically Meteor claims that it would fail a proportionality test because existing obligations have been exceeded and liberalisation is likely to enhance coverage without the need for regulatory intervention. Recalls that in 09/99c we recommended a medium level coverage obligation of 50-70% of the population which could apply to the provision of voice and/or mobile broadband services which was based on a reasoned assessment of coverage obligations and international best practice. In addition Meteor notes our observation that the current obligations for 2G licences were high in comparison to those identified in Table 18 of 09/99c. Tends to agree with our recommendations in this respect, to the extent that coverage obligations can be demonstrated to be necessary.

	However, it believes that we have erred in our subsequent discussion of roll-out obligations because they state that our recommendations in respect of population coverage and geographic roll-out are inconsistent (see graph on page 41 of Meteor's response to ComReg's consultation 09/99). In paragraph 658 of 09/99c we suggested that roll-out obligations should be set at 25-30% and 50-70% of geographic coverage however according to Meteor's graph this equates to population coverage levels of approximately 75% and 94% respectively. Claims that this error is further compounded by ComReg's "arbitrary determination that the ultimate geographic coverage target should be set at 90%." In its view this is an exceptionally aggressive target "which flies in the face of the cautious approach recommended by DotEcon particularly in respect of mobile broadband coverage where the economics of provision have yet to be fully understood."[75] Stresses that ComReg must also consider the interplay between minimum prices and coverage obligations because in Meteors view both are set excessively therefore ultimately its the competitiveness of the auction and may discourage participation. Asserts that to the extent that coverage and rollout obligations can be objectively justified, which to date in their view they have not, the targets should be set in accordance with DotEcon's recommended coverage in the region of 50-70% of the population.
O2	No comment on the actual coverage level however states that asymmetric licence conditions would fundamentally undermine a fair auction process.
Vodafone	Strongly disagrees with ComReg's proposal that a new entrant should have a very low level of geographic coverage obligation within the first 6 years of the licence. Believes that a requirement to meet a 70% minimum geographic coverage obligation within 3 years, applied symmetrically to all licensees should be adopted.
Tesco Mobile	No comment

[75] See page 41 of Meteor's response to ComReg's consultation 09/99.

Table 22: Respondents' views on the minimum coverage level proposed by ComReg in Consultation 10/71

Respondent	Views on the minimum coverage levels proposed by ComReg in 10/71 (responses to 10/71)
Ericsson	Asserts that with the mobile operators not obliged to provide any coverage in excess of, what is in its view, the extremely modest 70% population target, it is unlikely that the operators will make any effort to go beyond this target. Therefore Ericsson warns that this exposes Ireland to the risk that over time, coverage could shrink back down to the 70% level which would result in broad swathes of the country being deprived not only of advanced mobile but also potentially of basic mobile voice and text as well. Furthermore, it noted that even if the Irish operators which are subsidiaries of multinational operators wanted to maintain nationwide coverage for liberalised communications services they would need to make a compelling case to their parent companies for the kind of investment they would need to roll out 800/900MHz networks to support the provision of liberalised communications on a nationwide basis. Therefore the Irish operations of these companies are, in effect, in competition with operating units overseas for scarce capex resources and therefore it may be more difficult to obtain the scarce resources required to maintain nationwide coverage in Ireland unless the Irish operations face licence obligations requiring them to do so. Contrasts ComReg's proposals with the recent award of and proposals for the award of 800MHz spectrum in Germany, the UK and Sweden and believes that there is no impediment to ComReg if it decides to follow what is in its view the enlightened approaches adopted in these countries. Believes that a more appropriate coverage obligation for services deployed using 800/900MHz spectrum would be the 90% geographic target that ComReg proposed in 09/99 and that ComReg should actively facilitate Radio Access Network (RAN) sharing between operators after an immediate economically feasible coverage target (50-80% population coverage) has been met. Stresses that ComReg should draw up specific service zones within the country (rural and remote parts of the country) where active equipment or spectrum sharing would be allowed. Makes the suggestion that perhaps like in Germany, operators must have coverage in these zones before they can be commercially active in the other zones.
ESBN	Agrees with the proposal with the exception that in the absence of allocation of dedicated spectrum to facilitate a Utility Optimised Telecommunications network, ESBN would require guaranteed network coverage significantly greater than the 70% to meet its operational requirements.

H3GI	Agrees with ComReg's proposed coverage and roll-out obligation.
Imagine	Disagrees with the proposal because believes it greatly reduces the prospects of new entry to this market. States that the coverage requirement should be relaxed to no more than 50% of the population and national roaming should also be facilitated through the licencing regime to enable national coverage for a new entrant.
Meteor	Agrees with ComReg's proposal to set a symmetric obligation to provide coverage to 70% of the population.
O2	Believes that on balance ComReg's proposal is a reasonable accommodation of the many conflicting considerations that impact this aspect of the licence conditions.
Qualcomm	Agrees with ComReg's proposal.
RTÉ and RTENL	Disagrees with the proposal because a roll out obligation on the lower 800MHz blocks would encourage licensees to deploy their networks in the Dublin and east cost areas early in their network roll-outs to meet coverage targets and these areas are among those where broadcasting services are most susceptible to interference due to the broadcasting frequency plan.
UPC Ireland	Considers that the proposals should aim to have higher geographic coverage. As it takes new entrants longer to build out networks they should be given more time than that provided and suitable regulated roaming agreements should be applied for the period of the build to allow them to readily compete prior to completion. Argues that using a percentage of population is appropriate for a new entrant but a percentage of land mass metric should be used for existing operators otherwise the digital dividend will enforce rather than resolve the digital divide.
Vodafone	Agrees with ComReg's proposal to set a symmetric population coverage obligation to all licences but disagrees with ComReg's proposal that an asymmetric roll-out obligation should apply to licences. States that the proposal to allow a new entrant to potentially offer only a very low level of coverage for up to the first 6 years of the licence does not adhere to ComReg's statutory regulatory obligations to ensure the efficient use of the spectrum and to promote competition. Where ComReg determines that an asymmetric roll-out obligation for new entrants is appropriate Vodafone considers that a more superior way of setting this would be to oblige new entrants to roll-out coverage to 30% of the population after 3 years, 50% population after 5 years and 70% after 7 years.

Table 23: Views on measuring the coverage obligation

Respondent	Views on measuring the coverage obligation (responses to 09/99)
An Post	No comment
BT	States that field strength levels seem to be an acceptable metric.
Digiweb	Agrees with ComReg's proposal to define a distinct field strength level for each type of technology.
H3GI	Agrees with ComReg's proposal.
Meteor	Disagrees with ComReg's proposal to measure coverage based on field strength levels. Considers that in order to invoke a truly technology neutral licencing regime, all aspects of the licence should, as far as possible, be independent of the technology being used by the licence. Asserts that coverage should, therefore, be defined on the basis of the availability of services offered by an undertaking, provided that the minimum internationally recognised service quality measures apply. Considers that this approach would also simplify the assessment of coverage obligations while ensuring that targets remain customer centric regardless of the service on offer or the underlying technology that is being used.
O2	Agrees with ComReg's proposal.
Vodafone	Not opposed to ComReg's proposal.
Tesco Mobile	No comment

Annex J Other licence conditions

518. The views of respondents to ComReg consultation 09/99 on licence conditions other than those relating to roll-out and coverage obligations are presented in Table 24 below.

Table 24: Views raised by respondents to ComReg consultation 09/99 in relation to other licence conditions

Respondent	Views on other licence conditions (responses to 09/99)
An Post	No comment
BT	No comment
Digiweb	Expresses its explicit agreement with most of the proposed approach to other licence conditions Agrees that a minimum QoS should be set to ensure that consumers have a reasonable service Argues that it is necessary to set QoS for voice, market will drive standards for mobile broadband so QoS standards unnecessary Argues that QoS standards should not be reviewed during the licence period
H3GI	Expresses its explicit agreement with most of the proposed approach to other licence conditions Agrees that a minimum QoS should be set to ensure that consumers have a reasonable service Disagrees with the proposal to include a €2 million performance guarantee against coverage and roll-out obligations or a €1 million performance bond, arguing that this should not be necessary for compliance Argues that it is not necessary to set a mobile broadband QoS obligation Argues that QoS standards should not be reviewed during the licence period on the basis that when making an investment in spectrum a prospective licensee needs certainty in respect of it's future licence obligations.
Meteor	Disagrees with the proposal to include a €2 million performance guarantee against coverage and roll-out obligations or a €1 million performance bond, arguing that this creates unnecessary overhead for licensees in maintaining these guarantees. Argues that the threat of a fine and licence withdrawal would be equally effective. Disagrees generally with the imposition of QoS standards, stating that they are not necessary and would be highly disproportionate

	Believes that QoS standards, including emergency service access, where imposed should be applied via the General Authorisation to ensure universal application of such standards
O2	Disagrees with the imposition of QoS standards Agrees with a €2m performance bond subject to finding an appropriate coverage obligation for inclusion in the licence Believes that only minimum QoS standards should be included in the licence. Where obligations are imposed, they must be the same for all bidders Disagrees with the proposed voice call QoS obligation on the basis that it is not service neutral Argues that it is not necessary to set a mobile broadband QoS obligation Argues that any specific billing conditions should be in the General Authorisation Argues that ComReg should not include any service-specific QoS obligations as it does not know what services will be provided
Vodafone	Disagrees with the imposition of QoS standards – the robust competition in the market is sufficient to ensure that acceptable QoS standards will be maintained. Inclusion of QoS standards in new licences is neither proportionate nor objectively justified. Agrees with the proposal to include a €2 million performance guarantee against coverage and roll-out obligations Disagrees with QoS metrics to be set for VOIP calls States that it is not necessary to set a mobile broadband QoS obligation Argues that any specific billing conditions should be in the General Authorisation Disagrees with the proposal to include a €1 million performance bond

Annex K Issues related to spectrum fees

K.1 Structure of payments

Respondents to ComReg consultations on an award process for allocating spectrum including 900MHz frequencies made comment on the proposed structure for the payment of licence fees, the amount of which would be determined in the auction. Commentary by respondents in their respective responses to ComReg consultations 09/99, 10/71 and 10/105 are presented in Table 25, Table 26 and Table 27 respectively.

Table 25: Views on the proposed structure of payment of licence fees expressed in response to ComReg consultation 09/99

Respondent	Views on the proposed break-down of licence fees between an upfront fee and ongoing annual fees (responses to 09/99)
An Post	No comment
BT	No comment
Digiweb	No public comments
H3GI	No comment
Meteor	There can be merit in establishing reserve prices and SUF price levels respectively at 50% present value of the minimum price. A balance needs to be struck between discouraging frivolous or non-constructive speculative participation in an auction and facilitating near term investment in infrastructure development.
O2	Agrees that the overall price should be divided between an annual fee and an upfront element, as this gives an ongoing incentive to use any allocated spectrum.
Tesco Mobile	No comment
Vodafone	Disagrees with ComReg's current proposals on the structure of reserve prices and spectrum usage fees and considers that it is both proportionate and justified that most of the licence price of the spectrum should be captured in the up-front payment. Asserts that charging most of the licence price in the up-front payment would serve to limit the risk of bidders overpaying for spectrum and subsequently being unable to finance the rollout of a network or having to return the spectrum allocation to ComReg part way through the licence term. Annual SUFs, if any, should be charged only within the first 3-5 years of the licence and set at a level broadly in line, on a per MHz basis, with those currently charged for existing 900 MHz and 2.1 GHz licences. ComReg's proposals differ significantly from common practice in

	other European countries, which is to have low or no annual fees. ComReg's decision to diverge from this practice is not adequately justified.

Table 26: Views on the proposed structure of payment of licence fees expressed in response to ComReg consultation 10/71

Respondent	Views on the proposed break-down of licence fees between an upfront fee and ongoing annual fees (responses to 10/71)
Digiweb	No comment
Ericsson	No comment
ESBN	Any fee proposals should take account of ComReg's position on spectrum for GSM-R.
H3GI	No comment
Imagine	Recommends a graded licence with significantly lower licence fees for a new market entrant.
Meteor	Re-iterates its view that: There can be merit in establishing reserve prices and spectrum usage fee levels respectively at 50% of the present value of the minimum prices. A balance needs to be struck between discouraging frivolous or non-constructive speculative participation in an auction and facilitating near term investment in infrastructure development.
O2	Re-iterates its agreement with ComReg on the general approach to the structure of licences fees (i.e. split between an up-front payment and annual fees.)
Qualcomm	No comment
RTÉ and RTENL	No comment
UPC	Reserve prices for 800 spectrum are structurally too high for an entrant. There needs to be different treatment of new entrants and incumbents, with ComReg clearly carving out spectrum for new entrants.
Vodafone	Re-iterates its strong disagreement with the proposed structure of the reserve prices and annual spectrum usage fees. Considers that it is both proportionate and justified that most of the

	licence price of the spectrum should be captured in the up-front payment.

Table 27: Views on the proposed structure of payment of licence fees expressed in response to ComReg consultation 10/105

Respondent	Views on the proposed break-down of licence fees between an upfront fee and ongoing annual fees (responses to 10/105)
H3GI	No comment
Meteor	Re-iterates its view that: There can be merit in establishing reserve prices and spectrum usage fee levels respectively at 50% of the present value of the minimum prices, subject to a satisfactory deferral option. A balance needs to be struck between discouraging frivolous or non-constructive speculative participation in an auction and facilitating near term investment in infrastructure development.
O2	No comment relating to the structure of payments.
Vodafone	Re-iterates its view that it considers that it is both proportionate and justified that most of the licence price of the spectrum should be captured in the up-front payment. The approach to the structure of payments must be adopted for the spectrum in each of the bands to be included in the joint award process.

K.2 Deferral option

The issue of a deferral option was raised in DotEcon's first report for ComReg on an award process for allocating spectrum including 900MHz frequencies, 09/99c, published in December 2009, and ComReg's related consultation, 09/99, published at the same time. Commentary by respondents on the subject is presented in Table 28 and

519. Table 29.

Table 28: Views on the proposed deferral option expressed in response to ComReg consultation 09/99

Respondent	Views on a deferral option for payment of the licence price less annual fees (responses to 09/99)
An Post	No comment

BT	No comment
Digiweb	Agrees that in the current financial and economic climate a deferral option is prudent and safeguards against potential financial constraints.
H3GI	No comment
Meteor	Considers that a balance must be struck in the near term between the payment of spectrum fees and the necessary investment that must be made by network operators to facilitate the Government's objective of a smart economy. This can be achieved through a deferred payment scheme or a smoothing of licence fee payments over the duration of the licences. Asserts that if a pre-qualification phase is adopted to verify the bona fides of potential new entrants at the start of the process then all of the excess beyond minimum prices could be phased over the duration of the licence rather than 50% of the excess over a three year period. Argues that in the context of ComReg's indexation proposal to use a coupon rate of 12% in any deferred / phased payment scheme, it considers a rate of 12% to be outrageous coupled with the fact that it offers no flexibility to investors. To the extent that indexation may apply, it should be based on Irish Government bond yields representing the opportunity cost to Department of Finance of deferred payment.
O2	Disagrees with the deferred payment scheme – it increases the likelihood that a bidder can bid an excessive price in order to win, but then default on their payments, thus depriving other bidders access to the spectrum. Asserts that all upfront payments arising from the Main Stage of the auction should be received by ComReg before that stage of the auction is declared complete. This would prevent the outcome being effected by a bidder who decides to walk away (that is, default on its payment obligation).
Tesco Mobile	No comment
Vodafone	Considers that the proposed deferred payment scheme is neither proportionate nor justified, and runs the risk of undermining ComReg's statutory objectives in regard to the efficient use of the spectrum and the promotion of end user rights. Considers that the proposal to charge an interest rate of 12%, above the cost of normal commercial funding, to the deferred portion of any up-front licence price would not deter the take up of the deferred payment option by an operator pursuing a high risk commercial strategy, but would in fact only increase the probability of their defaulting, with all of the associated adverse impacts on spectrum use

	and end user welfare that this would involve. Considers that not only should a deferred licence payment option not be made available, but it should be a requirement that for licence applicants to qualify to participate in a 900 MHz licence award process, they would need to demonstrate their ability to meet reasonable criteria in relation to financial strength and access to capital.

Table 29: Views on the proposed deferral option expressed in response to ComReg consultation 10/105

Respondent	Views on a deferral option for payment of the licence price less annual fees (responses to 10/105)
H3GI	Believes that the inclusion of 1800MHz spectrum in the auction increases the rationale for including a deferral option as the capital required to purchase spectrum has increased. States its view that a deferral option should be included in the award process given the implications of the economic crisis for a company's ability to raise finance. Suggests a pre-qualification process to deter frivolous participation in the auction. Considers that the interest rate proposed by ComReg of 12% is unnecessarily high and does not represent a reasonable assessment of the default risk. Asserts that the deferral option should be extended beyond 3 years.