Commission for
Communications Regulation

Consultation on Proposed 3.6 GHz Band Spectrum Award

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Chapter 1

1 Introduction

1.1 This document is:

- a response to consultation and deals with all the issues raised in Document 14/101 that are related to the release of the 3.6 GHz band; and
- a further consultation that considers and proposes the release of spectrum rights of use in the 3.6 GHz band in a separate competitive award process in advance of the 2.6 GHz and other bands.

1.2 In arriving at its proposals set out in this document, ComReg has had regard to the statutory functions, objectives and duties relevant to its management of the radio frequency spectrum (the most relevant of which are summarised in Annex 2). ComReg has also had regard to various international decision documents, technical documents relating to the spectrum proposed for inclusion in the award process (see Annex 3) and its most recent spectrum strategy statement[1].

1.3 This document considers amongst other issues:

- the key aspects of the spectrum proposed for inclusion in the award process;
- the type of award mechanism that might be used;
- the proposed approach to setting fees for rights of use to the award process; and
- appropriate licence conditions.

1.4 ComReg is publishing, alongside this document:

- a report on the design of a spectrum award from its economic and award design consultants, DotEcon, as Document 15/71;

[1] Strategy Statement - Strategy for Managing the Radio Spectrum: 2011 – 2013, ComReg document 11/89. For the avoidance of doubt, ComReg intends to shortly consult upon a new spectrum strategy statement, and the preliminary views expressed in this document are without prejudice to the position which may be articulated by ComReg on related matters in any future spectrum strategy statement resulting from the above mentioned consultation process or future processes.

- a reserve price benchmarking report from its economic and award design consultants, DotEcon, as Document 15/72;

- a report analysing the potential co-existence obligations for any sub-national (regional) assignments in the 3.6 GHz band to facilitate co-channel and adjacent channel co-existence from its technical consultants, Plum Consulting London LLP, as Document 15/73;

- a report examining likely rollout considerations and timelines for the deployment of the technologies and potential services likely to be put into use for regional assignments in the 3.6 GHz band including equipment and rollout considerations from its technical consultants, Plum Consulting London LLP, as Document 15/74; and

- a report analysing the spectrum potentially required for the provision of an advanced Wireless Broadband (WBB) service in the 3.6 GHz band by a single provider (or consortia) in each region from its technical consultants, Plum Consulting London LLP, as Document 15/75.

1.1 This document is structured as follows:

- **Chapter 2:** sets out some background on this consultation process and on the 3.6 GHz band;

- **Chapter 3:** contains a draft regulatory impact assessment of the spectrum for the award, the award process and an assessment of the Preferred Options against ComReg's functions, objectives and duties;

- **Chapter 4:** details some key aspects of the proposed award including band plan, regionalization, and licence duration;

- **Chapter 5:** sets out details of the award including ComReg's proposed award type, fees and implementation;

- **Chapter 6:** details the licence conditions that might apply in any award of spectrum in this band, including protection of adjacent users, coverage requirements, technology and service neutrality, the non-exclusive assignment of spectrum and rollout conditions;

- **Chapter 7:** considers transitional issues that may arise as a consequence of this proposed award process; and

- **Chapter 8:** details how to submit comments and the next steps in this process.
- **Annex 1:** Glossary of Terms;
- **Annex 2:** summarises ComReg's statutory functions, objectives and duties relevant to the management of Ireland's radio frequency spectrum;
- **Annex 3:** Relevant EC/CEPT Decisions and technical documents
- **Annex 4:** lists recent international developments with respect to the 3.6 GHz band.
- **Annex 5:** shows maps of the urban regions proposed in Chapter 4
- **Annex 6:** CSO data on population flows
- **Annex 7:** Consultation questions

Chapter 2

2 Background

2.1 On 16 February 2015, ComReg published an information notice (Information Notice 15/14) indicating that it intended to consider the possible release of rights of use in the 3.6 GHz band (3 400–3 800 MHz[2]), in a separate competitive award process and to issue a consultation seeking the views of interested parties on such a proposal (the purpose of the present consultation). This chapter briefly sets out some background on the process leading up to publication of the above Information Notice.

2.1 Document 14/101

2.2 On 30 September 2014, ComReg published a consultation (ComReg Document 14/101[3]) setting out its preliminary proposals on the details of a competitive award process for spectrum rights of use in the 2.6 GHz band. ComReg also considered the potential release of other appropriate bands in the same award process, including the 700 MHz, 1.4 GHz, 2.3 GHz and 3.6 GHz bands. Detailed information around the characteristics of and legal framework surrounding these bands can be found in Section 3.1 of Document 14/101.

2.3 In that consultation, ComReg proposed the release of all of the above bands in the same award process, whilst noting certain peculiarities around the 3.6 GHz and 700 MHz bands which would require further assessment before coming to firm proposals[4]. For example, ComReg noted that while there were potential benefits to the inclusion of the 3.6 GHz band in the proposed award process, the band also had certain characteristics (e.g. the likely interest from different types of users) which would differentiate it from, and might justify its different treatment to, other bands being considered for inclusion.

2.4 The responses received to Document 14/101 touched upon a wide range of issues outlined in the consultation. However, one of the more prominent issues raised by respondents was in relation to the inclusion of the 3.6 GHz band in the proposed award process. There was general acknowledgment by

[2] The band is often considered to be two separate bands (3400 – 3600 MHz and 3600 – 3800 MHz) and is defined as such in the International Telecommunication Union (ITU) Radio Regulations.

[3] ComReg Document 14/101 - *Spectrum award - 2.6 GHz band with possible inclusion of 700 MHz, 1.4, 2.3 and 3.6 GHz bands.*

[4] See, for example, paragraphs 3.74, 3.75 and Section 5.6 of Document 14/101.

respondents of the differences between the 3.6 GHz band and the other bands being considered for inclusion. Indeed, a number of respondents strongly favoured the release of the 3.6 GHz band in a separate award process.

2.2 Document 14/126

2.5 On 4 December 2014, ComReg issued a call for input on the regulatory implications of the National Broadband Plan[5]. In addition to the responses received to Document 14/101, a number of the respondents to the call for input (Document 14/126) made submissions in relation to radio-spectrum related matters, including in respect of the 3.6 GHz band. As outlined in ComReg's response to Document 14/126 (Document 15/57), ComReg has taken into account all relevant information, including the radio spectrum-related submissions to Document 14/126, in the preparation of this document.

2.6 That being said, ComReg would take this opportunity to:

- reiterate that ComReg has no decision-making role in regard to the design of the NBP or the award of any contracts under the NBP; and
- confirm that, to the extent that interested parties have views on how ComReg's spectrum award proposals may, in their view, better align with the NBP (including when more detailed information becomes available about the NBP), then ComReg remains open to consideration of such views in the context of ComReg's own statutory remit.[6]

2.3 Summary of key relevant points received regarding inclusion of 3.6 GHz band in multi-band award proposed in Document 14/101

2.7 Set out below is a summary of the key relevant points raised by respondents both for and against the inclusion of the 3.6 GHz band in the multi-band award proposed in Document 14/101[7]. Submissions on this issue fall into the following three categories: mobile network operators ("MNOs"); Fixed Wireless Access ("FWA") operators and equipment manufacturers; and other interested

[5] ComReg consultation titled "National Broadband Plan - Call for Input on Regulatory Implications" (Document 14/126).

[6] In this regard, interested parties are refereed to Annex 2 to Consultation 15/70.

[7] ComReg observes that submissions on this issue in responses to Document 14/126 were of a similar nature.

parties. Please see ComReg Document 15/15 for non-confidential versions of the submissions received.

MNOs

2.8 Vodafone did not consider the 3.6 GHz band to be a substitute for the 2.6 GHz band or other bands considered in Document 14/101. In particular, Vodafone noted that the likely primary assignments are FWA and non-line of site transmission links to applications for small cells and that the propagation characteristics at 3.6 GHz make this spectrum significantly less suitable for "true mobile" applications. While Vodafone noted that there may be future mobile applications, possibly for small cells although this is uncertain, Vodafone strongly agreed with ComReg's view that the 3.6 GHz band may not be fully substitutable with the 2.6 GHz band; in fact Vodafone maintained that there is only "*very weak substitutability*" between these bands and only a weak case for common demand with other bands.

2.9 Eircom noted that higher frequency spectrum needs to be complemented by lower frequency spectrum if national services are to be provided. Eircom also noted that there is likely to be substantial complementarity and substitutability of the capacity bands with the 700 MHz band and the 2.6 GHz band respectively but welcomed ComReg's proposal to include the 3.6 GHz band in the award process.

2.10 3IHL[8] was of the view that propagation characteristics and device availability mean that the 3.6 GHz band is not a substitute, or a complement, for the other bands under consideration. As a result, it considered that this band should not be included in the same award process and could be proceeded with separately.

FWA operators and equipment manufacturers

2.11 Imagine was not in favour of including the 3.6 GHz band as part of the multi-band award process. In support of this view, Imagine noted that other bands considered by ComReg (e.g. 700 MHz, 2.3 and 2.6 GHz) have a far stronger mobile ecosystem than 3.6 GHz and that 3.6 GHz is an ideal band for FWA. Imagine concluded that in its view the evidence strongly suggested that 3.6 GHz is not a close substitute or complement to 2.6 GHz, nor the other bands considered by ComReg.

[8] Three Ireland (Hutchison) Limited

2.12 Ripplecom maintained that the 3.6 GHz band should be excluded from the proposed 2.6 GHz award and awarded on a different basis. It contended that the propagation characteristics of the 2.3 GHz and 2.6 GHz bands make them better suited to wide-area mobile deployments than the 3.6 GHz band, which is more likely to be used by MNOs in urban hotspots. This view was echoed in the Joint FWA Operators Response by Fastcom, Lightnet, Permanet, Ripplecom and Westnet. This response document is herein referred to as "Joint FWA Operators Response".

2.13 While favouring a multi-band award including the 3.6 GHz band, Viatel noted that the lower propagation characteristics of the 3.6 GHz band, as well as the low numbers of LTE handsets available in the band, make it of considerable lower value than the 2.6 GHz band.

2.14 Further, FWA respondents to Document 14/126[9] expressed the view that decisions on the 3.6 GHz band should be prioritised and accelerated in order to provide clarity on the availability of this band post 2017.

2.15 While supporting the inclusion of the 3.6 GHz band in a multi-band award process, Qualcomm noted that the 3.6 GHz band represents a special case, as it has characteristics which are not available in other bands (very wide bandwidth) but requires a much denser deployment, matching very well with the expected introduction of pico- and femto-cells in mobile networks. Further it maintained that although, in general, bands above 1 GHz provide capacity, not all bands above 1 GHz can be considered equally. For example, there are major differences between the 1 800 MHz and 3.6 GHz bands. It could be argued that the 3.6 GHz band belongs to another category, i.e. 'performance bands', which are especially suited for the deployment of HetNets[10].

Other interested parties

2.16 ESBN supported the inclusion of all the bands in the award process and added that additional bands should be included. It was in agreement that releasing multiple spectrum bands together in one award is advantageous in particular from a timing perspective and facilitating this ensures different operators with different interests can acquire their desired spectrum rights of use.

[9] http://www.comreg.ie/_fileupload/publications/ComReg14126.pdf

[10] Heterogeneous networks are designed to allow macro cells and small cells use the same frequency channels thereby increasing the combined spectrum efficiency. It is therefore expected that the introduction of a Het net architecture could facilitate a massive capacity increase in a network.

2.17 As can be seen from the above, a number of respondents strongly favoured the release of the 3.6 GHz band in a separate award process[11]. Furthermore, while a number of respondents were in favour of the inclusion of the 3.6 GHz band in a multi-band award as proposed, there was still broad acknowledgement of the differences between the 3.6 GHz band and the other bands being considered for inclusion.

2.18 In light of the above, ComReg published Information Notice 15/14 indicating that it intended to further consider how best to release rights of use in the 3.6 GHz band. As a result, ComReg has issued this consultation.

2.19 The following chapter sets out ComReg's assessment on how best to release rights of use in this band, including whether they should be released alongside one or more other bands and pursuant to a competitive award process. Before doing so, ComReg firstly sets out below some relevant information on the 3.6 GHz band (see also Annex 4: of this document for further information). Further detailed information on this and other bands discussed in this document can be found in Section 3.1 of Document 14/101.

2.4 The 3.6 GHz band

2.20 The entire 3.6 GHz band is licensed in Ireland. The majority of the band is currently licensed for the provision of Fixed Wireless Access Local Area (FWALA) services and the sub-band 3 435-3 475 MHz is licensed for the provision of State services.

2.21 The FWALA licensing framework has helped facilitate the provision of wireless broadband (WBB) services across Ireland and has been particularly beneficial for the provision of these services in small towns and rural areas.

2.22 The band is fully harmonised in Europe for electronic communications services (ECS), mainly targeting the provision of WBB services, since 2008 with EC Decision 2008/411/EC. The recently adopted EC Decision 2014/276/EU further strengthens the harmonisation of the band in Europe and is mandatory for all Member States including Ireland. Throughout the remainder of the paper the two decisions are referenced as "3.6 GHz EC Decision". If relating to the specific EC decision the term "2008 3.6 GHz EC Decision" or "2014 3.6 GHz EC Decision" as appropriate is used.

2.23 The 3.6 GHz band is considerably higher in frequency than the traditional, core mobile telecommunications bands (i.e. 800 MHz, 900 MHz, 1 800 MHz, 2.1

[11] ComReg notes that the submissions to Document 14/126 (see ComReg 14/126s) also broadly supported this view.

GHz and 2.6 GHz bands) giving it comparatively less favourable propagation characteristics for mobile applications. These limiting characteristics have, so far, reduced the interest from mobile operators and limited the deployment of mobile services in the band. In addition, the number of mobile devices available has remained low compared to other bands.[12]

2.24 The 3.6 GHz band has, however, been identified by the Radio Spectrum Policy Group as a suitable band for addressing the potential spectrum "crunch" brought about by the wireless broadband data explosion. Also, given the quantum of spectrum in the band and the preferred TDD channelling arrangement[13], the 3.6 GHz band could be suitable for reducing mobile data capacity constraints for operators with a portfolio of spectrum holdings, or indeed acting as the core band for providing fixed WBB services.

2.4.1 **FWALA**

2.25 The existing FWALA framework was launched in 2003 to provide a wireless alternative for broadband access for consumers. The current FWALA licensing framework has been added to over the years and currently FWALA licenses are available in three spectrum bands:

- 3.6 GHz band;
- 10.5 GHz band; and
- 26 GHz band.

The FWALA licensing framework was very successful in Ireland, particularly in the earlier years, and has provided consumers with access to broadband services, particularly in rural areas of Ireland where fixed line broadband alternatives were limited or unavailable. However, FWALA services reached their peak subscriber numbers of circa 121,000 in 2008 and have been declining steadily since. The reduction in subscriber numbers may be due to increased competition from mobile broadband services and an increase in the availability of fixed line broadband, particularly in rural areas.

[12] According to GSA (Global mobile Suppliers Association), in April 2015 there were 26 LTE devices available in the 3.6 GHz band. This number of devices is low compared to the other spectrum bands and ComReg notes that this number of devices has remained static for the last 6 months and potentially longer. www.gsacom.com

[13] 2014 3.6 GHz EC Decision states that TDD shall be the preferred mode of operation in the 3 400-3 600 MHz band and the mode of operation for the 3600-3800 MHz band.

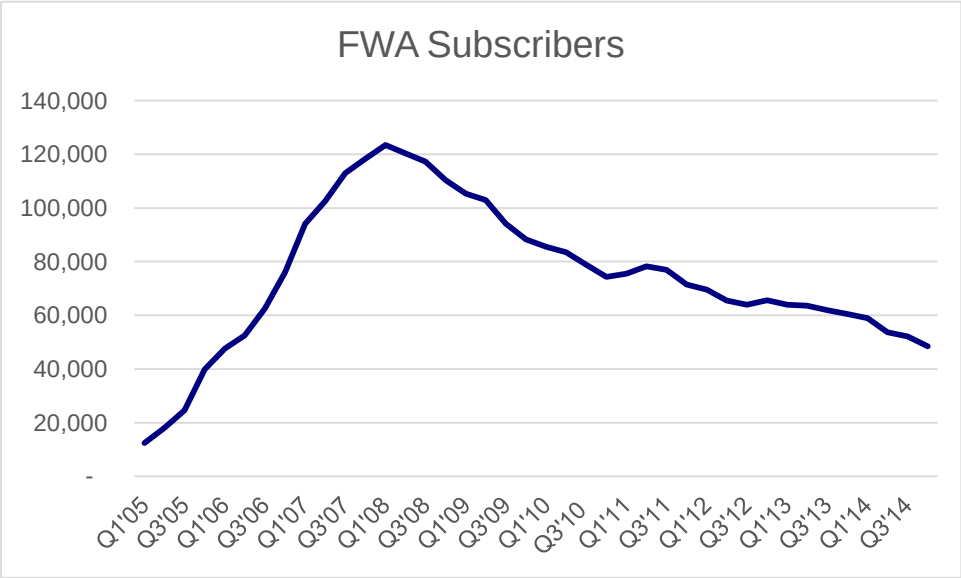

Figure 1 FWA Subscriber numbers in Ireland

2.26 Currently, there are fourteen 3.6 GHz FWALA operators, providing services in the band, serving 27,302 customers[14]. All existing FWALA rights of use in the band are set to terminate on 31 July 2017.[15]

2.4.2 State Services

2.27 A portion of the band (3 435 – 3 475 MHz) is currently licenced for use by State services and these services are likely to continue using those frequencies beyond the anticipated timeframe of the award process.

2.28 However, this view is subject to developments that may arise as a result of ongoing discussions between ComReg and the responsible state body.

2.5 Treatment of submissions to Document 14/101 in this consultation

2.29 ComReg welcomes and thanks respondents to Document 14/101 for all submissions received. In light of the scope of this consultation, and its focus on how best to release rights of use in the 3.6 GHz band, ComReg intends to address submissions to Document 14/101 only to the extent that they are

[14] This figure is based on information received from operators in response to Quarterly Key Data Report Information Request

[15] ComReg Document 10/29: Fixed Wireless Access Local Area Licensing, end date for FWALA licensing in the 3.6 GHz band.

relevant to this particular issue. ComReg will engage in one, or more, separate consultations on other general issues raised and issues concerning the release of the other spectrum bands proposed in Document 14/101 in due course.

Chapter 3

3 The Draft RIA

3.1 Introduction

3.1 As noted earlier, all existing licences in the 3.6 GHz band awarded by ComReg under the Fixed Wireless Access Local Area ("FWALA") scheme are due to expire on or before 31 July 2017. This chapter discusses, at a high level, how rights of use in the 3.6 GHz band, in respect of the period following that expiry, should be awarded.

3.2 In Document 14/101, ComReg consulted on the possible inclusion of this band in a multi-band award process involving the 2.6 GHz band and other potentially suitable bands. However, responses to that consultation indicated that there was broad support, for a variety of reasons, for the separate treatment of the 3.6 GHz band from that multi-band award process.[16] Accordingly, ComReg indicated in early 2015[17] that it was considering the possible release of rights of use in this band in a separate competitive award process.

3.3 This chapter sets out ComReg's draft regulatory impact assessments (RIAs) on:

- whether the 3.6 GHz band should be released in a separate award process and, if so, what, if any, bands should be included in that award process (the **"Spectrum for Award RIA"**); and
- in light of the preferred option arising from the Spectrum for Award RIA, how best to assign the rights of use in the relevant band(s) (the **"Assignment Process RIA"**).

3.4 The chapter concludes with ComReg's assessment of the preferred option arising from the two RIAs (the **"Preferred Option"**) against ComReg's statutory objectives,[18] regulatory principles and duties.

[16] This view was also supported in the responses submitted to ComReg Document 14/126.

[17] See Information Notice 15/14.

[18] Set out in Annex 2.

3.5 References to “RIA(s)”, “this RIA” and “the RIA(s)” in this document should be read as meaning the draft RIAs set out in this chapter, unless the context otherwise requires.

3.2 RIA Framework

3.6 In general terms, a RIA is an analysis of the likely effect of a proposed new regulation or regulatory change, and, indeed, of whether regulation is necessary at all. A RIA should help identify the most effective and least burdensome regulatory option and should seek to establish whether a proposed regulation or regulatory change is likely to achieve the desired objectives, having considered relevant alternatives and the impacts on stakeholders. In conducting a RIA, the aim is to ensure that all proposed measures are appropriate, effective, proportionate and justified.

Structure of a RIA

3.7 As set out in ComReg’s RIA Guidelines, [19] there are five steps in a RIA. These are:

- Step 1: Identify the policy issues and identify the objectives.
- Step 2: Identify and describe the regulatory options.
- Step 3: Determine the impacts on stakeholders.
- Step 4: Determine the impact on competition.
- Step 5: Assess the impacts and choose the best option.

3.8 In the following sections ComReg identifies the relevant stakeholder groups, specific policy issues to be addressed and relevant objectives (i.e. Step 1 of the RIA process). This is followed by the identification of two fundamental policy issues.

3.9 ComReg then considers these two policy issues in separate RIAs, in accordance with the four remaining steps of ComReg’s RIA process.

[19] See Document 07/56a - Guidelines on ComReg’s approach to Regulatory Impact Assessment - August 2007.

Identification of stakeholders

3.10 The focus of Step 3 is to assess the impact of the proposed regulatory options available to ComReg on stakeholders. A precursor to the subsequent steps in the RIA, therefore, is to identify the relevant stakeholders. Stakeholders consist of two main groups:

i. consumers (for the purposes of this RIA, consumers include both business and residential end users of spectrum), and

ii. industry stakeholders.

3.11 There are a number of key industry stakeholders in relation to the matters considered in this chapter:[20]

- existing service providers:
- licensees with spectrum rights of use in the 3.6 GHz band (e.g. FWALA licensees);
- parties who currently provide services using other spectrum (licensed or unlicensed) for whom the spectrum being considered for inclusion in the award may be of particular interest to satisfy existing and potential demand (e.g. mobile network operators or other wireless broadband providers); and
- potential new entrants who do not currently provide any services using spectrum in the State. ComReg is of the view that such potential entrants would most likely wish to deploy wireless broadband (WBB)[21].

3.12 Prior to receiving submissions on ComReg's various proposals contained in this consultation, ComReg has, in the following analysis, taken a reasonable and pragmatic approach to considering the likely impact of each option on the various stakeholders without, in some cases, being in a position to reference

[20] ComReg acknowledges that other stakeholders have an interest in the 3.6 GHz Band including the State (in respect of State services provided using spectrum in the Band), entities using the adjoining spectrum and equipment manufacturers. However, it does not appear to ComReg that these stakeholders would be impacted by how the 3.6 GHz band is allocated. Accordingly, they are not considered further in this chapter.

[21] While other ECS services can also be provided in the 3.6 GHz band and the other bands discussed in Consultation 14/101, WBB is generally considered to be the most likely use. Indeed, the relevant EC harmonising decision (EC Decision 2008/411/EC), emphasises that "*the services provided in this frequency band should mainly target end-user access to broadband communications*". Accordingly, this RIA focuses the likely demand for this band and other bands in the context of WBB.

particular views expressed by those stakeholders, but having regard to its experience and expertise and also having regard to the advice of its consultants.

3.13 The focus of Step 4 is to assess the impact on competition of the proposed regulatory options available to ComReg. In that regard, ComReg notes that it has various statutory, objectives, regulatory principles and duties which are relevant to the issue of competition (see Annex 2:).

3.14 Of themselves, the various RIA guidelines and the RIA Policy Direction[22] provide little guidance on how much weight should be given to the positions and views of each stakeholder group (Step 3), or the impact on competition (Step 4). Accordingly, ComReg has been guided by its statutory objectives which it is obliged to pursue when exercising its functions. ComReg's statutory objectives in managing the radio frequency spectrum, as set out in Annex 2:, include:

- the promotion of competition;
- contributing to the development of the internal market; and
- to promote the interest of users within the Community.

3.15 In this document, ComReg has adopted the following structure in relation to Step 3 and Step 4 – the impact on industry stakeholders is considered first, followed by the impact on competition, followed by the impact on consumers. The order of this assessment does not reflect any assessment of the relative importance of these issues but rather reflects a logical progression. For example, a measure which safeguards and promotes competition should also, in turn, impact positively on consumers. In that regard, the assessment of the impact on consumers draws substantially upon the assessment carried out in respect of the impact on competition.

Identify the policy issues and identify the objectives (Step 1)

3.16 All rights of use in the 3.6 GHz band awarded under the FWALA licencing scheme are due to expire on or before 31 July 2017. In Document 14/101, ComReg began the process of consulting on the award of new rights of use in this band and proposed its release as part of a multi-band award process. However, there was limited support for this proposal amongst respondents to that consultation. In particular, there was broader support for releasing this band in a separate award process. As a result, ComReg has given further

[22] See Policy Direction Number 6 in Annex 2:

consideration as to how to approach releasing rights of use in this band. Accordingly, the 3.6 GHz band is the focus of the policy issues to be considered in this document.

3.17 On a related note, a number of respondents to Document 14/101 expressed the view that the 700 MHz band should have formed the focus for the RIA in that consultation rather than the 2.6 GHz band. For example, Eircom noted that the 700 MHz band is advanced in terms of the international harmonisation process, and it *"is expected to have good propagation characteristics for wide area mobile broadband coverage"*. Eircom added that, if ComReg wishes to encourage national competition, then the correct starting point for consideration and focal point for a potential multi-band spectrum award, must in its view, be the 700 MHz band. Eircom went on to state that the RIA in Document 14/101 was not complete because ComReg, in its view, used an incorrect starting point by placing the 2.6 GHz rather than the 700 MHz band as the focal point. ComReg notes that the political impetus within Europe to release the 700 MHz band continues to progress[23] and that some member states (e.g. Germany) have recently completed their award process to assign rights in the 700 MHz band. This consideration provides a helpful counterfactual when assessing whether, on balance, other bands should be included in a separate award process for the 3.6 GHz band or excluded from this separate award process for potential inclusion in a future award.

Policy Issues

3.18 ComReg is of the view that there are two primary policy issues to be considered in relation to the assignment of liberalised rights of use in the 3.6 GHz band:

a) Whether to release the 3.6 GHz band in a multi-band award process, as proposed in Document 14/101, or in a separate award process (either on its own or with additional bands); and

b) If it is proposed to release the 3.6 GHz band in a separate award process (with or without additional bands), how best to assign rights of use in such an award process.

3.19 ComReg takes the view that these two important issues, while related, are sequential in nature and can therefore be considered separately.

[23] For example, a 2020 timeframe (with some flexibility e.g. +/- 2 years) for the release of the 700 MHz band in Europe has been broadly suggested in the Lamy Report for the EC (http://europa.eu/rapid/press-release_IP-14-957_en.htm) and the RSPG opinion on the future use of the UHF band (http://rspg-spectrum.eu/wp-content/uploads/2013/05/RSPG15-595_final-RSPG_opinion_UHF.pdf).

The bands

3.20 In relation to the first policy issue, ComReg sets out below some relevant high level observations which will feed into the identification of valid regulatory options.

3.21 It is generally agreed that the 3.6 GHz band is primarily suitable for the provision of WBB services. Indeed, as noted previously, this is emphasised in the 3.6 GHz EC Decision and WBB is the main use to which the band is put (i.e. FWALA licensees). Accordingly, this RIA focuses on the likely demand for this band and other bands in the context of WBB.

3.22 The 3.6 GHz band has characteristics which somewhat set it apart from other bands considered for inclusion in Document 14/101. In particular:

- Unlike other bands, this band can be considered "brownfield" in terms of the provision of wireless broadband services.

- Compared to the other bands, this band has the most spectrum available for release, making it particularly suitable for the potential deployment of high speed broadband services by multiple wireless broadband providers.

- Compared to most of the other bands (i.e. 2.3 GHz, 2.6 GHz and 700 MHz) the LTE device ecosystem for the 3.6 GHz band is not well developed.[24] The status of the LTE device ecosystem is one of the factors that interested parties are likely to consider in assessing the attractiveness or suitability of a band for the deployment of LTE services. That said, a WBB provider will likely select all equipment (base stations and consumer premises equipment). Accordingly, a small range of equipment may be sufficient, while a mobile broadband provider is likely to require that a wide range of user terminals support a band (as users select their own terminals). ComReg recognises that other technologies compliant with the relevant EC Decisions (e.g. WiMAX) may also be deployed in these bands but notes that a number of responses to Document 14/101 and Document 14/126 identified LTE as the likely technology to be deployed in the 3.6 GHz band in the coming years.

[24] In April 2015, the Global mobile Suppliers Association (GSA) indicated that there were 26 LTE TDD devices in the 3.6 GHz bands (Bands 42 and 43). For the other bands, the GSA indicated that there were 1200 LTE FDD devices in the 2.6 GHz band, 788 LTE TDD devices in the 2.3 GHz band (Band 40), 685 LTE TDD devices in the 2.6 GHz band (Band 38) and 92 LTE FDD devices in the 700 MHz band. The 1.4 GHz band is not mentioned in the GSA report.
Source: Status of the LTE Ecosystem. 20 April 2015
http://www.gsacom.com/downloads/pdf/GSA_lte_ecosystem_report_200415.php4

- This band has the least favourable propagation characteristics for delivering coverage of all the bands being considered.

3.23 The timing of the availability of spectrum, of three of the other spectrum bands (i.e. the 1.4 GHz, 2.3 GHz and 2.6 GHz bands) is currently known. The 1.4 GHz and 2.3 GHz bands are "greenfield" bands and could be made available now while the MMDS licences in the 2.6 GHz band expire in April 2016. This suggests that these spectrum bands could be considered for inclusion alongside the 3.6 GHz band. On the other hand the availability of the 700 MHz band is as yet unclear, and this uncertainty weighs against releasing the 700 MHz band in the same award process as the 3.6 GHz band, particularly given the FWALA licence expiry date of 31 July 2017. [25] Furthermore, the propagation characteristics of the 700 MHz band and its likely uses for wide area / indoor coverage (and potentially capacity purposes) suggest that this band is more likely to be seen as a complement to the other higher frequency bands (such as 3.6 GHz) rather than as a substitute.

3.24 As alluded to by respondents to Document 14/101, given its favourable propagation characteristics and international harmonisation, the 700 MHz band could be considered a focal spectrum band in a future spectrum award. Therefore, in considering the potential inclusion of the other spectrum bands (1.4 GHz, 2.3 GHz and 2.6 GHz) in an award process with the 3.6 GHz band, ComReg remains cognisant of what impact their inclusion/exclusion would have on a potential future award process which might have the 700 MHz band as the focal spectrum band.

3.25 Focusing firstly on the 1.4 GHz band, while this band has some characteristics which suggest that it might be appropriate to include this band in an award process with the 3.6 GHz band (e.g. both bands might be used for LTE in the future), on balance its characteristics would weigh against releasing it in a separate award process with the 3.6 GHz band. For example:

- in Document 14/101 ComReg noted that, while there may be complementarity between paired 2.6s GHz frequencies and the 1.4 GHz band, this is less clear with the 3.6 GHz band given the differences in propagation;

[25] In Huawei's response, while supporting the release of the 700MHz band, they indicate the importance of minimising the lead time between assigning spectrum rights of use and actual frequency availability.

- while noting that the question was not specifically asked, there was little or no indication in the responses to Document 14/101 that the 1.4 GHz band should be included in an award with 3.6 GHz spectrum;

- the band is much closer in propagation characteristics to the sub-1 GHz (or coverage bands) than to the 3.6 GHz band and is therefore potentially most beneficially used as a complementary downlink for FDD networks operating sub-1 GHz spectrum;

- further the 2015 EC Decision on the 1.4 GHz band[26] allows Member States to set an increased in-block power limit such that the 1.4 GHz band could be used in aggregation with spectrum in lower frequency bands. This possibility was also noted by one the respondents to Document 14/101;

- as noted by Qualcomm (page 16), the joint award of the 1.4 GHz and 700 MHz bands would enable a potential new entrant or an MNO without spectrum in the 900 MHz or 800 MHz bands to fully benefit from the 1.4 GHz band;

- the ECC 1.4 GHz Decision refers to this band specifically as a mobile broadband system and calls it "a strategic tool to tackle the growing mobile data traffic asymmetry". This supports the view that it should be included in an award where there is likely to be strong demand from MNOs. This is more likely to be the case in an award of the 700 MHz band than the 3.6 GHz band; and

- while Document 14/101 noted that equipment is likely to become available within the timeframe of the award, as of April 2015 the Global Mobile Suppliers Association (GSA) indicated that there were no LTE devices available in the 1.4 GHz band[27].

3.26 For these reasons, the 1.4 GHz band is not, in ComReg's view, considered to be suitable for inclusion in a separate award of the 3.6 GHz band (as distinct from the 700 MHz band) and is not therefore considered further in this RIA.

[26] EC Decision (EU) 2015/750 of 8 May 2015 http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015D0750&from=EN

[27] Source: Status of the LTE Ecosystem. 20 April 2015 http://www.gsacom.com/downloads/pdf/GSA_lte_ecosystem_report_200415.php4

3.27 Focusing on the 2.3 and the 2.6 GHz bands, the characteristics of these bands are such that these bands could be considered substitutable bands with the 3.6 GHz band as:

- the provision of fixed wireless broadband services is likely to be possible with all these bands; and
- for mobile services these bands (i.e. the 2.3 GHz, 2.6 GHz and 3.6 GHz bands) are likely to be used for capacity purposes in areas where there is constant or periodic spikes in demand (e.g. in urban areas).

3.28 On the other hand, the somewhat more favourable propagation characteristics of the 2.3 GHz and 2.6 GHz bands and the considerably better LTE device ecosystem might suggest that these bands would be better suited to a future award process which could have the 700 MHz band as the focal spectrum band.

3.29 In light of the above, if the 3.6 GHz band is considered suitable for release in a separate award process, it would appear appropriate to assess whether the 2.3 and/or the 2.6 GHz bands should be included in that award process. This is considered further below.

The award process

3.30 In relation to the second policy issue, a range of possible assignment procedures are available to ComReg in determining how best to assign rights of use in these band(s). For example, rights of use could be selected on the basis of administrative assignment, following a comparative selection procedure (e.g. beauty contest) or following a competitive selection procedure (i.e. auction). Each type of award process has its own relative merits and drawbacks and one approach may, on balance, be more suitable than the others depending on the rights of use to be included in the award process (i.e. the outcome of the assessment under the first policy issue). These policy issues before ComReg are also reflected in the relevant options set out below.

Objectives

3.31 The focus of this RIA is to assess the impact of the proposed measure(s) (see regulatory options below) on stakeholders, and on competition and consumers. In that way, it allows ComReg to identify and implement the most appropriate and effective means to assign spectrum rights of use, while still allowing ComReg to achieve its objectives of:

- assigning rights of use in the 3.6 GHz band and, if appropriate, one or more other bands;

- assigning rights of use in the 3.6 GHz band in line with the 3.6 GHz EC Decision and other relevant legislation;
- taking measures in advance of the timing of licence expiry in the 3.6 GHz band;
- providing further clarity on the likely availability of spectrum for release in other relevant bands; and
- promoting the interests of the economic development of the State and the electronic communications sector.

3.32 ComReg also aims to design and carry out this assignment process in accordance with its broader statutory objectives (set out in Annex 2), including, but not limited to, the promotion of competition in the electronic communications sector.

3.33 A further key objective in designing and carrying out this assignment process is to seek to encourage the efficient use and ensure the effective management of the radio frequency spectrum. ComReg's other overarching objectives are to contribute to the development of the internal market and to promote the interests of users within the Community. ComReg also notes that, in achieving its objectives, its ultimate aim is to choose regulatory measures which maximise the benefits for consumers in terms of price, choice and quality.

3.34 Unlike other bands considered in this RIA, the 3.6 GHz band is essentially "brownfield" in terms of the provision of wireless broadband services. There are currently 27,302[28] existing customers in the 3.6 GHz band who may be at risk of losing their service on licence expiry[29] and ComReg has a general objective to take all reasonable measures aimed at promoting the interests of users. In this regard, ComReg observes that respondents to Document 14/101 and Document 14/126 have provided comments in relation to ComReg's objectives for assigning spectrum and in particular to the potential impact on same to existing users. While ComReg has considered these views, the views however objective of promoting the interests of users cannot not be read in isolation and must be balanced against other principal objectives including the

[28] This figure is based on information received from operators in response to Quarterly Key Data Report Information Request.

[29] ComReg would note that there are specific consumer circumstances relating to the 3.6 GHz band where the existing WBB customers of the 3.6 GHz licensees may not have another comparable fixed broadband service in their area at the time of licence expiry. This could leave such customers without a fixed broadband service. In that regard, ComReg notes that a distinction can be drawn between this situation and the MMDS licence expiry in the 2.6 GHz band, where the MMDS customers are likely to have alternative comparable TV platform providers to turn to, such as Sky Ireland, Saorview, FreeSat, etc.

promotion of competition which includes encouraging efficient use and ensuring the effective management of radio frequencies. ComReg will therefore promote the interests of users, but only to the extent that it is proportionate vis-à-vis its other statutory objectives.

3.35 Having identified the above policy issues and objectives, the remainder of this chapter is divided between the two stand-alone primary policy issues identified above. Consideration of these policy issues is set out below with a separate assessment of the four remaining steps in the RIA process. They are referred to as the 'Spectrum for Award' RIA and the 'Assignment Process' RIA, respectively.

3.2.1 The 'Spectrum for Award' RIA

Regulatory Options (Step 2):

- Option 1 – a single multi-band award process as proposed in Document 14/101;
- Option 2 – an award of the 3.6 GHz band alone;
- Option 3 – an award of the 3.6 GHz band with the 2.3 GHz and/or 2.6 GHz bands.

Impact on Stakeholders and Competition (Steps 3 and 4)

3.36 The focus of this section of the draft RIA is to assess the impact of the aforementioned regulatory options on:

i. industry stakeholders (being existing operators and potential new entrants),

ii. competition, and

iii. consumers.

3.37 In Section 3.3.2 (under the heading 'Demand for Spectrum') of Document 14/101, ComReg set out some useful background information concerning the characteristics of, and developments in, the demand for the spectrum bands (including the 3.6 GHz band) that were under consideration. ComReg does not propose to repeat that information here except to note that such information remains relevant to the current process, at least to the extent that it assists ComReg in understanding the likely attitudes of industry stakeholders and consumers to the release of the 3.6 GHz band.

3.38 ComReg sets out below a comparative analysis of the three spectrum band award options outlined above, in terms of their impact on stakeholders,

competition and consumers. ComReg notes that it intends to further develop this draft RIA in light of feedback from respondents to this consultation.

Impact on Industry Stakeholders

3.39 As noted above, industry stakeholders can be split between those operators that are currently active in the electronic communications sector and potential new entrants that may be considering entry into the electronic communications sector in the State.

Option 1 (Multi-band award) versus Option 2 (3.6 GHz band only)

3.40 The benefits of, and likely views of industry stakeholders in respect of, Option 1 were discussed at length in Chapter 3 of Document 14/101. In particular, ComReg's preliminary view was that industry stakeholders would prefer a multi-band award process comprising all of the bands being considered. However, ComReg notes that Document 14/101 was a first consultation on the matter and that its views were therefore preliminary and necessarily based on predictions based on its knowledge, experience and information to hand at that time. As noted above, ComReg received detailed submissions from industry stakeholders on whether it should hold a multi-band award process which indicated broad support for holding a separate award process for the 3.6 GHz band.

3.41 In Chapter 2, ComReg summarises and assesses the submissions received on this subject and is of the preliminary view that industry stakeholders would, on balance, prefer for the 3.6 GHz band to be released in a separate award process to the multi-band award process considered in Document 14/101.

Option 2 (3.6 GHz band only) versus Option 3 (3.6 GHz band and 2.3 and/or 2.6 GHz bands)

3.42 For the purposes of this consultation, ComReg is not considering the possibility of releasing the 2.3 GHz and/or the 2.6 GHz bands in a standalone award process. Unlike for the 3.6 GHz band, such possibility was not generally raised by respondents to Document 14/101. Instead, ComReg currently intends to release these bands either as part of a multi-band award process involving the 3.6 GHz band, or a multi-band award process involving the 700 MHz band (depending on the preferred option identified). The appropriate point of reference for the assessment here is therefore whether these bands would be better released with the 3.6 GHz band on the one hand, or the 700 MHz band (and the 1.4 GHz band) on the other.

3.43 It is unclear whether industry stakeholders would, on balance, prefer the inclusion of one or both of these bands in an award of the 3.6 GHz band. However as can be seen from the responses described in Chapter 2, there was general acknowledgment by stakeholders of the differences between the 3.6 GHz band on the one hand and the other bands considered for inclusion in the multi-band award process on the other, including the 2.3 GHz and 2.6 GHz bands. Indeed, a number of respondents highlighted the benefit to including the 2.3 GHz and 2.6 GHz bands in any award of the 700 MHz band.

3.44 In light of the above, it would appear that, on balance, stakeholders would prefer Option 2 over Option 3. However, as this specific question was not asked in Document 14/101, the above preliminary view should be read in that light, and responses to this consultation will further inform ComReg's assessment of these options.

Impact on Competition

3.45 Where the demand for spectrum in different bands is interdependent, this may give rise to strong economic efficiency reasons for combining bands into an integrated award process to reduce the risk for interested parties and to provide maximum opportunity for different types of interested parties (with potentially different intended uses and technologies) including potential new entrants.

3.46 Encouraging the efficient use and ensuring the effective management of available spectrum should, in turn, promote competition on the relevant downstream markets.

Option 1 (Multi-band award) versus Option 2 (3.6 GHz band only)

3.47 Including substitutable and/or complementary spectrum in the same award (i.e. a multi-band award) can be efficient and lead to greater competition in the award process and more efficient entry. On the other hand having a separate award process for the 3.6 GHz band poses potential risks around creating artificial scarcity in that award process and/or in a subsequent multi-band award. This also poses risks around creating common value uncertainty for parties interested in spectrum across both award processes.

3.48 The extent of these potential risks is linked to the difficulties which interested parties may have in bidding in consecutive award processes. However, given the large amounts of spectrum available in both the 3.6 GHz band and the other bands considered in this paper, and the broad support expressed by interested parties for a separate award of the 3.6 GHz band given its different

characteristics (as detailed earlier in this chapter), the potential risks described above would appear to be minimal.

3.49 In addition, as noted previously, releasing the 3.6 GHz band in a multi-band award including the 700 MHz band could delay the award of new rights of use in this band beyond the FWALA licence expiry date of 31 July 2017. This could result in the 3.6 GHz band being left fallow for a period of time, although it might be possible for the existing licensees to use this spectrum under transition arrangements (see for example the transition proposals as outlined in Chapter 7 and it could delay the provision of more advanced WBB services in this band.[30] As there is demand to use this spectrum for the provision of more advanced WBB services, leaving it fallow for a period of time without good reason would, ostensibly at least, not be an efficient use of that spectrum and would not therefore promote competition in the WBB sector. Failure to provide clarity and certainty around the availability of this spectrum as early as possible is important so as to avoid any potential negative effects on competition.

3.50 On the contrary, making this spectrum available sooner rather than later could promote new entry, investment and competition in the WBB sector.

3.51 In light of the above, ComReg is of the preliminary view that, on balance; Option 2 is preferred to Option 1 in terms of the impact on competition.

Option 2 (3.6 GHz band only) versus Option 3 (3.6 GHz band and 2.3 and/or 2.6 GHz bands)

3.52 It is important to note that there are, on the face of it, a number of reasons to consider releasing one or both of the 2.3 and 2.6 GHz bands with the 3.6 GHz band. For example, like the 3.6 GHz band, both of these bands:

- are higher frequency bands (what might be viewed as ‘performance’ or ‘capacity’ bands, depending on the operator);
- are available for release within a short time period[31]; and
- are harmonised or are in the process of being harmonised, for ECS services including WBB at EU level[32].

[30] In the response to Document 14/101 some FWA operators indicated an intention to roll-out LTE services in this band but ComReg notes that if operators were reliant on short term transitional licences they would have difficulty justifying significant capital expenditure.

[31] While UPC Ireland currently provides television services to a number of customers using MMDS licences in this band, all existing MMDS licences in this band will expire on 18 April 2016 (see ComReg Document 13/31). As discussed in Document 14/101, the 2.3 GHz band is largely a ‘greenfield’ band and thus available for release.

3.53 In addition, both of these bands have equipment and technology roadmaps which suggest suitability for the deployment of fixed and mobile broadband services in the foreseeable future. Indeed, as discussed earlier, the LTE device ecosystem for the 2.3 GHz and 2.6 GHz bands is considerably more extensive than the LTE device ecosystem for the 3.6 GHz band.

3.54 The above factors suggest some substitutability between these bands which enables the consideration of the 2.3 GHz and 2.6 GHz bands in an award process with the 3.6 GHz band. As discussed in Document 14/101, there are general benefits to including substitutable (and complementary) spectrum in the same award process. For example, this increases the ability of award participants to express a full suite of preferences, thereby enhancing the efficiency of the award outcome which, in turn, has a positive impact on competition. This benefit is particularly pronounced given the exponential growth in consumer demand for wireless data services and the consequent increased demand for wireless broadband spectrum.

3.55 However, there are also a number of potential drawbacks of Option 3 over Option 2, as this would preclude the inclusion of the 2.3 GHz and 2.6 GHz spectrum bands in a potential future award process where the 700 MHz band could be the focal spectrum band. The benefits of including large amounts of complementary 'capacity' type spectrum in a future award of the 700 MHz band were described in Document 14/101. In particular, this would increase the potential for efficient new entry. In respect of MNO demand, optimal network configuration also often involves a mix of both coverage and capacity bands and operators should be enabled, where possible, to obtain spectrum which allows them to configure an optimal network. This would support the inclusion of 'capacity' type bands in an award of sub-1 GHz spectrum where possible.

3.56 Existing MNOs already have significant spectrum holdings of sub and above 1 GHz spectrum. However, this would not be the case for a potential new MNO entrant. Thus, there may be merits in including a suitable mix of sub-1 GHz and capacity based spectrum in an award process where possible, in order to facilitate new entry.

3.57 As also noted in Document 14/101, the limited coverage range of cells operating at higher frequencies such as the 2.6 and 3.6 GHz bands makes these bands more suitable for deployment in high demand areas such as shopping centres, railway stations and airports, where large numbers of users

[32] EC Decision 2008/477/EC harmonised the 2.6 GHz band. An ECC Decision on the 2.3 GHz band (ECC/DEC/(14)02) in 2014 and harmonisation discussions on a potential EC Decision on the 2.3 GHz band are currently ongoing in the EC Radio Spectrum Committee.

congregate and require access to a localised capacity site. In fact, the large bandwidth available at these higher frequency bands makes them especially suitable for this purpose.

3.58 Furthermore, there is already a significant amount of spectrum (350 MHz) available for release in the 3.6 GHz band, and the benefits of adding large amounts of other spectrum to a 3.6 GHz award appear doubtful.

3.59 In addition, the 3.6 GHz band is a 'brownfield' band in terms of WBB and is likely to have multiple interests that would differentiate this band from other bands on that basis. This would arguably reduce the substitutability between the 3.6 GHz band and the 2.3 and 2.6 GHz bands in any combined award, particularly where many existing 3.6 GHz licensees may only be interested in acquiring 3.6 GHz spectrum given their existing network configuration.

3.60 Indeed, although the question was not specifically asked in Document 14/101, the industry submissions to same (summarised above) did not suggest that there was, on balance, much demand for the inclusion of the 2.3 GHz and 2.6 GHz in a combined award with the 3.6 GHz band. This might indicate that there may be weak substitutability between the 3.6 GHz band on the one hand and the 2.3 GHz / 2.6 GHz bands on the other.

3.61 Furthermore, removing one of the 2.3 or 2.6 GHz bands from a subsequent multi-band award, could lead to risks of common value uncertainty and artificial scarcity in respect of 2.3 or 2.6 GHz spectrum, particularly if there were to be strong demand from MNOs across both awards.

3.62 It would therefore appear that the benefits to competition of releasing the 2.3 GHz and 2.6 GHz bands in a potential future award of the (complementary) 700 MHz band would outweigh the benefits of an earlier combined award with the 3.6 GHz band.

3.63 In light of the above, ComReg is of the preliminary view that, on balance, Option 2 is preferred to Option 3 in terms of the impact on competition.

Impact on Consumers

3.64 As noted previously, for the purposes of this RIA, consumers include both business and residential end users of services provided over spectrum.

3.65 It can be assumed that what is good for competition, and what promotes investment in infrastructure, is, in general, good for consumers. This is because increased competition between wireless service providers brings benefits to their customers in terms of price, choice and quality of services. Consumer demand for wireless data services has grown significantly in recent

years and is expected to grow exponentially, in data volume terms, over the coming years. This has and will increase the demand for spectrum suitable for WBB services. The spectrum bands under consideration in this RIA are all suitable for the provision of wireless broadband.

Option 1 (Multi-band award) versus Option 2 (3.6 GHz band only)

3.66 To the extent that holding a separate award for the 3.6 GHz band provides greater certainty around the future use of the band to existing end-users in that band, ComReg considers that they are likely to prefer Option 2 over Option 1.

3.67 To the extent that holding a separate award process for the 3.6 GHz band can be expected to provide earlier certainty on the 3.6 GHz spectrum rights of use post licence expiry, ComReg considers that consumers in general are likely to prefer Option 2 over Option 1.

3.68 Furthermore, ComReg is of the preliminary view that Option 2 is, on balance, preferable over Option 1 in terms of its impact on competition. sIn turn, it can be expected that the benefits of competition will be experienced by consumers in terms of price, choice and quality.

3.69 Accordingly, ComReg is of the preliminary view that Option 2 is preferred to Option 1 in terms of the impact on consumers.

Option 2 (3.6 GHz band only) versus Option 3 (3.6 GHz band and 2.3 and/or 2.6 GHz bands)

3.70 ComReg has not identified any obvious efficiency gain from the inclusion of the 2.3 GHz and/or 2.6 GHz band in a separate award with the 3.6 GHz band. Indeed, ComReg has identified drawbacks in relation to the exclusion of one or both of these bands from any future award which included the 700 MHz band.

3.71 As noted above, ComReg is of the preliminary view that Option 2 is, on balance, preferable over Option 3 in terms of its impact on competition. In turn, it can be expected that the benefits of competition will be experienced by consumers in terms of price, choice and quality.

3.72 In that light and to the extent that the inclusion of these bands is capable of undermining competition and effective entry arising from a subsequent 700 MHz band award process, consumers of mobile services are unlikely to have a preference for the inclusion of one or other of these bands in an award process with the 700 MHz band.

3.73 Accordingly, ComReg is of the preliminary view that Option 2 is preferred to Option 3 in terms of the impact on consumers.

The Spectrum for Award' RIA: Assessment and the Preferred Option (Step 5)

3.74 In light of the above, ComReg is of the preliminary view that, on balance, Option 2 (i.e. the release of the 3.6 GHz band alone in a separate award process) is the preferred option in terms of its impact on stakeholders, competition and consumers.

3.2.2 The 'Assignment Process' RIA

3.75 As described at the beginning of this chapter, Step 1 of the draft RIA (Policy Issues and Objectives) is common to both the draft 'Spectrum for Award' RIA and the draft 'Assignment Process' RIA. Therefore, it will not be repeated in this section the draft 'Assignment Process' RIA.

3.76 Before setting out the specific options under review it is useful to provide a general overview of the two main ways spectrum can be assigned. These are:

a) **Auction** whereby, subject to objective and transparent constraints set *ex ante* by the regulator, a market mechanism determines the winners of spectrum rights and how much is assigned to same; or

b) **Administrative assignment**, whereby the regulator determines who obtains spectrum rights, how much spectrum they obtain and what price is paid.

3.77 An administrative assignment can take many forms depending on the specific issues that it is intended to address. It could, for example, involve the administrative grant of spectrum to certain operators (such as incumbents), the reservation of spectrum for particular groups (such as new entrants) or the reservation of spectrum for other purposes. A comparative award (or "beauty contest") may be useful if there is a particular objective in mind. However in assigning the rights of use to certain spectrum and in the targeting of a particular objective, the fees may not be appropriately set.

3.78 An administrative process could also take the form of an extension or renewal of an existing licence or an administrative assignment of spectrum to particular operators, for a particular period of time. The administrative process could also be used for all or part of the spectrum being awarded or relate to particular locations within the band.

3.79 Administrative approaches are likely to be most beneficial where there is little or no competition for a large amount of spectrum or, even where demand does exist, the value of that spectrum is not likely to be large due to the probable end use of the spectrum, and the opportunity cost associated with its use can therefore be accurately calculated and assessed.

3.80 Administrative awards, however, rely on the regulator making decisions on the efficient use of spectrum where such decisions could be made with significant information asymmetries. This approach raises concerns that regulators may pick the incorrect technologies[33], or that market conditions may change too quickly for regulators to respond by re-planning available spectrum. By awarding spectrum to certain types of users it may be seen to be favouring one use over another and reduces the amounts of spectrum available to other bidders. Finally, even where there is sufficient transparency over the end use there is a risk that the regulator will award the spectrum to less efficient users reducing the social value from the spectrum.

3.81 Spectrum auctions are designed to incentivise bidders to express their willingness to pay for spectrum, and aims to assign the available spectrum to the bidders who value it the most. An appropriately designed auction extracts information regarding bidders' willingness to pay for the spectrum rights thereby enabling an assignment to the bidders who value the spectrum most.

3.82 By ensuring that those bidders who value the spectrum the most obtain the rights to the spectrum, auctions should result in an efficient outcome in terms of assignment. In particular, spectrum auctions result in the most efficient assignment of spectrum where robust auction design and rules limits the extent to which a bidder's private value may differ to the social value that can be obtained from the use of spectrum. This in turn tends to promote competition in the downstream retail market, to the benefit of consumers. Using an auction to assign spectrum removes much of the risk of the regulator making incorrect decisions, as a result of not having access to all relevant information, which could have long standing negative effects on the relevant market/s. Auctions avoid the need for making administrative decisions when faced with imperfect information, including where there is uncertainty regarding the ideal use of spectrum.

3.83 Auction formats however are silent on the type of services that should be provided by the winning bidders. Where spectrum for award that is currently being used to provide certain existing services is assigned to an operator who

[33] Article 9 of the EC Framework Directive has been amended to promote technology neutrality.

utilises the spectrum to provide unrelated services, there is a danger consumers reliant on existing services will be left unserved. Where this occurs additional measures to protect consumers are necessary.

3.84 3IHL in its response to Document 14/101 was of the view that an auction is not automatically the best assignment method in all cases. ComReg is of the view that ultimately the choice of assignment process warrants an assessment on a case-by-case basis having regard to the specifics of each band available for release and the market circumstances in which the proposed release is occurring.

Identifying the regulatory options

3.85 Given that multiple complementary and or non-competing services (e.g. fixed broadband, mobile broadband, backhaul capacity for mobile networks, etc.) may be used in this band, ComReg is of the view that there is sufficient uncertainty around the future use of the band that the adoption of a comparative award could result in the incorrect assignment of spectrum to services not valued by bidders and/or that differ from the likely requirements of end-consumers. ComReg considers such an approach to be inappropriate here and this RIA will not, therefore, consider a comparative award type assignment within Option 2.

3.86 Furthermore, this RIA does not consider the extension of existing 3.6 GHz licences as a valid regulatory option for a number of reasons including[34]:

1. In April 2010 ComReg published an Information Notice[35] announcing that the current FWALA licensing scheme in the 3.6 GHz band would be terminated by 31 July 2017, allowing all existing 3.6 GHz licences to run for their full 7 year duration. In that Information Notice, ComReg noted that in order to maximise the efficient use of the 3.6 GHz band, and particularly in light of the 2008 3.6 GHz EC Decision, which Ireland must implement, ComReg must ultimately replace the current 3.6 GHz FWALA licensing scheme.
2. The 3.6 GHz EC Decision amended the 2008 3.6 GHz EC Decision. This obliges Member States to apply new technical conditions for new liberalised 3.6 GHz spectrum rights of use.

[34] ComReg Notes that two respondents queried whether the existing licences in the 3.6 GHz band might be renewed or extended beyond 31 July 2017.

[35] ComReg 10/29 – Fixed Wireless Access Local Area Licensing: End date of the FWALA licensing scheme in the 3.6 GHz band – 8 April 2010.

These new technical conditions are designed to accommodate developments in wireless broadband access technology, in particular large channel bandwidths, while ensuring efficient spectrum use, and to ensure the availability of equipment and coherent coordination between networks of different operators. ComReg is of the view that the current FWALA licensing scheme is unsuitable in light of the 3.6 GHz EC Decision, as the existing 3.6 GHz FWALA band plan does not comply with the harmonised band plan channelling arrangements as set out in 3.6 GHz EC Decision. In particular:

i. the FWALA FDD mode of operation in the 3.6-3.8 GHz sub-band does not comply with the liberalised mode of operation which shall be TDD; and

ii. A number of the channels in the current FWALA band plan are not a block size of 5 MHz or a multiple of 5 MHz as required by 3.6 GHz EC decision.

3. Finally even it were possible to amend the technical conditions of the FWALA licensing scheme such that it would comply with 3.6 GHz EC Decision, ComReg is of the view that the local area nature of the FWALA licensing scheme is unsuitable for liberalised 3.6 GHz rights of use, as:

   i. it would likely impede the development of new liberalised services in the 3.6 GHz band, such as mobile broadband. In this regard, ComReg notes that currently there are no mobile services provided in the 3.6 GHz band despite the introduction of the Geographic Service Areas (GSAs) in 2007[36] and the BWALA licensing scheme in 2013[37];

   ii. it could lead to reduced spectrum efficiency given the current requirement to have a 10 km guard band zone around each local area licence. For adjacent networks on the same channel there is at least 20 km between channels where spectrum cannot be used to provide a service to customers. Therefore the extension of the current licensing system could

[36] The was introduced in revision 2 of the FWALA guidelines (Document 06/17r2) http://www.comreg.ie/_fileupload/publications/ComReg0617r2.pdf

[37] The Wireless Telegraphy (Broadband Wireless Access Local Area licence) Regulations, 2013 (S.I. 214 of 2013) established the BWALA licensing scheme in 2013.

result in customer black spots and the inefficient use of the radio spectrum; and

iii. the weight of FWALA responses to Document 14/101 did not support the continuation of a local area licensing approach for the 3.6 GHz band.

3.87 ComReg therefore considers that the two regulatory options available to it are:

- **Option 1**: Assignment of all available spectrum in the 3.6 GHz band using a competitive, open, transparent auction format; or
- **Option 2:** Assignment of some or all available spectrum in the 3.6 GHz band by administrative assignment.

Determining the impact on stakeholders

3.88 There are three broad stakeholder groups the impacts upon which are considered in the draft 'Assignment Process' RIA, being:

- Current incumbents in the 3.6 GHz band who are currently providing FWALA services;
- Mobile network operators (MNOs); and
- New FWALA entrants[38]

3.89 Consumers include;

- Current consumers of FWALA services; and
- Consumers generally who depend on any service provided through the utilisation of spectrum.

Impact on stakeholders

3.90 Should an administrative assignment process be designed for the incumbents it is likely that each of the existing incumbents in the band would prefer Option 2 because it is likely that they would have a greater opportunity of retaining spectrum under such an award process.

3.91 FWALA operators who responded to Document 14/101 and also responded to Document 14/126, appear to be of the view that ComReg should reserve spectrum for an incumbent or incumbents above other potential users of the spectrum. Specifically, Imagine expressed the view that ComReg should

[38] ComReg does not consider that new MNO entry is feasible given the spectrum mix available in this particular award process. Therefore a new entrant for the purpose of this RIA refers to a new FWALA entrant in the 3.6 GHz band.

assign to it 240 MHz on a national basis. Ripplecom asserted that a significant proportion of the 3.6 GHz band should be reserved generally for rurally focused Wireless Internet Service Providers ('WISPs') to deliver NGA speeds. Finally, the Joint FWA Operators[39] similarly asserts that spectrum in this band should be reserved for the provision of broadband services in small towns and rural areas.

3.92 Therefore, it is likely that existing FWALA providers would prefer Option 2 and the reservation of spectrum for incumbents on a national and or regional basis. This would ensure that these operators would have the option of remaining in the band for the period of the duration of the licence. It might also allow some incumbents the option of being assigned more spectrum than currently assigned to them under the current FWALA licensing system. That said, an existing licensee may not prefer Option 2 over Option 1 if the terms of any administrative assignment (e.g the amount of spectrum rights proposed to be assigned to an individual operator) was considered by it to be insufficient for its existing/future needs.

3.93 MNOs and new entrants would likely prefer Option 1 over Option 2 because the administrative award of spectrum to incumbents would reduce the amount of spectrum available and would cause the price of any residual spectrum to increase for other award participants. Under Option 2, MNOs and new entrants could be forced to pay a higher price or refrain from accessing the spectrum altogether. This contrasts with what would occur if all spectrum was made available for all bidders on a fully competitive basis and sold at the market clearing rate.

3.94 MNOs and new entrants would also likely prefer Option 1 over any reservation of spectrum for incumbents, as an open, transparent competitive award format for all available spectrum gives each participant an equal opportunity to access spectrum where the value they place on that spectrum for a particular use exceeds all other valuations.

3.95 While new entrants would prefer Option 1 over the administrative award of spectrum to incumbents, it is likely that it would prefer a variant of Option 2 over Option 1 whereby a reservation of spectrum is made solely for new entrants.

3.96 Vodafone is of the view that a well-designed auction should provide a transparent process in which winners are incentivised to build and operate services in order to earn a return on investment. Similarly, Eircom has no objection to a competitive award process as these tend to give greater

[39] Fastcom, Lightnet, Permanet, Ripplecom and Westnet.

certainty compared to administrative assignment processes. 3IHL does not accept that an auction is automatically the best assignment method in all cases and even where it is appropriate it can only deliver the correct outcome where specific auction mechanisms, rules and conditions are appropriate.

3.97 Given Option 1, as described in Chapter 5, envisages such a design, it is likely MNOs would prefer Option 1 over Option 2. ComReg recognises that MNOs may not agree that the design of the auction as set out in Chapter 5 is correct in their view, in which case they may be indifferent among the options set out or have an alternative preference.

Impact on competition

3.98 The impact on competition is assessed at two levels which are interconnected:

- Competition during the award process. This occurs where bidders compete with each other for blocks of spectrum and the value attached to each block of spectrum is reflected in the relative price paid; and
- Downstream retail competition between winning bidders and other market participants. The promotion of competition at this level is a primary goal of this proposed Award Process because competition at retail level is ultimately what drives consumer benefits.

1. Competition within the award process

3.99 Any form of administrative assignment imposes a restriction on the range of possible outcomes. The more extensive the restriction, in terms of the possible assignment outcomes which it precludes, the more likely it is that the actual optimal assignment is precluded from arising. The probability of users being assigned spectrum below their opportunity costs are higher in an administrative award.

3.100 Efficient assignment is best obtained if those that are assigned spectrum pay at least the opportunity cost of that spectrum. This is because a winning bidder needs to pay at least the amount that the highest value alternative user of the spectrum would be prepared to pay. If spectrum is assigned at below the opportunity cost, there exists some other bidders who would have been prepared to pay more, leading to an inefficient assignment because the winning bidder is paying less than the true market value of the spectrum. If a user of spectrum pays less than the opportunity cost under Option 2, other potential users who do not have access to the spectrum will be disadvantaged because the spectrum is not assigned at the highest value amongst alternative uses as those alternative uses are artificially excluded.

3.101 In the case of a direct administrative assignment of spectrum of the type likely to be favoured by incumbents, the regulator has limited information about the value of the services that each applicant could provide and the bandwidth of frequencies that would need to be assigned to the applicant. It is therefore difficult for ComReg to make an accurate assessment of the alternative assignment options, and there is a risk that spectrum would be assigned inefficiently, both in terms of selection of applicants who are awarded spectrum and in terms of the amount of spectrum awarded to each successful applicant.

3.102 Similarly, a reservation of spectrum for new entrants could result in inefficient entry by a new entrant if the new entrant was to win the reserved spectrum only because demand for it had been artificially restricted and there would otherwise have been another bidder (i.e. an incumbent) which valued the spectrum more. This is specifically true for this award where a number of incumbents exist across different regions. The reservation of spectrum in this award would need to decide on which region/s spectrum should be reserved and could unnecessarily disadvantage incumbents by reducing the amount of spectrum available.

3.103 Furthermore, even where an administrative award of spectrum does not satisfy a reserved bidder's demand entirely, the reserved bidder would hold a considerable spectrum advantage over alternative bidders who wished to compete on the same basis for residual spectrum available after a portion had been assigned administratively. Essentially, where a new entrant and an incumbent both wished to be assigned the same amount of spectrum, the total price per MHz of spectrum would likely be less for an incumbent (where the reservation was for the incumbent) because a portion of its demand was satisfied through an administrative award rather than through an open competition[40].

3.104 In contrast, competition for spectrum in an auction format reveals information about the most valuable uses. This information is not available to the regulator where it assigns spectrum administratively. Where the spectrum is offered in an open auction, blocks can be combined allowing bidders to express the value they place on different amounts of spectrum. Spectrum auctions are designed to incentivise bidders to express their willingness to pay for spectrum, and therefore aim to assign rights of use to the bidders who value them most.

3.105 By assigning spectrum using an appropriately designed auction, prices are determined within the award process. Final prices are at a level at which

[40] The same is true where the reservation is made for a new entrant.

winners are willing to be assigned the spectrum while losers are not willing to be assigned this spectrum. In this way, and taking account of the auction design and specific auction rules attached, the award spectrum is assigned efficiently limiting distortions to competition.

3.106 Therefore, and for all the reasons stated above, Option 1 would, in ComReg's preliminary view, better promote competition within the award process.

2. Competition at retail level

3.107 The previous section discussed the regulatory options in terms of their impact on competition within the auction. Now the impacts on downstream retail competition are considered.

3.108 If an award process fails to deliver an efficient outcome, this would likely result in a negative impact on downstream competition. As noted above, Option 1 would more likely produce an efficient outcome as assigning spectrum through a competitive process results in the assignment of spectrum to those who value it the most. This is further strengthened where additional measures are included as part of the award format (for example, appropriate competition-based spectrum caps) and/or licence conditions to protect consumers and downstream competition. Therefore, Option 1 should, in ComReg's preliminary view, deliver the best outcome in terms of competition in the market.

3.109 The administrative assignment of 3.6 GHz spectrum to a particular operator or group of operators (incumbents or new entrants) would reduce the amounts of spectrum available to other bidders who may have the potential to provide more efficient and a differentiated range of services.

3.110 Therefore, there is a risk that applicants seeking to provide high value services to consumers may be awarded less spectrum than would be efficient, or none at all, while inefficient operators are awarded spectrum. An assignment of spectrum to inefficient operators made by the regulator resulting from asymmetric information could lead to a bifurcated market whereby competition between efficient operators is less than would have been the case had the assignment of spectrum been more efficient. The reduced levels of competition would likely result in lower quality services being offered by inefficient operators and higher prices from efficient operators offering improved services, than would have been the case in an open transparent auction.

3.111 In addition, and as noted above, the *ex-ante* direct assignment of spectrum to certain bidders reduces the amount of 3.6 GHz spectrum available for other bidders to bid on and could act as a barrier to entry if other bidders perceived the Irish market to favour pre-determined bidders. Reduced competition in the

auction would in turn lead to reduced competitive pressures in the retail market.

3.112 While attracting new entrants is clearly desirable in terms of promoting new entry at the retail level, inefficient entry through the reservation of spectrum solely for new entrants could result in the entry of a weak new entrant compared to the alternative of a more efficient incumbent had that incumbent been able to access more spectrum (i.e. the spectrum set aside for new entrants).

3.113 Option 1, however, would ensure that all bidders compete on an equal basis for all available spectrum and not on the basis of potentially inefficient means to incentivise entry. Option 1 would also produce the more efficient outcome by assigning the spectrum to operators which attach the highest value to same, which will generally be those operators that can generate the greatest benefits to society from the use of that spectrum.

3.114 Awarding spectrum using an auction, however, raises the possibility that bidders will try to maximise their profit in the downstream market by restricting the numbers of winning bidders and therefore the number of operators willing to provide retail services. This has an effect on the level of competition in the downstream market as there would be less choice available to consumers. Bidders will take account of the profitability of restricting competition at the retail level when determining how much to bid thereby reflecting their private value, not the social value they might generate.

3.115 ComReg, however, proposes to set in place a robust set of measures to ensure that downstream retail competition would not be distorted. Measures such as competition-based spectrum caps, as described in Chapter 5, have proven to be sufficient to address such potential concerns. This would appear to be the best means by which to ensure spectrum is efficiently used and in turn safeguard/promote downstream retail competition.

Impact on Consumers

3.116 Consumers should prefer the option which has the greatest potential to promote competition and increase consumer welfare thereby maximising the long term benefits to consumers in terms of choice, price, and quality in the provision of enhanced services. Consumers are also likely to prefer options which avoid significant disruption to services that they currently use.

3.117 As noted above, Option 1 should have a more positive impact on downstream retail competition than Option 2. Therefore by extension Option 1 would be better for consumers than Option 2. Competitive auctions, such as Option 1,

by ensuring that spectrum is awarded to those operators who value it most are a better means by which to ensure that consumer welfare is maximised where spectrum rights are sold.

3.118 There could be a significant impact on consumers from an administrative award process as it would create the risk that spectrum would be awarded to an inefficient operator as described above. Even small losses to consumer welfare as a result of an administrative assignment could result in a substantial aggregate loss over the period of the licence.

3.119 Administratively assigning spectrum to certain stakeholders automatically denies this spectrum to other potential providers of services and potentially more efficient providers of services. Consumers would suffer if the administrative assignment of spectrum resulted in deterring entry into the market or restricting incumbents from providing services in the future.

3.120 A delay to the introduction of advanced data services by awarding spectrum to inefficient users through an administrative assignment is a restriction on the current competitive process. This might benefit incumbent operators independently or as a group, in the short term, as the costs of network upgrades could be delayed. However this would not maximise consumer welfare. Additionally, administratively assigning too much spectrum to FWALA operators could cause harm to consumers who might benefit from the use of the 3.6 GHz band for the provision of other services such as mobile services and the introduction of new technologies which utilise spectrum more efficiently thereby delivering higher throughput.

3.121 In respect of potential disruption to current FWALA services, certain consumers might prefer Option 2 because it could better ensure that those consumers would not face any disruption to services by removing the risk that an incumbent would not win sufficient spectrum in an open auction. At the same time, ComReg observes that the potential for service continuity issues to arise can also be addressed by non-award measures, such as the proposed transition arrangements and rules outlined in Chapter 7. However, in light of the above benefits to consumers from an open auction, consumers would likely prefer Option 1 if concerns about disruption to existing services could be sufficiently mitigated against.

3.122 As described in Chapter 5, the proposed auction design is such that there would not be an unmanageable risk to business continuity, and therefore disruption to existing services, absent a decision by an existing FWALA operator to not pay a higher spectrum fee than another bidder to secure the spectrum. Additionally, as set out in Chapter 7, ComReg is proposing transitional arrangements and rules with which to, amongst other things,

mitigate against the potential for adverse effects on existing consumer services where a current FWALA operator does not win sufficient spectrum rights in the proposed award.

3.123 Finally, while consumers are likely to be generally in favour of new entry, this is only the case where:

- it results in the optimal number of operators providing services in all markets where demand exists; and
- any new entrants replace less efficient incumbents in providing services in all markets where demand exists.

3.124 The FWALA market currently consists of a large number of small operators who provide set services in a diverse range of local, regional and national geographic regions.

3.125 For the reasons stated above, any reservation for new entrants would disadvantage other bidders including incumbents. If ComReg was to reserve spectrum for new entrants, given the information asymmetry previously discussed, and the varied market structure, it could not be guaranteed that any new entrants would be at least as efficient as the incumbent operators they could replace or that any new entrant would serve regions previously served by incumbents. This would be particularly damaging to consumers if the reservation of spectrum for new entrants caused more efficient incumbents, who provide service currently where demand exists, to exit due to an artificially high price of spectrum or lack of suitable spectrum. Additionally, and as previously noted, administratively assigning spectrum to FWALA operators could cause harm to consumers who would benefit from the use of the 3.6 GHz band in the provision of mobile services.

3.126 Therefore, in ComReg's preliminary view, consumers are likely to prefer Option 1 over any of the alternatives available under Option 2.

Preferred Option

3.127 The above assessment has considered the impact of the various options from the perspective of industry stakeholders, as well as the impact on competition and consumers.

3.128 In summary, it is likely that incumbent FWALA operators would prefer Option 2 whereby spectrum is reserved for incumbent operators in the band, whilst new entrants would prefer Option 2 whereby a spectrum reservation is for new entrants. However based on the analysis above it is clear that these options would be in the best interests of those particular stakeholders and not in terms

of competition and consumers. Furthermore, it seems likely that all stakeholders would prefer Option 1 over the assignment of spectrum under Option 2 to certain specified stakeholders other than themselves.

3.129 Option 1, in this case, also appears to be the best means to promote competition for spectrum usage rights and, in turn, promote competition in the related downstream retail market. Option 1 would also ensure an efficient auction outcome and therefore ensure that competition in the downstream market is maximised to the benefit of consumers. Such an outcome would not be guaranteed under Option 2.

3.130 Therefore, and for the reasons outlined in this RIA, ComReg is of the preliminary view that offering all of the available spectrum in the 3.6 GHz band, and subjecting the auction format to certain rules and fees that reflect the value of retaining spectrum for potential future use is its preferred option. This approach is more flexible, as it allows for the full band to be utilised if there is strong demand for spectrum in the present award, while at the same time it would ensure that the spectrum is only assigned if its value to potential licensees is sufficiently high relative to the value of retaining spectrum for future assignment. Finally, the potential for service continuity issues to arise can also be addressed by non-award measures, such as the proposed transition arrangements and rules outlined in Chapter 7.

Overall Preferred Option

3.131 In light of the preceding discussion, ComReg is of the preliminary view that the 3.6 GHz band should be assigned by way of auction with no other bands included in the auction.

3.132 In Chapter 5 of this consultation paper[41] ComReg considers a number of different types of competitive award formats suitable for the award of rights of use in the 3.6 GHz band. Of the various auction formats considered, ComReg's reached the preliminary view that a CCA best mitigates against the risks described in that chapter.

3.133 The following section assesses the above Preferred Option against ComReg's other relevant functions, objectives and duties.

[41] Also Chapter 5 of Document 14/101

3.3 Assessment of Preferred Option against ComReg's other relevant functions, objectives and duties

3.134 The draft RIAs considered a number of options potentially available to ComReg within the context of the RIA analytical framework as set out in the ComReg's RIA Guidelines (i.e. impact on industry stakeholders, impact on competition and impact on consumers). It necessarily also involved an analysis of the extent to which various options would serve to facilitate ComReg in achieving certain statutory objectives in the exercise of its functions. In particular, it involved an analysis of the extent to which the various options would serve to promote competition and ensure that there would be no distortion or restriction of competition in the electronic communications sector, whilst at the same time encouraging efficient investment in infrastructure, promoting innovation and ensuring the efficient use and effective management of the radio frequency spectrum. This would enable ComReg to ensure that users would derive maximum benefit in terms of choice, price and quality.

3.135 In this section, ComReg has undertaken an assessment of the Preferred Option with regard to other statutory provisions relevant to the management of Ireland's radio frequency spectrum which are set out in Annex 2 of this document. It is not proposed to exhaustively reproduce those statutory provisions here. However, set out below is a summary of all statutory provisions which ComReg considers to be particularly relevant to the use and management of the radio frequency spectrum with an assessment (to the extent not already dealt with as part of the draft RIA) of whether, and to what extent, the Preferred Option accords with those provisions. In carrying out this assessment, ComReg has highlighted below some of the relative merits / drawbacks which would arise if it was to select some of the alternative options assessed under the draft RIA above.

3.136 For the purposes of this section, the statutory provisions which ComReg considers to be particularly relevant to the management of the radio frequency spectrum in the State are grouped as follows:

- general provisions on competition;
- contributing to the development of the internal market;
- to promote the interest of users within the Community;
- efficient use and effective management of spectrum;
- regulatory principles;

- relevant Policy Directions and Policy Statements; and
- general guiding principles (in terms of spectrum management, setting of fees and licence conditions):
    - Objective justification;
    - Transparency;
    - Non-discrimination; and
    - Proportionality.

3.3.1 General Provisions on Competition

3.137 As noted above, there is a natural overlap between the aims of the draft RIA and an assessment of ComReg's compliance with some of its statutory obligations, and, in particular, one of its core statutory objectives under Section 12 of the 2002 Act of promoting competition by, amongst other things:

- ensuring that users derive maximum benefit in terms of choice, price and quality;
- ensuring that there is no distortion or restriction of competition in the electronic communications sector;
- encouraging efficient use and ensuring effective management of radio frequencies;
- ensuring that elderly users and users with special social needs derive maximum benefit in terms of choice, price and quality; and
- ensuring that, in the transmission of content, there is no distortion or restriction of competition in the electronic communications sector.[42]

3.138 There are also other various statutory provisions requiring ComReg generally to promote and safeguard competition in the electronic communications sector including, amongst other things:

- Regulation 16(2) of the Framework Regulations which requires ComReg to apply objective, transparent, non-discriminatory and proportionate regulatory principles by safeguarding competition to the benefit of consumers and promoting, where appropriate, infrastructure based competition;

[42] The final two statutory obligations were introduced by Regulation 16 of the Framework Regulations.

- Regulation 9(11) of the Authorisation Regulations which requires ComReg to ensure that competition is not distorted by any transfer or accumulation of rights of use for radio frequencies;
- Article 4 of Directive 2002/77/EC (Competition Directive) which requires ComReg to refrain from granting exclusive or special rights of use of radio frequencies for the provision of electronic communications services; and
- the General Policy Direction on Competition (No. 1 of 2 April 2004) which requires ComReg to focus on the promotion of competition as a key objective, including the promotion of new entry.

3.139 Based on the draft RIAs, ComReg's view is that the Preferred Option is the one that would best safeguard and promote competition to the benefit of consumers. In particular, it would maximise competition both within the proposed assignment process as well as in the downstream retail markets by facilitating potentially large variances in demand characteristics between categories of likely bidders (through, amongst other things, regional licensing[43], facilitating efficient new entry and avoiding potentially inefficient administrative assignment of spectrum). In identifying the Preferred Option, ComReg has applied objective, transparent, non-discriminatory and proportionate criteria and principles. In that light, ComReg is of the view that, in identifying the Preferred Option, it has also complied with the obligations contained in the above statutory provisions and the General Policy Direction, on Competition (No. 1 of 2 April 2004).

3.140 As noted in the draft RIAs above, the alternative options of including the 700 MHz band and/or the 2.3 GHz/2.6 GHz bands in the same award process may not achieve the above general objectives concerning competition to the same extent, if at all.

3.141 ComReg also considers that the alternative of using an administrative process to assign spectrum to particular operators would not achieve its general objectives concerning competition to the same extent as the Preferred Option, if at all. In particular, ComReg notes the observations made by DotEcon in Document 15/71 that, where there is excess demand for spectrum, using an administrative assignment process may fail to ensure an efficient outcome.

[43] See subsequent chapters in this regard.

3.3.2 Contributing to the development of the Internal Market

3.142 In achieving the objective of contributing to the development of the Internal Market, another of ComReg's core statutory objectives under Section 12 of the 2002 Act, ComReg considers that the following factors are of particular relevance in the context of this award process:

- the extent to which the Preferred Option would enable ComReg to ensure that harmonisation of the use of radio frequency spectrum across the EU is promoted, consistent with the need to ensure its effective and efficient use and in pursuit of benefits for the consumer such as economies of scale and interoperability of services, having regard to all decisions and measures adopted by the European Commission in accordance with the Radio Spectrum Decision[44] (Regulation 17 of the Framework Regulations);
- the extent to which the Preferred Option would encourage the establishment and development of trans-European networks and the interoperability of pan-European services, in particular by facilitating, or not distorting or restricting, entry to the Irish mobile market by Electronic Communication Services providers based or operating in other Member States; and
- in order to ensure the development of consistent regulatory practice and the consistent application of EU law, the extent to which ComReg has had due regard to the views of the European Commission, BEREC and other Member States in relevant matters, in selecting an option and considering any regulatory action required by ComReg in respect of such an option.

Promoting harmonised use of radio frequency spectrum across the EU

3.143 In relation to the first factor identified above, it is ComReg's view that the Preferred Option will result in a more timely award of spectrum rights of use in the 3.6 GHz band which are suitable for the provision of advanced WBB services. In this regard, the Preferred Option is consistent with and promotes the objectives of the relevant harmonisation decisions of the European Commission which emphasise the suitability of this band for WBB services.

[44] Decision No. 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the EU.

Encouraging the establishment and development of trans-European networks and the interoperability of pan-European Services

3.144 ComReg notes the overlap between this objective and the objective of promoting competition in the provision of electronic communication networks and services. Encouraging the establishment and development of trans-European networks requires that operators from other Member States seeking to develop such networks are given a fair and reasonable opportunity to obtain spectrum rights of use required for such networks and, particularly, access to critical spectrum rights of use. Accordingly, options which would restrict or distort competition or otherwise unfairly discriminate against potential entrants (such as through administrative assignment of rights of use to critical spectrum to incumbent operators) would not, in ComReg's view, satisfy the requirements of this objective.

3.145 In this regard, ComReg refers to the draft RIA and its preliminary finding that the Preferred Option is likely to be preferred by potential new entrants. This is because the Preferred Option would not involve an administrative assignment of valuable spectrum that is more likely to favour incumbents simply by virtue of their incumbency, with the associated disincentives for potential participation by undertakings from other Member States in the proposed award process.

Promoting the development of consistent regulatory practice and the consistent application of EU law

3.146 In relation to this aspect of contributing to the development of the internal market, ComReg continues to cooperate with other National Regulatory Authority's ('NRA's), including closely monitoring developments in other Member States to ensure the development of consistent regulatory practice and consistent implementation of the relevant EC harmonisation measures and relevant aspects of the Common Regulatory Framework.

3.147 For instance, ComReg has had clear regard to international developments in the context of:

- promoting the provision of WBB services;
- considering whether to include the 700 MHz, 1.4 GHz, 2.3 GHz and 2.6 GHz bands in the award process;
- harmonisation developments and equipment availability in relation to the 3.6 GHz and potential candidate bands;
- licence durations for spectrum rights in the 3.6 GHz band; and

- licence fees (and benchmarking in particular).

3.148 Furthermore, ComReg will continue to have regard to international developments during the course of this consultation process.

3.149 In the present case, ComReg considers that the Preferred Option is consistent with the approaches taken by and being considered in other Member States.

3.3.3 Promote the interest of users within the Community

3.150 The impact of the Preferred Option and other options on users from a more general perspective and, in the context of ComReg's objective to promote competition has been considered in the context of the draft RIA and it is not proposed to consider this matter in any further detail here.

3.151 ComReg also observes that the majority of measures set out in Section 12(2)(c)(i) to (vii) of the 2002 Act aimed at achieving this statutory objective are more relevant to consumer protection, rather than to the management of the radio frequency spectrum.

3.3.4 Efficient Use and Effective Management of Spectrum

3.152 Under Section 10 of the 2002 Act, it is one of ComReg's functions to manage the radio frequency spectrum in accordance with a Policy Direction under Section 13 of the 2002 Act. Policy Direction No. 11 of 21 February 2003 requires ComReg to ensure that, in managing spectrum, it takes account of the interests of all users of the radio frequency spectrum (including both commercial and non-commercial users) (see discussion on this policy direction in Section 3.3.6 below). Importantly also, in pursuing its objective to promote competition under section 12(2)(a), ComReg must take all reasonable measures to encourage efficient use and ensure effective management of radio frequencies. Section 12(3) of the 2002 Act also requires that measures taken with regard to encouraging the efficient use and ensuring the effective management of radio frequencies must be proportionate.

3.153 Regulation 9(11) of the Authorisation Regulations also provides that ComReg must ensure that radio frequencies are efficiently and effectively used having regard to Section 12(2)(a) of the 2002 Act and Regulations 16(1) and 17(1) of the Framework Regulations.

3.154 In relation to the Policy Direction No. 11, the draft RIA takes into account the interests of all users of the radio frequency spectrum (and assesses the extent to which such interests are consistent with ComReg's own statutory obligations), both commercial and non-commercial, and ComReg is of the view that the Preferred Option identified as a result of the draft RIA is one that

would safeguard and promote those interests. In that regard, see also the transition measures discussed in Chapter 7.

3.155 Based on the findings of the draft RIA, ComReg is of the view that the Preferred Option would encourage efficient use of spectrum. For example, inclusion of the 3.6 GHz band in an award of the 700 MHz band risks leaving this spectrum fallow, at least in the context of advanced WBB services, for a period of time following existing licence expiry. Also, the exclusion of the 2.3 GHz and 2.6 GHz bands would minimise the otherwise significant aggregation risk for bidders (in particular, MNO bidders) if one of these bands were included.

3.156 In addition, the spectrum assignment process preferred (an auction) should facilitate efficient new entry, and encourage an efficient use of spectrum by those successful in the proposed assignment process. This is because an auction will ensure that, subject to reasonable constraints inherent in the design of an auction e.g. spectrum caps, those who value the spectrum the most will win it and, because of these financial incentives, are the most likely to use the spectrum efficiently.

3.157 In that light, ComReg is of the view that the Preferred Option complies with the obligations contained in the above statutory provisions. ComReg is also of the view that the alternative spectrum and assignment options considered in the draft RIA would fail to satisfy the above provisions to the same extent, if at all.

3.3.5 **Regulatory Principles**

3.158 Under Regulation 16(2) of the Framework Regulations, ComReg must, in pursuit of its objectives under Regulation 16(1) and Section 12 of the 2002 Act, apply objective, transparent, non-discriminatory and proportionate regulatory principles by, amongst other things:[45]

- promoting regulatory predictability by ensuring a consistent regulatory approach over appropriate review periods;
- promoting efficient investment and innovation in new and enhanced infrastructures, including by ensuring that any access obligation takes appropriate account of the risk incurred by the investing undertakings and by permitting various cooperative arrangements between investors and parties seeking access to diversify the risk of investment, whilst

[45] Some of those principles listed in 16(2) are not listed here because they are either dealt with elsewhere in this chapter or were considered by ComReg as not being relevant to this award process.

ensuring that competition in the market and the principle of non-discrimination are preserved; and

- taking due account of the variety of conditions relating to competition and consumers that exist in the various geographic areas within a Member State.

Regulatory Predictability

3.159 ComReg notes that it places importance generally on promoting regulatory predictability and, as illustrated below, has complied with this principle in carrying out the current process.

3.160 In the present context, ComReg considers the following objectives to be of particular importance to achieving the aims of this regulatory principle:

- promoting regulatory predictability in relation to availability of spectrum rights to other users of spectrum by applying an open, transparent, and non-discriminatory approach to spectrum release; and
- promoting regulatory predictability by, to the extent appropriate, taking a consistent approach to the award of spectrum in this award process as that taken in the recent MBSA which ComReg notes was carried out successfully to the satisfaction of all award participants.

3.161 In relation to the first objective, ComReg notes that the Preferred Option ensures that the future assignment of rights of use in the 3.6 GHz band is known as soon as possible. This would give the market the utmost transparency and predictability in terms of the availability of spectrum rights in this band. The alternative of potentially delaying the award of rights of use in this band would not, in ComReg's view, contribute to the promotion of regulatory predictability.

3.162 In relation to the second objective, ComReg considers that the alternative options would not promote regulatory predictability due to the inherent uncertainties attached to administratively determining key parameters such as spectrum assignments and fees, particularly in the context of competing demands from stakeholders, imperfect information and the lengthy duration of the spectrum rights at issue. Rather, relying on a fully market based mechanism (with objective, transparent, non-discriminatory and proportionate rules) to assign rights of use in a large amount of valuable spectrum across a range of bands better promotes regulatory predictability. In that regard, current mobile network operators in Ireland (post MBSA) and further afield are becoming increasingly familiar with competitive auctions processes and the use of such processes should contribute to regulatory predictability.

3.163 In addition, ComReg considers that the Preferred Option - which, amongst other things, facilitates potentially significant variations in demand characteristics through regional licensing and would incorporate appropriate spectrum caps informed by this consultation to facilitate advanced WBB service provision while avoiding extreme outcomes - would better minimise the risk of award participants failing to win their desired spectrum assignments for reasons other than competitive tension within the award.

3.164 In light of the above, ComReg is of the preliminary view that the Preferred Option complies with the regulatory principle of promoting regulatory predictability.

Promoting Efficient Investment and Innovation in New and Enhanced Infrastructures

3.165 ComReg considers that the Preferred Option is consistent with the aims of this regulatory principle because it:

- has the capacity to facilitate a fully competitive release of the 3.6 GHz band at the earliest possible opportunity. Providing clarity around the availability of this band as soon as possible ensures that winners of rights of use are appropriately incentivised to invest in new and enhanced infrastructures, to deploy new technologies and to provide advanced WBB services to end users, while avoiding the potential costs, uncertainties and inefficiencies associated with a delayed release of such rights; and
- would give participants the scope to bid according to their own valuation of the spectrum rights, based on their own business plans and market and financial positions, and thus to invest efficiently.

Conditions of Competition in Various Geographic Areas

3.166 ComReg observes that the application of this regulatory principle is primarily relevant in the context of (a) the nature and extent of coverage conditions which may be attached to new 3.6 GHz rights of use and (b) existing local area FWALA services being provided in the 3.6 GHz band. ComReg has addressed geographic considerations in detail in Chapters 4, 6 and 7 of this document and is of the preliminary view that the proposed release of sub-national rights of use, appropriately designed coverage obligations and proposed transition measures would satisfy this regulatory principle.

3.3.6 Relevant Policy Directions and Policy Statements

3.167 ComReg has taken due account of the Spectrum Policy Statement issued by DCENR in September 2010 and its Consultation on Spectrum Policy Priorities issued in July 2014. ComReg notes that the core policy objectives, principles and priorities set out therein are broadly in line with those set out in the 2002 Act and in the Common Regulatory Framework and, in turn, with those followed by ComReg in identifying the Preferred Option.

3.168 Section 12(4) of the 2002 Act requires ComReg, in carrying out its functions, to have regard to policy statements, published by or on behalf of the Government or a Minister of the Government and notified to it, in relation to the economic and social development of the State. Section 13 of the 2002 Act requires ComReg to comply with any policy direction given to ComReg by the Minister for Communications, Energy and Natural Resources ("the Minister") as he or she considers appropriate to be followed by ComReg in the exercise of its functions.

3.169 ComReg considers below those Policy Directions which are most relevant in this regard (and which have not been considered elsewhere in this chapter).

Policy Direction No.3 of 21 February 2003 on Broadband Electronic Communication Networks

3.170 This Policy Direction provides that:

> *"ComReg shall, in the exercise of its functions, take into account the national objective regarding broadband rollout, viz, the Government wishes to ensure the widespread availability of open-access, affordable, always-on broadband infrastructure and services for businesses and citizens on a balanced regional basis within three years, on the basis of utilisation of a range of existing and emerging technologies and broadband speeds appropriate to specific categories of service and customers."*

3.171 The purpose of this policy direction was to ensure that the regulatory framework for electronic communications plays its part in contributing to the achievement of the Government's objectives regarding the rollout of broadband networks.

3.172 ComReg is cognisant of the fact that the three year objective described in this policy direction has now expired making this direction less relevant currently. In any case, ComReg is of the view that the Preferred Option is aligned with this Government objective, insofar as it is most likely to maximise utilisation of

the available radio frequency spectrum for WBB services. For example, it would promote the introduction of advanced WBB services in the 3.6 GHz band at the earliest possible date and it complements other schemes aimed at ensuring the widespread availability of, affordable, always-on broadband infrastructure and services for businesses and citizens on a balanced regional basis.

3.173 In addition, the proposed auction process should result in greater competitive tension than in the case of an administrative assignment, as it can be expected to positively impact on downstream retail markets in the deployment, or augmented deployment, of enhanced services in terms of bandwidth.

3.174 Furthermore, ComReg considers it unlikely that some form of administrative assignment of spectrum in the place of a competitive award procedure would incentivise the roll out of broadband infrastructure by recipients to the same extent as the Preferred Option, if at all.

Policy Direction No.4 of 21 February 2003 on Industry Sustainability

3.175 This Policy Direction provides that:

> "*ComReg shall ensure that in making regulatory decisions in relation to the electronic communications market, it takes account of the state of the industry and in particular the industry's position in the business cycle and the impact of such decisions on the sustainability of the business of undertakings affected*."

3.176 The purpose of this policy direction is to ensure that any regulatory decisions take due account of the potential impact on the sustainability of industry players, in particular in light of the business cycle at the time such decisions are taken[46].

3.177 ComReg observes that this policy direction concerns the industry as a whole rather than just the position of individual players. ComReg considers that an open auction which facilitates greater participation on a non-discriminatory basis facilitates the sustainability of the industry as a whole.

3.178 This policy direction is clearly relevant in terms of those costs that industry must bear which are, to some extent, within the control of ComReg, for

[46] In the context of this award process, the business cycle for services in the 3.6 GHz band is more than likely entering a new phase where the existing services and technologies are likely to be surpassed by the introduction of advanced services via new technologies (e.g. via LTE) due to the increasing consumer demand for more WBB capacity. Transition measures are proposed in this award process to facilitate the existing licensees in transitioning to these new services and technologies.

example, the nature and extent of any minimum prices in the proposed award process and related issue of the duration of spectrum rights of use. ComReg has and shall have regard to this policy direction when devising proposals in relation to licence duration and minimum prices.

Policy Direction No.11 of 21 February 2003 on the Management of the Radio Frequency Spectrum

3.179 This Policy Direction provides that:

> "*ComReg shall ensure that, in its management of the radio frequency spectrum, it takes account of the interests of all users of the radio frequency spectrum*."

3.180 The purpose of this policy direction is to ensure that ComReg achieves an appropriate balance between the interests of various users of the radio frequency spectrum, in particular, the respective interests of commercial and non-commercial users.

3.181 In preparing the draft RIA, ComReg has considered the Preferred Option in light of the interests of various categories of industry stakeholders and consumers.

3.182 ComReg is of the view that it has complied with this requirement in preparing the draft RIA and that the Preferred Option is the one that best serves the interests of all users of the radio frequency spectrum and strikes an appropriate balance where those interests may conflict.

3.3.7 General guiding principles (in terms of spectrum management, licence conditions and setting of licence fees)

3.183 ComReg notes that it is required to comply with the guiding principles of objectivity, transparency, non-discrimination and proportionality in carrying out its functions under the 2002 Act and the Common Regulatory Framework. In relation to the current process, ComReg considers that these principles are most relevant in terms of its functions concerning spectrum use and management, attaching conditions to rights of use and the setting of licence fees.

3.184 In relation to spectrum management and use, ComReg notes that:

- Regulation 11(2) of the Authorisation Regulations requires that ComReg grants rights of use for radio frequencies on the basis of selection criteria which are objective, transparent, non-discriminatory and proportionate; and

- the regulatory principle set out in Regulation 16(2) of the Framework Regulations requires ComReg in pursuing its objectives to apply objective, transparent, non-discriminatory and proportionate regulatory principles by, amongst other things, ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services.

3.185 ComReg notes that the above guiding principles are Irish and EU law principles that ComReg abides by generally in carrying out its day to day regulatory functions.

3.186 ComReg is of the view, having regard to the applicable legislation and legal principles, its draft RIA and other analyses, its expert advice and report and the material to which it has had regard, that its Preferred Option is objectively justified, transparent, proportionate and non-discriminatory.

Chapter 4

4 Key Aspects of the Proposed Award Spectrum

4.1 In accordance with Regulation 9(2) of the Authorisation Regulations, ComReg proposes to grant individual rights of use for radio frequencies under the proposed award process as this is necessary to, amongst other things:

- avoid harmful interference;
- ensure technical quality of service; and
- safeguard the efficient use of the spectrum proposed for inclusion in the award process.

4.2 This chapter discusses key aspects of the rights of use to be awarded under the proposed award process, in particular:

- the proposed band plan and frequency arrangement for the 3.6 GHz band;
- the regional rights of use to be considered; and
- the duration of the rights of use to be released in this award process.

4.1 3.6 GHz Band plan

4.3 This section sets out the band plan and frequency arrangements that ComReg proposes to use for the 3.6 GHz band. This proposal is based on the harmonised band plan as set out in the 3.6 GHz EC Decision.

4.1.1 Summary of Document 14/101

4.4 In Document 14/101, ComReg stated that the 3.6 GHz EC Decision harmonises the frequency arrangements for the band.

4.5 The 3.6 GHz EC Decision states that the preferred duplex mode for the 3400-3 600 MHz portion of the band is TDD and that the duplex mode 'shall' be TDD for the 3 600-3 800 MHz portion of the band.

4.6 The 3.6 GHz EC Decision also provides for the implementation of an FDD band plan in the 3 400 – 3 600 MHz for specific purposes[47]. However,

[47] Three specific purposes are listed in the EC 3.6 GHz Decision;

ComReg noted in Document 14/101 that none of those purposes appeared particularly applicable to the Irish context and so was minded to make the entire band available[48] on a TDD basis.

4.7 ComReg proposed to adopt the TDD band plan as set out in the 3.6 GHz EC Decision for the proposed award process, and identified 72 TDD blocks of 5 MHz that would be available for release. Guard bands or restricted blocks of at least 5 MHz would be required between assignments of unsynchronised networks.

4.1.2 State services and guard bands in the 3.6 GHz band

4.8 In Document 14/101 ComReg identified that a portion of the band (3 435-3 475 MHz) is in use by state services and these services are likely to continue beyond the anticipated timeframe of the award process.

4.9 In relation to guard bands, ComReg notes that the existing band plan for the FWALA licensing scheme, as detailed in ComReg Document 06/17R7, has a 10 MHz guard band from 3 400-3 410 MHz. This guard band is identified also in the ComReg Radio Frequency Plan for Ireland Document 13/118R as the upper limit for airborne radars. This guard band is likely to be required going forward and it is incorporated into the 3.6 GHz band plan in Figure 2 below. This guard band did not feature in Figure 5 of Document 14/101.

4.10 As such, any reference to the 3.6 GHz band herein should, unless the context requires otherwise, be read as excluding the portion of the band which is in use by State services and the 10 MHz guard band between 3 400-3 410 MHz. Hence, the 3.6 GHz band contains a total of 350 MHz of spectrum available for award.

4.11 Notwithstanding the above, in the interests of ensuring the most efficient use of spectrum, ComReg is engaged in exploratory discussions with the relevant bodies in relation to the State services and the guard band to investigate future requirements of and also the potential for interference between systems[49]. Any

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a) ensuring greater efficiency of spectrum use, such as when sharing with existing rights of use during a co-existence period or implementing market-based spectrum management; or

b) protecting existing uses or avoiding interference; or

c) coordination with non-EU countries.

[48] Excluding some spectrum used for State services, considered below.

[49] Eircom requested that ComReg provide further details of the state services that are supported using this spectrum so that they may better understand whether these uses create a risk of harmful interference. ComReg is engaged with the relevant bodies responsible for these state services and our technical consultants to perform interference studies in this regard. Updates on these matters as appropriate will be communicated through the ComReg consultation process.

updates in relation to these matters will be communicated through ComReg's consultation process.

4.12 ComReg notes the response to Document 14/101 from IRTS contending that the guard band 3 400-3 410 MHz could be used for the amateur service. ComReg notes that, subject to discussions on the future of 3 400-3 410 MHz as indicated above and in the interests of spectrum efficiency, ComReg may consider this matter further.

4.1.3 Views of respondents to Document 14/101

4.13 Considering ComReg's proposals in Document 14/101 and, in particular, that ComReg is minded to identify the whole available spectrum in the 3.6 GHz Band for TDD use, eight respondents (Permanet, Joint FWA Operators Response, Viatel, Huawei, Qualcomm, Ripplecom, Imagine and 3IHL) made comments that are directly or indirectly relevant to this point. ComReg addresses these comments below in relation to the duplex configuration for the band.

4.14 Other responses were received in relation to the block size that should be used in the award. This matter is addressed in Chapter 5, Award design.

Duplex arrangement

4.15 Nine respondents provided either direct or indirect comments in relation to the duplex configuration. In summary:

- Three respondents (3IHL, Vodafone and Huawei) expressed the view that TDD should be the configuration for the band;
- Three respondents (Ripplecom, Imagine and the Joint FWA Operators Response) indicated that future rollout of services would be based on TDD-LTE;
- Viatel stated that the band approach should be harmonised in line with the approach at European level;
- Permanet expressed a specific view that FDD should be facilitated in the award; and
- Qualcomm suggested caution in proposing the band as TDD-only.

Views in favour of TDD

4.16 The response received from 3IHL stated that ComReg's proposal to release the band on a TDD basis only is "acceptable" but did not provide any further detail.

4.17 Vodafone submits that the entire band should be made available on a TDD basis and considers that this would be the most efficient long-term solution even if the band has mixed applications or regional licences.

4.18 Huawei also supported the use of the band for LTE-TDD because:

- it ensures that Ireland can quickly benefit from the existing 3400-3800 MHz TDD ecosystem which supports both fixed and mobile users;
- the 3GPP spectrum bands 42 and 43[50] are set to become important global spectrum bands used on a worldwide basis for the delivery of mobile broadband services based on LTE TDD. In particular they have the potential to become some of the most widely available bands;
- by reference to a report from the Global TD - LTE initiative[51] from 2013, this ecosystem would develop primarily due to the capacity exhaustion in mobile networks. A smaller but more immediate driver, according to the report, will be the desire of Wimax operators to migrate their networks to LTE. The report observes that such migration is desirable for operators who would want to take advantage of the ecosystem that has developed, to access an improved range of devices for their customers and have a wider choice of network access technologies;
- growth assumptions for the number of active TDD-LTE 3.6 GHz network users between 2013 and 2020[52], according to the above referenced report, forecast that by 2020 in an upside case scenario[53], the number of users of LTE TDD 3.6 GHz services for three categories of users would be as follows

[50] Band 42 is a TDD band comprising 3 400 – 3 600 MHz and Band 43 is a TDD Band comprising 3 600 – 3 800 MHz. By contrast band 22 is an FDD band with uplink comprising 3 410 – 3 500 MHz and downlink comprising 3 510 – 3 600 MHz. There is currently no 3GPP band specified for FDD use between 3 600 and 3 800 MHz.

[51] GTI, 2013, The emerging ecosystem for LTE TDD networks at 3.5/3.6GHz: http://lte-tdd.org/upload/accessory/20139/201391311577882263.pdf

[52] See page 6 of Huawei submission as published in document 15/15

[53] Huawei cite the following source of this information. Innovation observatory

(1) Fixed wireless access users[54], (~ 7 million)

(2) 3.6 GHz mobile only users[55] (>20 million), and

(3) Multi mobile users[56] (>160 million);

- there are chipsets available that support 3.6 GHz LTE-TDD from three vendors at the time of writing (November 2014) and that 2 more will have them available in 2014/2015[57]; and
- network equipment availability is improving also. In that regard, Huawei states that it is aware of five network equipment vendors that support 3.6 GHz band LTE TDD based on Macro and Micro cells and notes that pico- and femto-cells are expected from other vendors in a very short timeframe.

4.19 Huawei also notes that consistency in approach in the designation of the band for TDD across EU Member States is very important for the establishment of a pan European market.

Respondents that contend rollout of service would be based on TD LTE

4.20 Imagine made multiple references to its intentions to rollout Time-Division Long-Term Evolution (TD-LTE) services into the future using a substantial portion of the 3.6 GHz band. This would suggest Imagine has a preference to have a TDD band plan for the majority if not all of the available spectrum in the 3.6 GHz band. Imagine states:

- It requires 240 MHz of spectrum nationally for its envisaged TD-LTE network to be able to compete with fibre offerings. It contends that the current LTE-advanced capability, when harnessing 160 MHz of spectrum, can deliver 150 Mbps, offering an alternative as well as being competitive with other NGA technologies.

[54] Users whose home networks (the networks whose services they use, not the home area network) have been configured for broadband fixed wireless services.

[55] Users whose home networks have been configured for mobile services, using TDD-LTE at bands 42 or 43 exclusively

[56] Users whose mobile services are delivered using TDD-LTE at bands 42 or 43, in combination with other mobile modes and spectrum bands. This covers situations where this is enabled in the home network; and also where the home network does not use bands 42 or 43 but the service provider has enabled wholesale carriage on a third party network over bands 42 or 43

[57] The earliest available devices will be for FWA. A limited number of smartphones are available that support 3.6GHz TDD at this time. According to GSA statistics there were 26 devices in the market in mid October 2014.

- It has made substantial investments and is committed to rolling out a new super-fast broadband FWA infrastructure using advanced 4G TD-LTE. It further states that this TD-LTE service has been fully tested and ready to deploy.
- Of particular importance has been the development and take up of TD-LTE designed to maximise the use of spectrum in the most efficient way to deliver higher bandwidth services. Derived from fixed wireless protocols and standards, TD-LTE uses the same channel for downloading and uploading data where the spectrum resources are assigned proportionally to reflect and cater for normal broadband usage where the primary requirement is downloading data.
- It recognises the importance of TD LTE infrastructure in delivering NGA services; Europe has designated these frequencies as preferred TD LTE.
- Imagine's "spectrum position", combined with the advanced capability of TD LTE Advanced deployed for fixed wireless using high channel bandwidths (initially 2x20 MHz), would enable it to deliver high-speed NGA services of a minimum of 30 Mbps and up to 150 Mbps to a large population over a wide area of 13km in diameter.
- It maintains that not only will TD-LTE Advanced Fixed Wireless be required to deliver NGA in areas where FTTX infrastructure will not be deployed at all, there will be a significant requirement for TD LTE Fixed Wireless to extend NGA coverage in 'areas' where actual availability of FTTC is extremely limited, though claimed by fixed network providers.

4.21 The Joint FWA Operators Response states their dependence on equipment suppliers/industry in determining the equipment and technology they ultimately are able to use. They note that the move in the industry will be to LTE in the future. However they observe that existing deployments will need time to transition to future technologies and that these existing technologies should be permitted in the transition period.

4.22 Ripplecom indicates that if sufficient spectrum is made available, for example minimum 20 MHz channels with ability to grow to 40 MHz channels, progressive WISPS can invest in technologies such as LTE TDD to deliver WBB services to rural households and businesses.

Views for allowing FDD operation

4.23 One respondent (Permanet) stated that FDD should be provided for in the band. It noted that the wireless-DOCSIS system developed by it is a spectrally

efficient technology and is comparable to alternative 3.6 GHz technologies when used over similar distances for line of sight connections[58].

4.24 Permanet observes that the main issue, in its view, in ensuring spectral efficiency of FDD vs. TDD systems is the appropriate balance in assignment of downlink vs. uplink spectrum. It suggests, based on the spectrum efficiencies achievable for its system, that an appropriate balance of downlink and uplink spectrum is 2:1. It proposes that the available spectrum could be divided into 10 MHz assignments, with certain 10 MHz uplink blocks being paired with suitable 20 MHz downlink blocks and that this would not preclude bidders from bidding for any particular 10 MHz slot for use by TDD equipment, but would also permit an operator using FDD equipment to bid for a pair of suitably combined slots.

4.25 Qualcomm noted in its response that the harmonised band plan for 3600-3800 MHz in ECC Decision 11(06) is TDD, with the understanding that TDD includes as one specific case SDL. Qualcomm further notes that while CEPT considers that SDL could be a specific case of TDD, the 3GPP considers SDL as a specific case of FDD. As such, Qualcomm contends that presenting the band plan as TDD would restrict the options of potential users further than what was proposed and agreed in CEPT.

4.1.4 ComReg assessment of the duplex mode of operation to be applied for the 3400-3600 MHz sub band

4.26 The following discussion relates to the long term configuration of the spectrum, and does not relate to any transitional arrangements that might be required for existing licensees. ComReg addresses the matter of transitional arrangements in Chapter 7 of this document.

4.27 ComReg currently intends that the 3 600-3 800 MHz sub band would use the TDD duplex configuration in line with the 3.6 GHz EC Decision and observes that the 3.6 GHz EC Decision, as a legally binding instrument on Member States, does not allow any discretion in this regard.

4.28 The 3.6 GHz EC Decision is clear that the preferred duplex configuration for the 3 400-3 600 MHz sub band is TDD although Member States may alternatively implement FDD for a limited number of purposes. As stated in Document 14/101, ComReg considers that such purposes are not particularly

[58] Permanet state that the wireless DOCSIS system uses fixed QAM64 downlink (DL) carriers and QPSK uplink (UL) carriers, and can deliver highly reliable high speed services at distances of over 20km with a DL spectral efficiency of 4.3bphz and UL spectral efficiency of 1.6bphz.

applicable in the Irish context and so is minded to make the entire band available on a TDD basis.

4.29 ComReg has carefully considered the responses received to Document 14/101 along with other information generally available. In arriving at this preliminary view, ComReg has also considered the following additional discussion points.

Importance of harmonisation

4.30 ComReg observes the general support and in some cases strong views that ComReg should adopt the harmonised approach to the designation of the band for the establishment of a pan-European market.

4.31 In particular, ComReg notes that the 3.6 GHz EC Decision and preceding ECC Decision 11(06) recognises the benefits of adopting a TDD approach in the 3 400-3 600 MHz sub band. The 3.6 GHz EC Decision has taken this view while still observing the principle of service and technology neutrality as indicated in *recital (8)* below:

> *"Spectrum users providing wireless broadband services would benefit from uniform technical conditions across the whole frequency range [3 400-3 800 MHz], which would ensure availability of equipment and coherent coordination between networks of different operators. To this end, a preferred channelling arrangement for the 3 400-3 600MHz frequency band should be set out based on the results of CEPT report 49, while observing the principle of technology and service neutrality."*

Strong view for TDD expressed by industry

4.32 In the main, industry has also demonstrated a preference for a deployment of a TDD band plan. In particular, in the development of CEPT report 49 "Technical conditions regarding spectrum harmonisation for terrestrial wireless systems in the 3 400-3 800 MHz frequency band" the ECC received 22 responses at the public consultation phase of the draft report. The results of the public consultation for channelling arrangements in CEPT Report 49 showed a clear preference for the TDD frequency arrangements in the 3 400-3 600 MHz band.

4.33 Out of 21 responses related to channelling arrangements, 20 responses[59] (including 2 from administrations)[60] indicated a preference for TDD while one administration (Denmark) proposed equal footing for TDD and FDD. The preference for the TDD band plan came from organisations within Europe, and respondents from China, Africa, Latin America, Australia and Japan. No respondents expressed a preference for an FDD band plan. Further many of the respondents cited that by identifying the band for TDD would facilitate a global harmonisation of the band. [61]

4.34 In the response from Permanet to Document 14/101 that indicated a preference for FDD, ComReg notes that this response proposes FDD in a configuration that aims to address the asymmetry in traffic by allowing an asymmetric holding of paired spectrum in the band. ComReg notes that this proposal is not in line with the 3.6 GHz EC Decision which sees an FDD plan being adopted on the basis of a paired 100 MHz duplex spacing. On the other hand, TDD by design allows flexibility to adjust the uplink downlink configuration subject to operator agreements over time as the asymmetry in traffic changes.

Operators are generally dependent on industry in determining the equipment they use

4.35 The Joint FWA Operators Response observes the influence of equipment manufacturers in determining the equipment and configurations deployed. They note that the move will be to LTE in the future and, in line with other information generally available, the international ecosystem for LTE equipment will focus on a TDD configuration.[62] The Joint FWA Operators Response maintained however that, in order to allow migration time and continuity of service, existing services provided by existing technologies should be permitted a transition period. This viewpoint is further explored in Chapter 7.

[59] Respondents that supported the band be used for TDD are as follows: Afrimax group, Bolloré Telecom, China Academy of Telecommunication & Technology (CATT), China Mobile, DaTang Group, Deutsche Telekom AG, E-Plus Mobilfunk, Huawei, Idilis, Imagine Group, Linkem, NII Holdings, Inc, Optus, SFR, SoftBank Group, UK Broadband, Vodafone and ZTE.

[60] Administrations of France and Germany

[61] In addition Plum Report 2 on rollout considerations indicate that in the main TDD is preferred by industry.

[62] GSA does not currently report any device availability for Band 22. GSA REPORT: Status of the LTE Ecosystem, April 20, 2015).

Flexibility in allowing FDD and TDD in the band plan creates technical inefficiencies

4.36 ComReg also observes that flexibility between paired (FDD) and unpaired (TDD) usage in the frequency range 3 400-3 600 MHz would cause technical compatibility challenges as indicated in the example below.

4.37 Taking the available spectrum in the band as a test case and if the lower band allowed FDD and TDD use, the available spectrum for FDD in line with the 3.6 GHz EC Decision would be as follows:

a) 2x25 MHz (3 410-3 435 MHz, 3 510-3 535 MHz) and 2x15 MHz (3 475-3 490 MHz, 3 575-3 590 MHz); and

b) the remainder of the band would be used for guard bands, duplex gap or TDD assignments.

4.38 Guard bands, restricted blocks or restrictions in terms of the allowed BEM are necessary to separate FDD and TDD blocks. In this case, and assuming guard bands of 5 or 10 MHz between FDD and TDD assignments are required, a situation would arise where guard bands and duplex gaps would constitute between 40-50 MHz of the available 150 MHz of spectrum in this sub-band. Moreover, as half of the FDD paired spectrum would be used for uplink and the required uplink capacity is expected to be a fraction of the required downlink capacity, the uplink spectrum would be inefficiently utilised. Clearly this would not be an optimal outcome from a spectrum management perspective.

4.39 Alternatively, assigning spectrum based on TDD has the potential to allow all 150MHz of spectrum in the sub band to be assigned and utilised by operators who synchronise their networks.

4.40 ComReg notes that the UK has decided that its 3.6 GHz band should be designated for TDD use[63] and, with a TDD designation, there is potential for greater efficiencies by means of network synchronisation at the border regions to Northern Ireland. ComReg observes that such efficiencies would not be possible between FDD and TDD systems.

[63] http://stakeholders.ofcom.org.uk/binaries/consultations/pssr-2014/summary/pssr.pdf

4.1.5 Summary of ComReg view on the proposed band plan for the award

4.41 ComReg is required to implement the 3.6 GHz EC Decision including the TDD configuration for the sub band 3 600-3 800 MHz and hence ComReg will release this sub band on that basis.

4.42 Having given careful consideration to the responses received to Document 14/101 and other available information ComReg is of the preliminary view that TDD is the optimum configuration in the interests of all stakeholder groups and would best meet its statutory functions, objectives and duties. ComReg also notes developments at a European level to harmonise the band for TDD use.

4.43 Regarding the interest of one operator in a FDD configuration and for the reasons discussed above, ComReg is not minded to propose a FDD duplex configuration and ComReg further notes that this operator's proposal to provide asymmetric FDD spectrum holdings to account for the asymmetry in traffic would not be compatible with the 3.6 GHz EC Decision.

4.44 ComReg notes Qualcomm's observations that by identifying the band for TDD, the options of some stakeholders may be restricted. ComReg observes, however, that the 3.6 GHz EC Decision indicates a preferred band plan to facilitate harmonisation and, in the main, TDD is the most favourable duplex configuration for stakeholders. Further as discussed above, the introduction of flexibility in terms of duplex configuration would also introduce technical inefficiencies and inevitably increased award complexity which Qualcomm itself acknowledges in other parts of its submission. On balance, it therefore appears to be in the best interest of the market and, ultimately, the consumer to designate the band plan on a TDD configuration. Hence ComReg is of the preliminary view that the band should be assigned using a TDD configuration.

4.45 The band plan proposed for the award is shown in Figure 2 below. This band plan is in line with the 3.6 GHz EC Decision and includes the other national uses and guard band as indicated in Section 4.1.2.

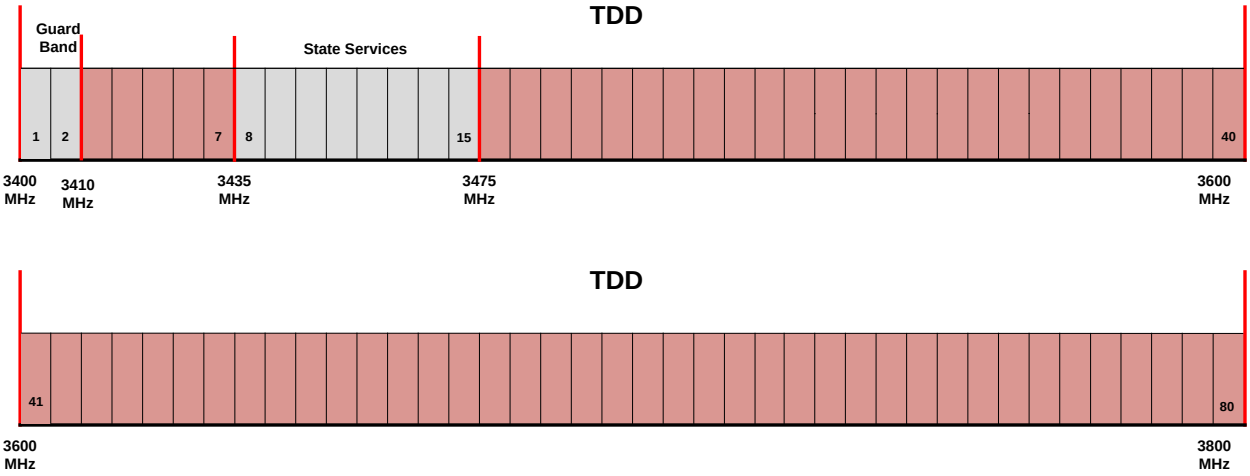

Figure 2. Proposed TDD Bandplan

4.2 National / Regional licences

4.46 In Document 14/101, ComReg sought views from interested parties on regional licences in the 3.6 GHz band. ComReg opened the discussion with the following observations of DotEcon on the potential for national/regional licences in the 3.6 GHz band:

- given the likely interest from different types of users of this spectrum from 2017, it may be appropriate to award a subset of the 3.6 GHz spectrum on a regional or local basis.
- In particular, this may be necessary for those operators currently holding a local licence or multiple local licences who have no demand for services in large parts of the country, and therefore have no need for a national licence.
- Offering some licences on a regional basis would provide an opportunity for such users to express their demand individually in the award process.

4.47 As it might not be efficient to be overly prescriptive about the amount of spectrum that should be made available on a regional basis, DotEcon suggested that regional and national licences could be obtained as part of the awarded process.

4.48 ComReg stated that it would consider the available options to identify the most appropriate mechanism for releasing spectrum in this band having regard to its obligations in respect of the management of the radio frequency spectrum. ComReg welcomed views in this regard.

4.49 This section further considers these matters and is structured as follows:

- View of respondents to Document 14/101 on national / regional licences in relation to the 3.6 GHz band.
- Facilitating national and regional licences
  - Justification for national / regional licences
  - The number of regional areas
  - Discussion on the establishment of the regional areas
- The two regional area options for consideration
- ComReg preliminary view on the regional licence areas

4.2.1 View of respondents to Document 14/101 and Document 14/126 on national / regional licences

4.50 In response to Document 14/101, ComReg received views from five respondents (Eircom, Joint FWA Operators Response, Imagine, Ripplecom and Viatel)[64] that related to the establishment of the geographic areas for licences (national/ regional). ComReg notes that two respondents to 14/126 requested clarity on ComReg plans for regional licences in the 3.6 GHz band. In general, from the responses received there was broad support for the inclusion of regional licences in the 3.6 GHz band.

4.51 One respondent (Imagine) expressed the view that while FWA is claimed to be needed to provide NGA in rural areas, FWA will also be needed in urban centres and remote towns where long fixed line lengths prevent the delivery of NGA services. In addition, it contends that even in areas where NGA is available, FWA solutions can provide much needed competition/choice for consumers in the urban areas. Consequently, Imagine requests that national licences are made available.

4.52 The remaining four respondents expressed views that suggest regional licences should be facilitated in the 3.6 GHz band, and one proposal was made with regard to the composition to such regional licence areas (the same proposal was submitted by both the Joint FWA Operators Response and Ripplecom).This proposal is considered in more detail later in this chapter.

4.53 The main reasons expressed with regard to regional licences are set out below

[64] The complete non confidential responses received to ComReg Document 14/101 are published in ComReg Document 15/15.

Mobile operators would not require 3.6 GHz spectrum in rural areas and would focus on urban centre use

4.54 The Joint FWA Operators Response and Ripplecom submit that reserving all 400 MHz[65] of spectrum in the 3.6 GHz band for national licences would result in a situation where spectrum may only be utilised in urban centres and would be at odds with ComReg's duties in making the most optimal use of spectrum for the benefit of all throughout the country.

4.55 Another respondent (Viatel) similarly contended that MNOs would probably not require the 3.6 GHz band outside of the very dense urban areas (due to the propagation characteristics of the band). It also argued that the entire band could be split geographically as it is unlikely in its view that MNOs would require the band in remote rural and suburban regions where approaches such as the current FWALA scheme operate.

4.56 In addition, the Joint FWA Operators Response and Ripplecom both maintained that existing FWA operators providing services in the band should have the opportunity to acquire spectrum rights of use and upgrade their networks with the potential to scale up their services over time. In conclusion they suggest that a significant portion of the band is reserved for rurally focussed WISPs to deliver NGA speeds.

4.57 Eircom stated that the bands 700 MHz 1.4 GHz, 2.6 GHz FDD blocks be awarded on a national basis while the 2.3, 2.6 TDD and 3.6 bands could be offered on a regional basis. Eircom, however, did not provide any supporting material for this view.

4.2.2 Facilitating national and regional licences

4.58 ComReg now sets out its considerations on this matter, having taken account of the views expressed in responses to Document 14/101, the expert reports that it has obtained, and, its statutory functions, objectives and duties.

Justification for national / regional licences

4.59 Notwithstanding that there may be any number or variety of interested parties[66] in this band, ComReg observes from the responses received that there are in the main two general categories of respondents, operators wishing

[65] As per paragraph 4.10 above, only 350 MHz is actually available for release in this band.

[66] ComReg notes that there may be many use cases for example, FWA, mobile use for small cells, small cell back haul, back haul links or some other novel use.

to provide FWA type services and MNOs perhaps wishing to provide services to mobile devices or backhaul.

4.60 A number of respondents submit that any potential use by MNOs would likely be in urban areas[67] as alternative lower frequency bands may be preferred (due to their more favourable propagation characteristics) to provide mobile services in more rural areas of the State. It is further noted that MNOs are perhaps likely to require additional bandwidth in high traffic spots typically in dense urban areas, such as the five cities, and this band may prove suitable for this purpose. Hence MNOs may particularly value this spectrum in dense urban areas. However it is also reasonable to consider the case where an MNO may wish to purchase national spectrum rights of use for widespread urban use and not just exclusively in dense urban centres such as the five cities.

4.61 In terms of FWA use, it seems FWA services are perhaps best suited to the provision of fixed broadband connections in rural locations to elevated CPEs[68]. This is in part due to the fact that this band is generally limited to line of sight applications and by using an elevated fixed receive configuration, wide area coverage is achievable from a single base station.[69]

4.62 Notwithstanding, one respondent (Imagine) contends that FWA operations are also of value in urban areas so as to provide NGA connections where long fixed line connections preclude NGA services being delivered, and also to allow competition/choice for consumers in these urban areas.

4.63 Considering this and taking into account the responses to Document 14/101, it seems that interested parties[70] may wish to obtain national licences or regional licences containing either, urban and rural locations or just rural locations.

4.64 Accordingly, it would seem appropriate and prudent for the award to allow flexibility and scalability for different types of operators to compete for the appropriate geographic footprint suited to their business case, be it national or regional.

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[67] An opposing view was expressed by one respondent (Imagine) where it contends that there is no expressed demand for Mobile use in this band.

[68] Consumer Premises Equipment

[69] Noting that this coverage is subject to a number of factors including, the number of subscribers, the service being offered and the capacity of the base station.

[70] It is noted that the Joint FWA response stated that it supported the establishment of regions but if it resulted in a delay of an award beyond summer 2015 that is would hold a concern as operators need sufficient time to transition to the new licensing scheme in good time before licence expiry. ComReg considers this and proposals for transitional arrangements are contained in Chapter 7.

4.65 If ComReg was to offer national licences in the 3.6 GHz band exclusively it seems that this might create the possibility of spectrum being less than optimally assigned. Secondary trading of spectrum could, ostensibly at least, help address such an issue, noting that ComReg has produced a framework for spectrum trading. There are however drawbacks to this approach, for example risks that these transactions may not occur, bargaining inefficiencies or the practical need to coordinate with many and/or disparate parties. ComReg maintains that primary assignment mechanisms should seek to be as efficient as possible from the start leaving secondary transactions to provide a backstop to potentially improve the spectrum outcomes of the primary assignment.

4.66 Considering the above, ComReg proposes that regional licences be established for the band in its entirety and that the regional areas should include rural regions and urban regions. ComReg observes that this approach would not preclude an operator obtaining a national footprint because the proposed award design would take account of, and cater for, such an outcome. This is discussed further in Chapter 5.

4.67 In terms of identifying the urban regions, indications from respondents is that the five cities could be considered. This seems a reasonable starting point in ComReg's view as they are smaller more densely populated areas giving rise to potentially different radio spectrum uses than rural areas.

The number of regional areas

4.68 In considering the number of regional areas to be awarded, ComReg observes that there is a balance to be struck between allowing bidders flexibility to obtain spectrum licences in an appropriately sized geographic area, and the complexity of the auction mechanism.

4.69 ComReg notes that DotEcon, in Document 15/71 published alongside this document, comments on the auction complexity in terms of the number of regions identified for award. Amongst other things, DotEcon has carried out detailed analysis on how the number of potential regions pose challenges for an award process and also how this can be mitigated in the award design.

4.70 In general terms, DotEcon observes that the lesser the number of regions the lower will be the complexity of the auction and *vice versa*. DotEcon cautions that increasing the number of regions could add unnecessary and disproportionate degrees of complexity which might discourage full and active participation in the award from all interested parties. On the basis of its analysis, DotEcon suggests that designing an award to contain a relatively

small number of regions (with a maximum of 10) would allow for a manageable award process in which all interested parties should be able to participate.

4.71 ComReg notes that the Joint FWA Operators Response contained a proposal for regionalisation based on four large regions. The respondents also identified Dublin as a potential further region of itself as well as suggesting that other major cities could also enjoy similar status, for example Cork and Galway. This suggests about nine regions for the award.

4.72 Having regard to the recommendations of DotEcon and responses to Document 14/101, ComReg is of the preliminary view that an appropriate number of regions, with which to strike the right balance in allowing bidders sufficient flexibility to obtain spectrum licences in an appropriately sized area whilst also not unduly increasing auction complexity, would be between five and nine.

4.73 ComReg considers this as a useful guiding principle in discussing regions in the following sections.

Discussion on the establishment of the regional areas

4.74 ComReg has set out above its preliminary views on the scope of any regional areas in the 3.6 GHz band.

- there should be between five and nine regions;
- the regions should be constructed bearing in mind, among other things, the two potential uses discussed by respondents to this consultation; and
- the urban regions could consist of the five cities, which represent the main urban centres in Ireland, that is Dublin, Cork, Limerick, Galway and Waterford.

4.75 This section now considers how the regional areas should be defined and is structured as follows:

- The designation of the boundaries
- Boundaries for the urban centres
- Principles for determining the borders of the rural regions
- Comparison of the above principles to the proposal provided by the Joint FWA Operators Response to Document 14/101

The designation of the boundaries

4.76 Generally a boundary is something that indicates bounds or limits, that is, boundaries that are most likely to function must be clearly understood by all the parties concerned.

4.77 In that regard, ComReg observes that established boundaries would probably afford the best opportunity to unambiguously define the border of a regional area. Established boundaries include county boundaries, county council boundaries, provincial boundaries or other established boundaries such as by the Central Statistics Office (CSO) or the Irish Regions Office (IRO). ComReg further observes that:

- Established boundaries have clear definitions and are widely understood by all, for example by operators and consumers alike.
- Statistics (such as population, population densities, households, demographics etc) are measured for these established boundaries and independently reported on by various bodies notably the Central Statistics Office.
- Such statistics can provide a useful input to operators in the development of business plans in rolling out services (including for the purposes of determining an appropriate valuation of any transfer or lease of 3.6 GHz rights). Furthermore these statistics can be used as an appropriate measure for generating spectrum usage fees/ reserve pricing.

Boundaries for the urban centres

4.78 Building on the considerations above, boundaries for the urban centres could be informed by:

- the five legal city boundaries as established under statute; or
- the CSO definition of the City and Suburbs for the five cities (Dublin, Cork, Limerick, Galway and Waterford).

4.79 In the case of Dublin, Joint FWA Operators Response proposed that County Dublin[71] or an extended boundary could be used to separate the Dublin area. While this approach could be considered for Dublin due to a significant proportion of it being either urban or suburban, this approach is less applicable

[71] ComReg understands this proposal to pertain to the Dublin region: The Dublin Region comprises the constituent city/county council administrative areas of Dublin City, South Dublin, Dún Laoghaire-Rathdown and Fingal.

to the other four cities, which constitute only a very small proportion of their respective counties.

4.80 It seems likely that MNOs might value the urban parts of the counties. With regard to more rural areas, it appears that such areas might be particularly valued by FWALA operators, although other potential bidders might also see value in acquiring spectrum rights of use in rural areas.

4.81 The first option outlined above uses the legal boundaries for the five cities. This is a representation of the urban areas and established for the purposes of local government. Notwithstanding, ComReg notes that these boundaries were last modified in 1985 [72] and therefore may not truly represent the urban/suburban areas that make up each of the five cities.

4.82 The second option considered is to employ the definition established by the CSO for cities and suburbs (e.g. Dublin city and suburbs etc.) which is an extension of the legal city to the environs and suburbs.[73] The CSO boundaries are larger than the legal city boundaries and Figures A1 to A5 in Annex 5: presents these two options for the five cities.

4.83 ComReg is of the preliminary view that the urban centre boundaries for the purpose of this award should be defined using the CSO boundary files for the five cities and suburbs for the following principle reasons:

- The CSO boundaries for the five cities and their suburbs give the most up to date (Census 2011) representation of the urban/suburban areas of each city and thus are more likely to align with the potential interested parties' demand in these areas. In contrast, the city council boundaries were established many years ago and do not generally give a genuine representation of the urban/suburban centres identified by the CSO. This point is particularly apparent in the case of Dublin as can be seen in Figure A1 to Annex 5: to this document.
- The CSO provides statistics for these boundaries (including population, number of households etc) that would be useful for business planning and the generation of reserve prices.

4.84 The latest CSO boundaries were established based on 2011 Census data. ComReg notes that this boundary is subject to periodic extensions to keep a pace with building development. In the interests of clarity ComReg intends to use the latest CSO boundaries available at the time of the award.

[72] Local Government (Reorganisation) Act 1985

[73] See annex 4 for the definition and illustration of the CSO city and suburb boundaries

Principles in determining the borders of the rural regions

4.85 In the previous section ComReg identified proposals for the five urban regions with a view to ensuring that an award is not overly complex. ComReg now considers how to set about establishing a limited number of rural regions.

4.86 In drawing up the larger rural regions it is useful to establish some guiding principles to assist in this task.

4.87 In paragraph 4.84 above ComReg has identified that the boundaries of regions should be based on established boundaries.

4.88 In line with the proposals in Chapter 6 for managing interference between networks in adjacent regions, inter operator agreements will most likely be required at the boundary between regions. To ease the complexity of this task, one guiding principle would be to limit the number of cases where agreements are required between regions and further constrain this where possible to agreements between two regions. Even with this principle ComReg understands that the outcome of the award may result in scenarios where multi-operator agreements are required[74]; however this principle aims to limit these cases. Further, it could be expected that, by having fewer instances where coordination is required between operators, could result in faster rollout of services in border areas as less inter-operator agreements would be necessary.

4.89 In addition, there may be particular benefits in eliminating a scenario where three regions intersect in or around a city. ComReg observes that smaller operators may be focussed in certain parts of the country and may wish to obtain licences for both a regional city and its surrounding counties[75].

4.90 Further, ComReg considers there to be merit in expanding this approach to allow each rural regional area to surround one or more of the cities thereby facilitating operators in acquiring a mix of urban and rural customers.

4.91 There are other potential benefits of this approach including, for example, the more logical establishment of appropriate minimum prices. For example, the CSO boundaries for Limerick capture population in three legal boundaries: County Clare, County Limerick and Limerick City. The minimum prices/reserve prices for the award as proposed would rely on price per population per MHz of spectrum (see Chapter 5) and the information for population drawn from the CSO data captured for each legal boundary.

[74] For example, spectrum in region A is awarded to one operator and the same spectrum in region B is awarded to two operators.

[75] This is suggested by examination of a number of the existing FWALA operators networks

4.92 In summary the five principles that ComReg proposes to use for establishing rural regions[76] are:

1. There should a small number of regions (i.e. between circa five to nine regions) including the major cities to provide a balance between allowing bidders flexibility to obtain spectrum licences in an appropriately-sized area and limiting auction complexity.
2. Use established boundaries for the identification of borders between regions e.g. County boundaries and/or County council boundaries.
3. Minimise the instances of tri-lateral agreements occurring between operators at boundaries between regions.
4. Eliminate, as far as practicable, the instances where a city region is adjacent to two other regions.
5. By extension, facilitate the potential for each regional operator to acquire both a city and surrounding rural region.

Comparison of the above principles to the proposal provided by the Joint FWA Operators Response to Document 14/101

4.93 ComReg welcomes the proposal from the Joint FWA Operators ("Joint FWA Proposal") and notes from its structure some similarities with the above considerations.

4.94 In summary, the Joint FWA Proposal identifies the following four main regions that broadly follow the provincial boundaries, with some adjustments made to account for the border counties:

- Borders : Including Counties Donegal, Leitrim, Cavan, Monaghan and Louth;
- Connaught: less county Leitrim;
- Leinster: less Dublin, and Louth
- Munster.

4.95 The Joint FWA Operators Response referenced the urban centres being separate from the rural regions, in particular, Dublin, Cork and Galway. The proposal was not specific on the boundaries that would constitute the urban centres save that Dublin could be the whole county or be extended somewhat.

4.96 ComReg firstly observes that the Joint FWA Proposal proposes four rural regions using established boundaries, which would accord with the first two

[76] It is noted that these principles are also applicable to urban regions; however they are used here for the establishment of rural regions specifically.

principles identified by ComReg above. Assuming that the Joint FWA Proposal could be modified to include cities, ComReg further observes that the Joint FWA proposal has three cases where cross-regional tri-lateral arrangements would occur, namely at the juncture between:

- Borders, Connaught and Leinster;
- Connaught, Leinster and Munster; and
- Munster, Leinster and the Waterford city.

4.97 ComReg notes that, depending on the radiated power and elevation of base station(s), there may be other cases where trilateral agreements would be required. It is not possible for ComReg to identify these cases as this will be subject to operators' individual network deployments. Hence, ComReg has focussed on regions that are directly adjacent to each other.

4.98 Of the three cases, ComReg observes that the third case would conflict with ComReg's fourth principle (i.e. eliminating, as far as practicable, the instances where a city region is adjacent to two other regions). ComReg also observes that the "Borders" regional area would not align with ComReg's fifth principle (i.e. facilitate the possibility of each regional operator to acquire both a city and surrounding rural region).

4.99 The following discussion considers whether there may be potential to make appropriate adjustments to the Joint FWA Proposal so as to better align with the above principles.

Potential modifications to the Joint FWA Proposal to better align with ComReg's proposed principles for determining rural regions

4.100 In relation to the third and fourth principle identified by ComReg (i.e minimising the instances of multi-lateral agreements at the borders and remove instances where a city region is adjacent to two other regions), ComReg observes that the Joint FWA Proposal could be better aligned with same by creating a new region in the south-east containing the counties/county-council boundaries that surround the City of Waterford.

4.101 ComReg notes, however, that with such a modification the number of regions would increase to ten. As this would exceed the proposed range of between five and nine, ComReg observes that a further modification would be required.

4.102 In that regard, and in line with the fifth principle (i.e. facilitating the possibility of each regional operator to acquire both a city and surrounding rural region), ComReg observes that this could be achieved by rebalancing the regional

areas by taking the “Border region” as identified in the Joint FWA Proposal and subsuming its constituent counties into the adjoining regions.

4.103 In ComReg’s preliminary view, this modification would provide benefits in terms of keeping the total number of regions at nine (thereby limiting auction complexity) and facilitating smaller regional operators to acquire combinations of regions that contain both city and rural counties in each region.

4.2.3 The two regional area options for consideration

4.104 In light of the foregoing, ComReg has identified two options for consideration, being (1) the Joint FWA Proposal and (2) a variant of same which, in ComReg’s view, would better align with its identified principles.

4.105 The options are now set out below for consideration.

Option 1 – Joint FWA Proposal

4.106 The Joint FWA Proposal consists of the following five regions:

- Borders: Including Counties Donegal, Leitrim, Cavan, Monaghan and Louth
- Connaught: less county Leitrim and the CSO boundary for Galway City and Suburbs
- Leinster: less county Dublin and county Louth
- Munster: less the CSO boundary for Limerick City and Suburbs and Cork City and Suburbs
- Dublin County

4.107 To aid understanding by interested parties, ComReg has mapped the Joint FWA Proposal against the county council boundaries and combined the boundaries into regions. This can be seen in Figure 3 below.

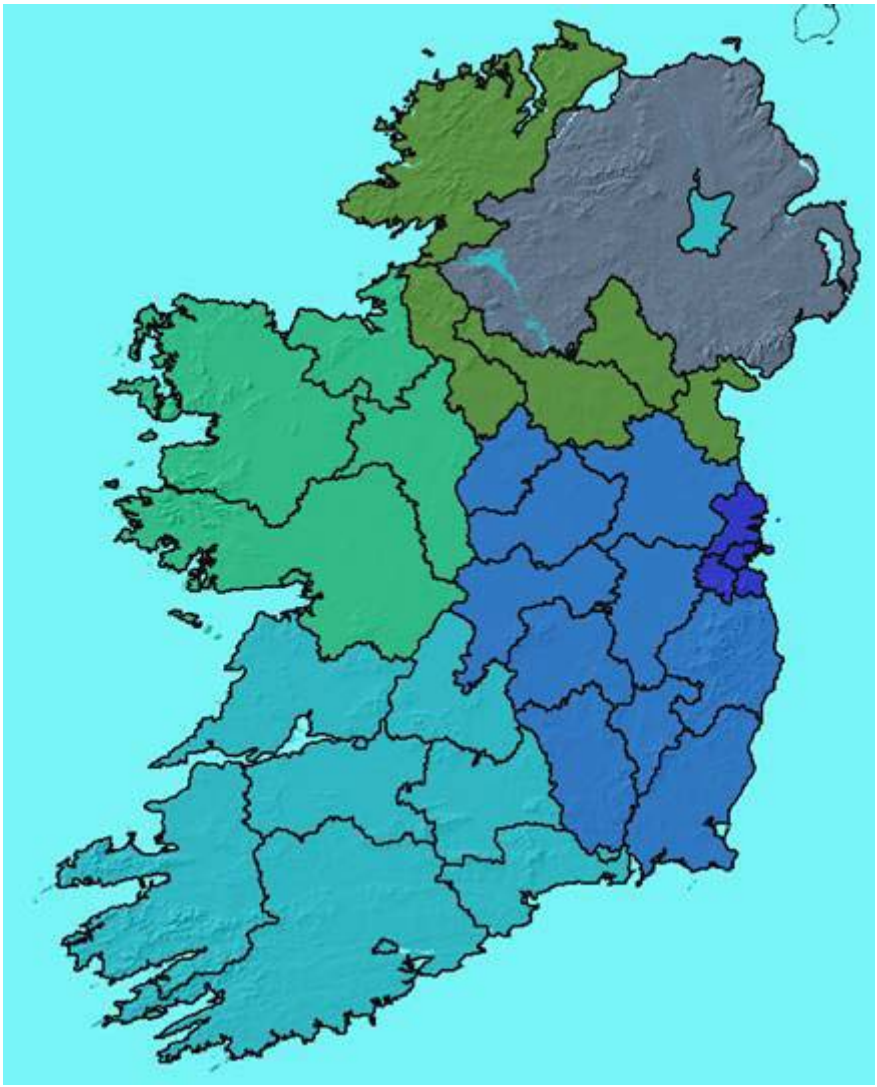

Figure 3. Regional proposal for Option 1.

Option 2 – ComReg variation of Joint FWA Proposal

4.108 Option 2 includes a number of variations to Option 1 so as to better align with ComReg's identified principles (see paragraph 4.92).

4.109 Option 2 consists of the following nine regions:

- **North West:** Counties Donegal, Leitrim, Sligo, Mayo, Roscommon and Galway excluding the Galway CSO City and Suburb region.
- **North East:** Counties Cavan, Monaghan, Louth, Longford, Westmeath, Meath, Offaly, Laois, Kildare, Wicklow and Dublin excluding Dublin CSO City and Suburb region.

- **South East:** Counties Kilkenny, Carlow, Wexford, the legal boundary of South Tipperary and Waterford, excluding Waterford City and Suburbs
- **South West:** Counties, Clare, Limerick excluding Limerick CSO City and Suburbs, Kerry and Cork excluding Cork CSO city and Suburbs and the legal boundary for North Tipperary.
- **Dublin CSO boundary for City and Suburbs**
- **Cork CSO boundary for City and Suburbs**
- **Limerick CSO boundary for City and Suburbs**
- **Galway CSO boundary for City and Suburbs**
- **Waterford CSO boundary for City and Suburbs**

4.110 To aid understanding, ComReg has mapped Option 2 against the county council boundaries and combined the boundaries into regions. It will be noted that the CSO boundaries for the cities are larger than their respective legal boundaries. This can be seen in Figure 4 below.

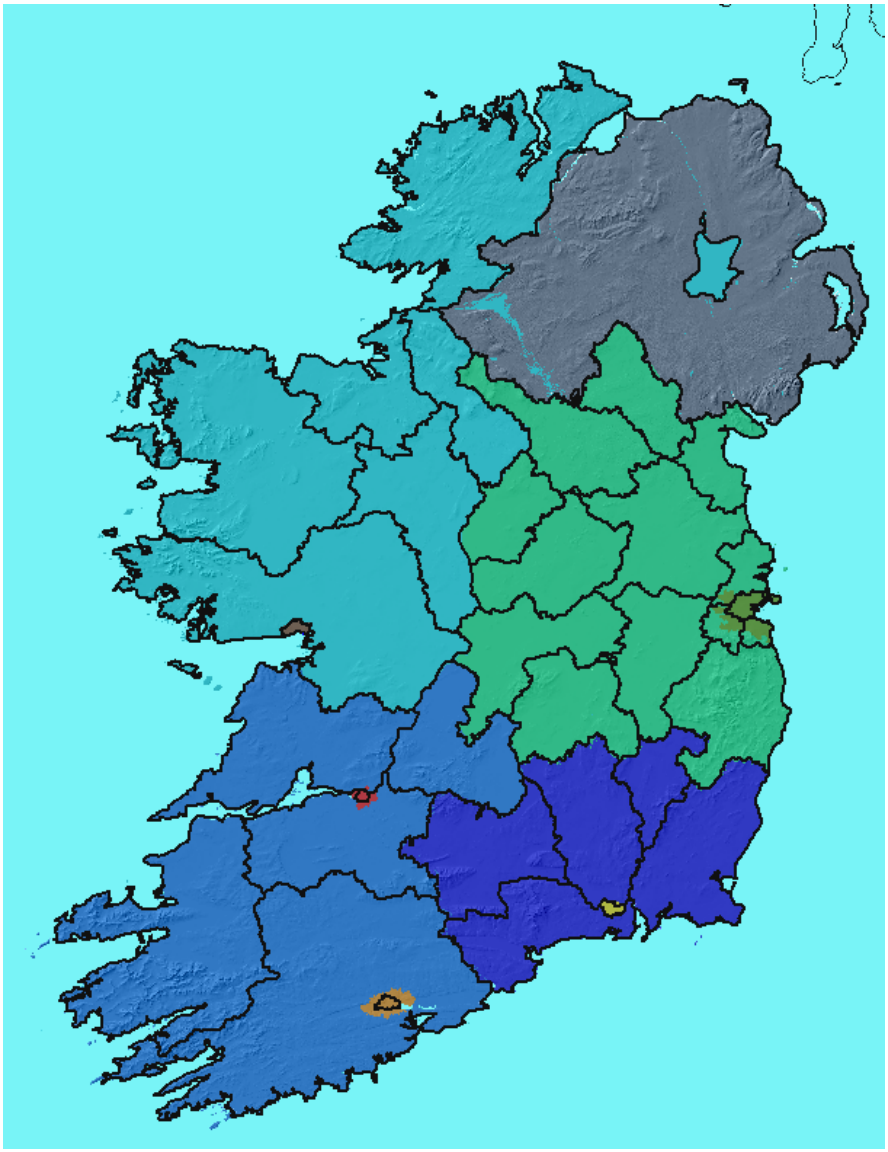

Figure 4. Regional proposal for Option 2

4.2.4 ComReg's preliminary view on the regional areas to form part of the award

4.111 As a general observation, ComReg acknowledges there may be many variations to the above two regional area proposals outlined above.

4.112 In wishing to address this matter as expeditiously as possible, ComReg does not, however, propose to undertake multiple rounds of consultation on the finer details of the composition of the regions. This is particularly so where diverging views from interested parties on such finer details may be (predominantly) based on idiosyncratic reasons. For example, a particular geographic

delineation may better suit the commercial interests/business case of a particular interested party or parties.

4.113 ComReg further observes that the regional approaches outlined above would, in any event, afford operators sufficient flexibility in ultimately determining their respective operational area (be that on a standalone or consortia basis).

4.114 In that regard, ComReg notes that there may be smaller operators who may wish to obtain licences to operate solely in certain regions of the State (e.g rural areas). There may, equally, be other operators wishing to acquire spectrum rights in this band in more densely populated areas, such as the cities. Indeed, there may also be many variations of the footprints that operators may adopt including a full national presence.

4.115 In that context, ComReg observes that Option 2 would allow sufficient flexibility and scalability for operators to obtain spectrum rights in a suitably sized area, and without unduly increasing auction complexity. In addition, ComReg considers that Option 2 would better meet the principles identified by it to assist in establishing optimal regions.

4.116 Accordingly, ComReg is of the preliminary view that Option 2 be used to designate the regional areas for the proposed award spectrum. Consequently ComReg intends to make available the band plan as per Figure 2 above, in each of the regional areas of Option 2.

4.117 ComReg also notes that further information relevant to the composition of the regions may become available in future.[77] For example, one or more interested party may have views as to how ComReg's spectrum award proposals could be better aligned with the NBP while ComReg also acknowledges that such views, if any, may not become fully formed until more detailed information about the NBP becomes available. ComReg will, as ever, consider any such views as are submitted, in the context of its statutory remit and provided that they are received within the overall time period of this consultation.[78]

4.118 ComReg welcomes views from respondents on the proposed Option2, including the principles identified by ComReg in developing same.

[77] For example, ComReg is aware that the NBP may define regional areas.

[78] In this regard, interested parties are refereed to Annex 2

4.3 Licence duration

4.3.1 Background

4.119 In Sections 4.4.1 and 4.4.2 of Document 14/101, ComReg sets out some background information relevant to its consideration on the setting of licence duration. In Section 4.4.3 of Document 14/101, ComReg then set out its preliminary consideration of what it believes to be the three central, but overlapping, issues to be addressed in reaching a view on this issue, namely:

- whether rights of use awarded under the proposed award process should be of finite or infinite duration;
- if rights of use are to be of finite duration, what is an appropriate duration for such rights of use, having regard to the nature of the spectrum involved and ComReg's obligations under the regulatory framework; and
- in considering the latter point, whether it is desirable that rights of use should co-terminate with other rights of use, whether they be rights of use currently in existence or which may be awarded at some point in the future.

4.120 ComReg received a number of submissions on these issues in the responses to Document 14/101 and also in response to Document 14/126. However, it is important to note that, as for submissions on other areas considered in this paper, the responses received were usually intended to apply generically across all of the bands rather than the 3.6 GHz band in particular. Accordingly, those responses should be read in that context. Notwithstanding, ComReg considers that the preliminary views expressed in Section 4.4 of Document 14/101 apply equally across all of the bands that were considered, including the 3.6 GHz band. As such, ComReg considers that there is merit in considering all submissions received on this issue even where they may not have been specifically focussed on the 3.6 GHz band, but of course welcomes further comments in response to this consultation.

4.121 For ease of reference, ComReg sets out below its preliminary view as outlined in Section 4.4.3 of Document 14/101. ComReg then considers relevant responses received to that consultation and sets out its preliminary views on licence duration in respect of the 3.6 GHz band having considered same.

4.3.2 Licences of indefinite duration

Preliminary view in Document 14/101

4.122 In Section 4.4.3 of Document 14/101, ComReg reiterated its general position regarding indefinite licences. In summary, ComReg favours licences of finite duration because, among other things it:

- promotes competition, spectrum efficiency and the internal market;
- is wholly compatible with the Common Regulatory Framework (see Annex 2 in this regard);
- once sufficiently long, allows licence holders sufficient time to obtain a return on investment in line with the expected life-cycle of the technology deployed;
- provides a sufficiently flexible approach to address future co-ordinated approaches that may be taken to particular spectrum bands at an EU-wide level;
- ensures that there are no long-term barriers to a co-ordinated approach to the bands. This is particularly important where a co-ordinated approach is necessary to introduce new and innovative services to a band; and
- ensures that there can be a co-ordinated approach to bringing about a desired change without perverse incentives emerging for incumbent firms to hold out strategically with a view to gaining more rents.

4.123 ComReg also noted that adopting a consistent approach in this regard across similar award processes contributes to regulatory certainty. Therefore, ComReg's preliminary view was that rights of use assigned under the proposed award process should be of finite duration.

Views of Respondents

4.124 ComReg received a number of responses to Document 14/101 in respect of its preliminary view on indefinite licences which are summarised below.

- Four respondents (Eircom, Vodafone, 3IHL, Imagine)[79], in the main submitted that licences should be of indefinite duration, or some variant of same[80] whereas four other respondents submitted observations on

[79] ComReg notes that Imagine responded to Document 14/126 providing a similar view.

[80] For example, Eircom favoured licences with a "minimum duration" of 20 years with the possibility of revoking licences only after that minimum term, subject to a reasonable notice period, to align with

what they considered to be an appropriate licence duration. Three of those respondents (Ripplecom, Viatel and Joint FWA Operators) favoured a licence duration in the range of 15 to 20 years.

- The rationale expressed by those respondents in favour of their views can be summarised as follows:
    - 3IHL contends that all of the benefits cited by ComReg in support of licences of finite duration are also applicable to licences of indefinite duration. 3IHL submitted that "rolling" licences subject to five year revocation after an initial term of 20 years are most appropriate for mobile spectrum bands.
    - Eircom agrees with DotEcon that "*spectrum use typically requires long-term, large-scale investments in networks*" and therefore suggests that licences of longer durations are preferred by operators. However, Eircom suggests that ComReg's approach is to establish arbitrary termination dates that do not align with significant regulatory and/or market developments. It therefore recommends that ComReg issue indefinite licences with a minimum term of 20 years to be revoked only if "*significant developments*" justify same.
    - Imagine expressed the view that licences should be issued on a nationwide basis for an indefinite term. In support of this view, Imagine contends that the UK has set precedence for Ireland following the award of spectrum rights of use by Ofcom and that it is in Ireland's interest and is consistent with ComReg's duties to follow the UK.
    - Vodafone expressed views that in the interests of promoting infrastructure competition, licences should be issued for a "*long or infinite duration*".

ComReg' Preliminary View

4.125 ComReg has considered and consistently addressed the issue of indefinite licences on many occasions in the past.[81] ComReg also reiterated above its view on indefinite licences as set out in Document 14/101. ComReg notes that the reasons suggested for licences of indefinite duration or a variant thereof

significant developments that may justify making the spectrum available to the market. ComReg notes that this suggestion is, for all intents and purposes, akin to a licence of indefinite duration.

[81] See, for example, Section 3.4.2 of Document 11/88, Section 4.3 of Document 11/89, Section 4.4.6 of Document 12/25 and, more recently, Section 4.4 of Document 14/101.

are in the same vein as previously put forward by some operators and considered by ComReg in developing its current position. Notwithstanding, ComReg again considers each of the issues raised by respondents below.

4.126 In summary, ComReg does not consider any of the arguments raised by respondents in favour of indefinite licences to be persuasive. In particular:

- ComReg notes that 3IHL does not proffer any justifications as to why licences of indefinite duration would better meet ComReg's statutory objectives. Indeed, it could be inferred from 3IHL submission that licences of finite and indefinite duration are equally as good at achieving those objectives. However, ComReg disagrees with this inference and notes that 3IHL submission does not address the problems with licences of indefinite duration which ComReg has highlighted on a number of occasions in the past[82]. Furthermore, ComReg has not received and is not aware of any compelling evidence to suggest that licence durations in excess of 20 years are required for licensees to obtain a return on investment.
- In respect of Eircom's support for licences of indefinite duration, ComReg notes that its sole justification for such licences appears to be on the basis that ComReg's current approach "*establishes arbitrary termination dates*". In response, ComReg would note that its approach to identifying appropriate termination dates is anything but arbitrary. Licence termination dates are always arrived at:
    - having regard to international practice and experience;
    - having had regard to the nature of the licences concerned in view of the objective pursued;
    - having taken due account of the need to allow for an appropriate period for investment amortisation;
    - following consultation with interested parties; and
    - having taken due account of ComReg's statutory functions objectives and duties generally.

  Even if Eircom was correct, which ComReg rejects, that would not, by itself, require or justify the granting of indefinite licences.

[82] Ibid.

- In relation to Imagine's submission, ComReg notes that the UK administration has decided to extend the duration of UK Broadband's licence in the 3.6 GHz band for an indefinite period. However, ComReg also notes that the UK indefinite licence duration approach for certain licence types is different to all other EU Member States, including Ireland and is thus an outlier in this respect.[83] Furthermore, Imagine has not provided reasoning why it considers that licences of indefinite rather than finite duration would be in Ireland's interest and consistent with ComReg's duties. On the contrary, as noted above, ComReg has previously identified problems with licences of indefinite duration.
- Vodafone states that ComReg should strongly support infrastructure competition and that it should make licences of long or infinite duration in order to do so. Vodafone does not provide any evidence to support its view that indefinite licences promote infrastructure competition (as opposed to, for example, simply insulating incumbent networks from potential competition) or why licences of finite, but sufficient, duration would not also promote infrastructure competition. In any case, ComReg notes that there are a number of statutory objectives which it must also balance when considering licence duration and that the promotion of infrastructure competition should not outweigh all other considerations.

4.127 ComReg is not aware of any market developments which would otherwise justify licences of indefinite duration.

4.128 In light of the above, ComReg does not currently propose to change its preliminary view in respect of indefinite licensing, as set out in Document 14/101 and summarised above, for the proposed award process. This is without prejudice to any alternative position that ComReg may take on this matter in the future.

4.3.3 **Licence duration**

Preliminary view in Document 14/101

4.129 As noted above, ComReg's preliminary view in Document 14/101 was that spectrum rights of use should be of finite duration and ComReg proposed that a licence duration of somewhere in the range 15 to 20 years would be appropriate. This view was arrived at considering, amongst other things, that:

[83] As noted in section 4.4 of Document 14/101, rights of use are generally of limited duration although a very small number of countries (e.g. the UK, USA and Argentina) assign rights of use of indefinite duration.

- licence durations attached to spectrum rights of use awarded through the MBSA process were between 15 years and 17 years and 5 months;
- in ComReg's response to consultation on the 2.3 GHz band (09/76) ComReg was of the view that licence duration of 15 years would be appropriate; and
- while, in CEPT countries, spectrum rights of use range from 5 to 20 years, the GSMA report an average duration of mobile licences for a selection of countries worldwide as being approximately 17 years with those used most frequently globally being either 15 or 20 years.

Views of Respondents

4.130 ComReg received a number of responses to Document 14/101 and Document 14/126 in respect of licence duration.

4.131 One respondent (Eircom) favoured licences with a "minimum duration" of 20 years, to allow a sufficient period for return on investment, only to be revoked thereafter in the event of "significant developments" justifying such revocation.

4.132 While favouring licences of indefinite duration, two respondents (Vodafone and 3IHL) submitted that, if licences were to be of finite duration, an appropriate duration would be either 25 years (Vodafone) or 20 years (3IHL).

4.133 Three respondents (Ripplecom, Viatel, Joint FWA Operators Response) agreed with ComReg that licence durations should be in the range 15 to 20 years with the Joint FWALA Operators contending that it should be towards the upper end of the range.

ComReg's Preliminary View

4.134 In relation to those respondents arguing for a duration longer than 20 years, ComReg notes that those arguments were primarily aimed at justifying licences of indefinite duration. ComReg has already addressed the validity of those arguments under the previous heading on indefinite licences. In summary, ComReg does not consider those arguments to be persuasive and does not propose to address them again here.

4.3.4 Co-termination

Preliminary view in Document 14/101

4.135 In considering the appropriate duration for rights of use assigned under the proposed award process, ComReg considered in Document 14/101 whether those rights of use should:

i. co-terminate with each other and, if so,

ii. co-terminate with the existing rights of use awarded under the MBSA (i.e. 12 July 2030) or terminate on some other date.

4.136 ComReg notes that (i) is no longer relevant in the present case given that it is proposed to carry out a single band (i.e. the 3.6 GHz band only) rather than a multi-band award process.

4.137 In respect of (ii) above, ComReg came to the preliminary view that there should be some temporal separation between the dates of expiry for rights of use considered in Document 14/101 and the rights of use arising from the MBSA process. ComReg came to this preliminary view on the basis that this approach:

- has the potential to facilitate business continuity and promote competition;
- helps mitigate risks of locking existing operators and potential new entrants out of the market and cementing the market structure for a substantial period of time thereafter;
- may be particularly beneficial in the case of innovation-driven markets characterised by on-going technological progress where the nature of potential users and uses can be expected to evolve relatively quickly over time; and
- assists existing operators in their ability to react to evolving technology, services and demand to adjust their amount and mix of spectrum holdings over time, particularly if alternatives like spectrum trading and/or business acquisitions do not provide the same level of certainty/opportunity.

Views of Respondents

4.138 ComReg received a number of responses to Document 14/101 on this issue. In general, respondents supported the view that co-termination with the MBSA

rights of use would be undesirable. For example, one respondent (Eircom) expressed the view that co-termination or termination dates that were too close *"could prove to be very disruptive".*

4.139 ComReg accepts that the views expressed by respondents to Document 14/101 on co-termination were generally made in the context of all bands considered and not just the 3.6 GHz band alone. However, ComReg is happy to receive any further views in the context of an award process involving the 3.6 GHz band only.

ComReg's Preliminary View

4.140 In light of the above, ComReg is of the preliminary view that rights of use under the current proposed award process need not co-terminate with those issued under the MBSA which expire on 12 July 2030.

4.4 Proposal for licence duration

4.141 In light of the above, ComReg proposes that rights of use awarded in the 3.6 GHz band to be made available under the proposed award process:

- should be of finite duration;
- should be for a duration of somewhere between 15 and 20 years; and
- need not co-terminate with spectrum rights of use awarded under the MBSA process.

4.142 However, it remains to be determined what is a suitable duration for rights of use in the 3.6 GHz band in light of the fact that:

- rights of use under the proposed award process are expected to commence following the expiry of the existing rights of use in the 3.6 GHz band on 31 July 2017;
- licence duration should be somewhere between 15 and 20 years; and
- rights of use granted under the MBSA expire on 12 July 2030.

4.143 In relation to the last bullet point, ComReg notes that while this consideration was appropriate in relation to the spectrum bands proposed in Document 14/101, it is of considerably less importance in this proposed award because the 3.6 GHz band is not considered a close substitute or a strong complement to the MBSA spectrum bands.

4.144 In relation to the second bullet point, ComReg firstly observes that recent developments in other Member States in relation to the 3.6 GHz band indicate

durations of between 10 and 15 years. Specifically, the Czech Republic proposes a licence duration of 15 years, and Slovakia and Romania have chosen durations of roughly 10 years[84].

4.145 ComReg further notes the additional factors which suggest that a duration at the lower end of the 15 to 20 year range would be appropriate:

- In its Mobile Termination Rate consultations[85] and draft model, ComReg noted that an asset life of 8 years is used for the vast majority of the mobile elements. Given that mobile and fixed deployments in the 3.6 GHz band appear to be moving towards the use of similar underlying technologies, ComReg observes that this asset life may be equally applicable to future fixed deployments in the band. Accordingly, a 15 year duration would allow potential licensees a generously sufficient period of time to obtain a return on its investment considering this asset life; and
- The on-going developments in the 3.6 GHz band that could over time change the attractiveness of this band to certain services and the demand for spectrum in this band. This may mean that the primary spectrum outcomes derived from this award process may not be the most optimal outcomes in the future. While market mechanisms, such as spectrum transfers and leasing, have the potential to address any such concerns, ComReg observes that a duration towards the lower end of the 15 to 20 year range would further mitigate the risk of sub-optimal outcomes in the longer term.

4.146 In light of the above, ComReg is minded to favour a licence duration of 15 years, save where circumstances justify a deviation.

[84] See International Update Annex 3

[85] See ComReg 15/19a – Table 11.

4.5 Chapter 4 Consultation Question

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

- the band plan for the 3 400-3 600 MHz sub-band should be TDD (in line with the preference expressed in the 3.6 GHz EC Decision);
- regions should be established in line with the principles identified by ComReg;
- the regions identified in Option 2 should be used for the proposed award; and
- a licence duration of 15 years should apply to the 3.6GHz band.

4.148 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory functions, objectives and duties.

Chapter 5

5 Award Type and Format

5.1 Introduction

5.1 On the basis of the draft RIA set out in Chapter 3, ComReg is currently of the view that an auction mechanism is the most appropriate mechanism with which to award rights of use in the proposed award process.

5.2 In Document 14/101, ComReg set out certain considerations for a multi-band award process which potentially could have included the 3.6 GHz band and potentially the 700 MHz band. However, ComReg is now considering a separate award for the spectrum rights of use in the 3.6 GHz band. It is therefore appropriate to re-evaluate what considerations would apply to this separate award process and determine what auction characteristics, in this specific case, would best meet with ComReg's statutory objectives.

5.3 In that regard, this chapter is structured as follows:

- considerations for this award process;
- the preferred auction format;
- packaging of available spectrum;
- frequency generic or frequency specific lots;
- competition caps; and
- fees

5.2 Considerations for this Award Process

5.4 The DotEcon report attached to Document 14/101 identified and examined a number of suitable auction formats for awarding rights of use across those bands under consideration. These auction formats include:

- simultaneous multiple-round ascending (SMRA) auction;
- simple clock auction (SCA);
- combinatorial clock auction (CCA); and
- sealed bid combinatorial auction formats (SBCA)

5.5 Similar to the approach taken in Document 14/101, it is not proposed to fully repeat DotEcon's discussion and analysis of these formats. Rather,

stakeholders are again encouraged to review the mechanics of each auction format as set out in the DotEcon report (14/102) and the DotEcon report which accompanies this consultation.

5.6 In order to assess which of the aforementioned auction formats is best suited to the proposed award process, it is necessary to consider a number of risks outlined by DotEcon as likely to arise, and determine which auction format best mitigates those risks while ensuring spectrum is awarded to those users who value it the most. The main risks associated with this award process are:

- aggregation risks;
- gaming opportunities;
- substitution risks;
- common value uncertainty; and
- complexity.

5.2.1 Aggregation risks

5.7 Aggregation risk refers to the risk that bidders may only partly satisfy their demand for certain spectrum. Where a bidder has a minimum spectrum requirement, it may be exposed to winning unwanted subsets of its demand. Aggregation risks can arise as regards a bidder not winning:

1. lots in one or more bands, where it has demand in multiple bands;
2. lots in one or more regions, where it has demand in multiple regions;
3. the minimum number of lots it requires in a band in a region; or
4. any combination of the above.

5.8 In this award process, aggregation risk between bands does not arise[86] if only 3.6 GHz spectrum is being offered. However, aggregation risk may arise where bidders are seeking complementary lots, such as a footprint that requires several or all available regions or a bandwidth that exceeds that of an individual lot.

5.9 Offering lots on a regional basis potentially exposes bidders to aggregation risks when bidding on lots in more than one region, if there are complementarities across regions. As described by DotEcon, if bidders are subject to the risk that they may not win spectrum in all the regions for which

[86] In a multi-band award as discussed in Document 14/101 aggregation risks arise where there is complementarity between bands and a bidder requires a minimum amount of spectrum across a number of bands, for example a bidder may require both coverage and capacity spectrum.

they bid, a bidder might even be assigned rights of use that are not geographically contiguous causing demand and coverage to be split across different regions. Aggregation risk may also arise because bidders want a certain minimum amount of spectrum which requires them to win multiple lots in each region. Moreover, even where a bidder is assigned spectrum across all regions of interest that bidder can be exposed to wining below its minimum spectrum requirement in any of those regions.

5.10 DotEcon considers that SMRA auctions are not suitable where aggregation risks are likely to be significant. Firstly, the SMRA provides no guarantee that the minimum amount of spectrum required by a bidder across regions will be achieved, as a bidder might eventually win fewer lots than is required by its own minimum objective.[87]

5.11 DotEcon notes that addressing aggregation risks in the context of an SMRA is difficult. While a number of measures can be introduced to mitigate against aggregation risk, none of these methods can fully mitigate the risk without creating significant additional complexity in the award process. Furthermore, this is not a costless exercise for bidders who wish to switch across aggregations or acquire a subset of lots across different regions, because restrictions or penalties are needed so as to maintain the integrity of the auction[88].

5.12 It is possible to use pre-defined packages in a SMRA format, where pre-defined packages of lots are offered alongside the individual lots that form the package. Bids for pre-packaged lots would then be in competition with those for individual lots. However, DotEcon does not recommend the use of such an augmented SMRA format as bidders would have no certainty over winning any complementary lot outside of the pre-defined package. This format would also require ComReg to pre-determine the aggregations that would form the pre-defined packages and therefore such an approach is less flexible with respect to allowing different types of users to specify the combinations of lots they want. Finally, such an approach adds additional complexity to the SMRA.

[87] DotEcon note that this may be an issue where bidders are trying to win an appropriate amount of bandwidth to allow efficient deployment of TDD-LTE (for example, ideally a multiple of 20 MHz, reflecting LTE carriers).

[88] For example, allowing for the withdrawal of bids in SMRA auction mitigates aggregation risks. However, allowing bidders to withdraw bids might also allow for strategic bidding that may distort the auction outcome. Therefore, there are usually restrictions on the number of withdrawals allowed and often also financial penalties if a withdrawal then leads to a lot not being sold.

5.13 The issue of aggregation does not arise in combinatorial auctions such as the SBCA, SCA or CCA as bidders can only ever win packages, in their entirety, of lots that they have bid on. In this way bidders can express their full value for preferred packages and their aggregate demand will be satisfied provided they have expressed the greatest value for that spectrum. This form of package bidding is also fully flexible, allowing bidders with different demand to compete on a level playing field.

5.2.2 **Gaming Opportunities**

5.14 Gaming opportunities refer to all opportunities for bidder behaviour aimed at acquiring spectrum at a price below what would have been paid had the auction been run in a competitive manner, acquiring more spectrum than they would have acquired in fair competition or at compromising downstream competition. This type of behaviour includes strategic demand reduction, tacit collusion, territory sharing, signalling or predatory pricing. As noted in Document 14/101, such behaviour can be facilitated by poor auction design; for example, by providing too much information to bidders about the value being attached by other bidders.

5.15 As noted in Section 5 of Document 14/101 and DotEcon report 14/102, SBCA offers the greatest level of protection against the gaming opportunities outlined above because a single sealed bid ensures bidders cannot signal to each other and ensures no information is available with which to behave strategically during the award. Secondly, strong incentives to reduce demand strategically do not exist as a SBCA does not impose linear pricing and a second price rule is used.

5.16 In its response to Document 14/101, 3IHL contends that DotEcon has failed to show any significant likelihood of strategic demand reduction occurring. While 3IHL may have been referring to the other bands considered in 14/101, ComReg is of the view that the scope for strategic demand reduction is likely to be higher in this award due to the large amount of spectrum available. This allows bidders greater opportunity to obtain sufficient spectrum (although less than optimal) without having to compete strongly. As described in Document 14/101 and DotEcon Report 14/102 the scope for strategic demand reduction increases in low participation scenarios. ComReg considers that such demand scenarios[89] could arise in certain of the proposed regions, individually or collectively, within this award process.

[89] Even if excess demand exists in all regions, bidders may reduce demand early to reduce the competitive pressure on prices and win spectrum close to reserve prices.

5.17 The incentives to engage in strategic demand reduction arise when a bidder may moderate the quantity demanded to benefit from reducing competition within the auction and securing a smaller quantity than wanted, but at a much better price. The high level of price transparency associated with an SMRA makes it particularly susceptible to strategic demand reduction, by allowing bidders to assess when they may stop prices from increasing further by reducing their demand. As noted in Document 14/101, prices in an SMRA cannot decrease during the auction, and hence price increments are irreversible. When bidders aggregate identical lots, competition for additional lots will drive the price for all lots. As a result, bidding for additional lots increases the price faced by all winners, those who do not reduce demand and those who may eventually need to reduce their demand in response to high prices. Therefore, all bidders have an incentive to settle for fewer lots at low prices.

5.18 Additionally, and as noted by DotEcon, various forms of predatory bidding and tacitly collusive behaviour are also possible under an SMRA. DotEcon highlights past experience with SMRAs in other countries has shown that bidders may respond to other bidders competing in their region and by reciprocating in the other bidders' preferred regions ("if you bid on my regions, I'll bid on yours"). The possibility of territory sharing is also higher under an SMRA as there is a risk that bidders could tacitly collude and bid only in particular regions to avoid competition with rivals.

5.19 DotEcon also points out that an SMRA auction can further gaming opportunities when some bidders bid for lots in several regions. Because certain bidders have demand across multiple regions and as a result face aggregation risks, other bidders seeking smaller coverage areas have the incentive to bid for regions they have no demand for with the aim of discouraging larger bidders from competing in their preferred regions[90]. This type of predatory bidding can result in the inefficient assignment of spectrum by creating a price for spectrum above the normal market clearing rate.

5.20 These types of behaviour are facilitated by the high level of transparency associated with the standing high bids making it easy to formulate gaming strategies aimed at reducing competition.[91] It is possible to limit transparency to reduce this problem, by not revealing the identity of the standing highest bidders or the number of bids received for each lot, but this increases

[90] This occurs either because they lose synergies across regions or because they have a fixed budget that becomes exhausted.

[91] DotEcon notes that SMRAs in both the US and Canada with regional licence structures have suffered from this problem.

aggregation risks as bidders have less information to assess the chances of being stranded as the highest bidder.

5.21 The SCA also suffers from bidders having the incentive to strategically reduce demand. As outlined by DotEcon, the use of uniform prices (i.e. all lots in a category have a common price per lot) means that competing for additional lots will drive the price that a bidder would pay even if it were to win a smaller number of lots in that category.

5.22 In the SCA, no bids are binding until the last round, which is a particular problem as it facilitates strategic bidding such as predatory or vexatious bidding. This can result in the inefficient assignment of spectrum if prices were to be driven up by non-truthful bids and the auction were to end, leaving the lots assigned to those that do not value them the most. Additionally, the ability to withdraw bids involves a greater risk of lots going inefficiently unsold under some demand scenarios.

5.23 Strategic demand reduction is unlikely to work in a CCA. If a bidder moderates the quantity it demands, by not bidding for larger packages it actually values, this benefits the rival bidder, and not the bidder that moderated demand at the outset. The second price rule [92] disincentives gaming behaviour and encourages straightforward bidding. If a bidder competes for a larger spectrum package unsuccessfully, this does not drive up the cost of then acquiring a smaller amount of spectrum as an alternative. Because of this, the CCA provides incentives for competition at the margin.

5.24 In a CCA price transparency is possible by revealing information about aggregate demand but not detailed information on the specific bids of each and every bidder. This information is of significant benefit with regard to price discovery but also prevents bidders conditioning their bids on the specific behaviour of one or more rivals so as to sustain a tacitly collusive outcome or to engage in predatory bidding.

5.25 In a CCA the clock rounds facilitate price discovery as bidders indicate the number of lots they would be prepared to acquire at the price on the clock in that round. However, provided that only aggregate demand is disclosed at the end of each round, it is not possible to see where exactly each bidder was bidding, only the total number of bids made in each region. This would allow regional operators to compete for lots outside their existing footprints without the risk of retaliatory bidding on the part of other bidders.

[92] See 14/101 for discussion on the benefits of using a second price rule as the pricing mechanism.

5.26 Unlike the SCA, the CCA provides strong incentives for truthful bidding and discourages strategic bidding. All bids in the CCA are binding and may become winning bids, which creates a risk for bidders bidding on unwanted lots or above actual valuation during the clock rounds, as they may win such unwanted lots or at a price above valuation.

5.27 In their responses to Document 14/101, Vodafone and 3IHL outline that price setting or price driving can lead to an increase in the price of spectrum. However, as explained in the DotEcon Report, it is possible that some bidders may try to submit bids that are not reflective of their demand and are simply aimed at increasing competitors' prices. However, these strategies are highly risky when there is limited information about other bidders and their willingness to pay, as it may lead to the bidder winning a less preferred package, possibly at a price above valuation. In addition concerns about price driving is limited in this award given that demand for spectrum from different bidders is somewhat uncertain.

5.28 Additionally, Vodafone contends that evidence from other auctions around Europe would not appear to point to collusion being a significant risk and the final prices on a price per MHz per pop basis in Germany and France are in line with other jurisdictions. Vodafone, however, has not presented detailed information to support this contention and it is not clear what band or bands (3.6 GHz or otherwise) are being referred to. ComReg maintains that each individual award carries its own risks and in light of its own experience and the advice from DotEcon is of the view that it is important to take appropriate measures to prevent tacit collusion in the award of 3.6 GHz spectrum.

5.2.3 **Substitution Risks**

5.29 Substitution risks arise when a bidder or bidders view an alternative package of lots as substitutes but cannot switch due to some impediment to switching. In Document 14/101 this was discussed in terms of switching between spectrum bands in a multi-band spectrum award. Given the single band nature of this award such concerns do not arise. However, because of the regional nature of this award there is a risk that a bidder or bidders cannot switch between regions that could be viewed by an individual bidder as substitutable. For example, where a bidder has a coverage footprint across a number of regions the nature of competition might force up the price in one region and that bidder may be unable to switch to an alternative region with a lower price. In such a case, it could result in a bidder obtaining spectrum in one region, when at prevailing prices it would have enjoyed a higher surplus if it had won spectrum in a different region.

5.30 Additionally, it is preferable for switching to occur because it promotes competition in the award process by allowing bidders to expand beyond their existing regions if the price prevailing within a region merited such a decision. ComReg is therefore of the view that switching regions should be permitted as part of this award process. Similarly, DotEcon is also of the view that switching should be provided for in this award process because it cannot be ruled out that some bidders may want to adjust their footprint in response to relative prices.

5.31 As described by DotEcon, substitution risks can be addressed by offering bidders the option to bid for alternative packages and adopting a winner determination mechanism that maximises bidder surplus given the bids received and the price rule adopted. This means that a bidder can express its valuations for a number of alternatives and then rely on the auction mechanism to select the most preferred outcome against those valuations. Both the CCA and the SBCA adopt this approach. A SBCA, however, does not mitigate the uncertainty faced by bidders before they need to submit their final bids, which might be particularly challenging with a regional structure as envisaged under this award process. It has no price discovery mechanism whereby bidders can process the information made available through the auction (at the end of each round in a multi-round auction) in order to update their valuations or identify and switch between alternative regions given the demand in others.

5.32 In an open auction, the bidder might switch back and forth between lots depending on the relative price. As noted in Document 14/101 switching can be provided for in a SMRA. This is achieved by introducing rules to allow bidders to switch active bids between lots. This however does not remove the impediments to switching entirely and increases the likelihood for gaming behaviour by allowing bidders to hide demand by bidding on unwanted regions and then switching demand later in the auction.

5.33 A SCA and a CCA can both provide for switching between regions. However, as described by DotEcon, in a SCA, when a bidder reduces its eligibility, then it will be unable to submit any further bids that would involve an activity level greater than its current eligibility level. This can lead to substitution risks when lots have different eligibility levels. Finally, because in a SCA only the final bids are binding a bidder can engage in predatory or vexatious bidding by driving up the price of spectrum in a rival's preferred region and switch to an alternative region in the later clock rounds.

5.34 A CCA can prevent this type of behaviour because all bids are binding. CCA activity rules link the final round of bids to earlier clock phase bids. In this way

earlier bids constrain a bidder's behaviour in subsequent rounds and for different packages preventing bidders from holding back their demand. These constraints will limit the bidding options for the bidder both during the clock stage and the supplementary bids round.

5.35 In a CCA, bidders can also be given, subject to activity rules, the opportunity to place bids in the supplementary round for packages that they did not bid on in the clock rounds. Regardless of format, a series of activity rules would have to permit the types of switching that are deemed desirable and keep bids committing.

5.2.4 Common Value Uncertainty

5.36 In Document 14/101, ComReg noted that significant common value uncertainty exists in relation to the capacity bands due to uncertainty regarding the level of industry demand for mobile deployment in the 3.6 GHz band. In their responses to Document 14/101, Vodafone and 3IHL also expressed the view that common value uncertainty was a consideration for the various spectrum bands. In particular, 3IHL suggested that the auction mechanism and transparency rules must allow for price discovery.

5.37 In terms of the award format, Document 14/101 concluded that common value uncertainty can be reduced by allowing bidders to observe the bidding behaviour of competitors. In particular, with multi-round auction formats including the SMRA, SCA and the CCA, the initial rounds of bidding provide bidders with an indication regarding the value others place on the spectrum. This price discovery helps reduce the uncertainty. It also reduces the corresponding risk that one or more bidders maintain expectations about common factors which are significantly at odds with the view of the market about these same factors.

5.38 However, as outlined by DotEcon, while demand information during a multi-round auction process reduces common value uncertainty by disclosing information about the highest valued use of spectrum it is more limited for updating value estimates according to a specific use, given that competitors may have rather different plans for using the spectrum. Therefore, the extent to which a bidder could incorrectly estimate the value of spectrum in this award applies only in respect of the use that bidder envisages for the spectrum.

5.39 A SBCA is unsuitable to mitigate against these concerns, as it offers no price discovery. As there is only one round of bidding, bidders are unable to adjust their own valuation in light of the bidding behaviour of rivals.

5.40 DotEcon, however, also outlines that the award process envisaged a multi-round auction does mitigate against value uncertainties in relation to likely final prices or to identifying which regions will have strong competition. Additionally, minimum prices and how they are derived will be important in providing value information to bidders particularly in low participation scenarios.

5.41 ComReg is therefore of the preliminary view that for this award process a multi-round auction such as the SMRA, SCA or CCA provides the best format for reducing the extent to which common value uncertainty exists. An SMRA provides a degree of price discovery greater than the SCA or CCA as bidders can be given information about individual bids. In this regard, an SMRA may provide more transparency and detailed bidder information in the open rounds. DotEcon however caution that increased information increases the scope for gaming, predatory or vexatious bidding and tacit collusion as described above in 5.2.2. Such behaviours could cause greater disruption and inefficiencies than common value uncertainty.

5.42 Additionally, where a bidder observes price changes or price differences across regions, it may be able to discern certain information about the likely bidders and adjust its strategy accordingly. However, as discussed above, under SMRA or SCA, switching is difficult and therefore the extent to which a bidder can act on such information is limited.

5.43 The CCA is best able to deal with substitution risks therefore where a bidder observes price changes or price differences across regions, bidders are able to move their demand between packages as these prices vary. Additionally, as the CCA uses a second price rule this ensures that bidders only pay a price based on the opportunity cost of denying lots to their rivals. Therefore, the winning price set depends on competition from the bids of others. This ensures that the amount a winning bidder has to pay depends on the amounts bid by others and any winning bid will be of the same magnitude to, at least, the next highest bidder.

5.44 Finally, ComReg considers that any residual uncertainty could be mitigated through the use of a more conservative approach to setting the minimum price. (See Section 5.7). In addition, DotEcon has calculated the current FWALA fees on the same basis (price per MHz per capita) as that of the estimated market price benchmark below. This provides bidders with information on the extent to which the interaction of bidders causes the price to grow in excess of current applicable fees for the band.

5.2.5 **Complexity**

5.45 Complexity is an important consideration because it can lead to inefficient outcomes whereby the bidder who places the highest value on the spectrum fails to acquire that spectrum because of a failure to adequately understand the assignment mechanism and the interaction of bids made by it and other operators. ComReg analysed the extent of complexity across all four auction types in Document 14/101 and so does not restate it here.

5.46 In relation to this award process, ComReg's remains of the view that the SBCA is the least complex for award participants in terms of the mechanics of the bidding process. While combinatorial auctions have more complicated elements than a SMRA auction this complexity is primarily on the auctioneer's side[93]. Package bidding does introduce some complexity, but designing an effective bidding strategy for an award with many lots organised into categories such as this auction adds complexity regardless of the format.

5.47 Facilitating a regional award to allow bidders be assigned spectrum that better suits their business case than national licences creates additional complexity. As described by DotEcon, the greater number of regions leads to an exponential increase in the number of combinations across regions. Under an SMRA, with these additional regions, it could become difficult for bidders to assess their chances of obtaining their desired footprint. This scenario does not arise for auction formats using package bidding where bidders can bid on a package of lots rather than having to bid on each lot independently of other lots in that package. Package bidding simplifies a bidders attempt to aggregate across regions by removing the risk of being stranded with unwanted regions or lots because a bidder either wins a package with all individual lots included, or none at all, and a bidder can only win one of the packages applied for.

5.48 ComReg also noted in Document 14/101 that there is the possibility that small bidders or potential new entrants may lack auction experience and the resources to invest in substantial auction preparation and development of bid strategy. ComReg notes that such factors might be present in this award process given that the likely participants consist of:

[93] DotEcon note that given the computational complexity associated with a regional award of more than five regions given the large number of lots available, it may be necessary to impose some restrictions on the bids that can be made. A common approach to this is to limit the total number of packages each bidder can bid for, rather than excluding some lot configurations. This simplifies the computations needed, while at the same time it should not excessively constrain bidders unless many small regions are used, as many of the theoretically possible lot combinations are unlikely to be commercially rational. See section 2.4 of the DotEcon report

- incumbents or new entrants with little experience of spectrum auctions of the type described above; and
- new band entrants who may have the experience of the 2012 MBSA where similar award mechanisms were considered.

5.49 In its response to Document 14/101, 3IHL expressed the view that the auction should not be overly complex, and in relation to the 3.6 GHz band, some bidders could be placed at a disadvantage if the rules are too complex to implement their bidding strategy. In that regard, and in consideration of the above, the design of the proposed award process should, to the extent possible, seek to minimise the complexity for bidders. In this regard, ComReg will assist all bidders in developing a detailed understanding of the auction rules through, for example, the running of workshops, mock auctions and providing the tools necessary for bidders to simulate auction conditions.

5.2.6 ComReg's Preferred Auction Format

5.50 In selecting a suitable auction format, and taking account of the discussion above, the selected auction format should be the one that, on balance, best achieves the following objectives:

- the auction should be transparent, to the extent possible without facilitating gaming opportunities, and easily understood by potential bidders;
- the auction should allow bidders to place bids on certain regions without having to acquire spectrum on a national basis but should also be flexible enough that bidders are able to construct their preferred geographic aggregations (including the acquisition of spectrum on a national basis);
- the auction format and rules should minimise the risk of inefficient outcomes for bidders and allow all operators to express their demand without creating excessive complexity ;
- the auction should encourage participation in the process and avoid outcomes where spectrum goes unsold despite efficient demand existing for that spectrum;
- the auction should allow bidders to switch between lots and regions in light of the price other bidders are willing to pay for rights of use; and
- the auction should promote incentives for bidders to engage in a manner expected of normal competition, and not to engage in strategic or collusive behaviour.

5.51 In light of the foregoing and having considered the DotEcon report, responses to Document 14/101 and in light of its statutory functions, objectives and duties, ComReg is of the preliminary view that a CCA is the auction format best suited to deal with the considerations outlined in this paper. In particular, the CCA:

- avoids the aggregation risks associated with the SMRA by allowing bidders the opportunity to bid for a package of lots and ensuring that any package is assigned to the bidder that values it the most;
- allows for the ability to switch across regions without creating an unacceptable risk of gaming or strategic behaviour that weakens competition;
- can mitigate the problem of inefficiently unsold lots through a supplementary bids stage;
- provides limited transparency reducing the likelihood of tacit collusion and strategic demand reduction; and
- is very flexible and can be adapted to cope with a situations where bidders are competing for different amounts of spectrum and want to deploy different services and technologies.

5.52 As discussed in Document 14/101 the SBCA remains the least complex and most easily understood by bidders. It is also best suited to preventing tacit collusion occurring in the award process. However, it does not offer price discovery or allow for adjusting bids after initial bids have been made. Where there is some uncertainty about the value of spectrum particularly in some regions, it exposes bidders who might be wholly or significantly reliant on the 3.6 GHz band to not being able to react to a rival offer for the same spectrum, and choose between alternative targets, thereby posing a threat to business continuity. Furthermore, DotEcon notes that a SBCA would only be suitable if there was sufficient confidence that bidders would be able to determine which packages are relevant for them to bid for in a situation in which there may be a great number of potential packages. However, this is unlikely to be the case, especially if many regions are used and it is necessary to restrict the maximum number of packages that each bidder can bid for. Therefore, ComReg is of the view that a SBCA is unsuitable for the proposed award process.

5.53 The SMRA provides for price discovery and bidders have a high degree of visibility on spectrum value across each region. However, ComReg notes the limitations in region switching afforded by this approach. Furthermore, the aggregation and substitution risks are high in an SMRA award. These may be acute when offering licences on a regional basis, as a bidder might not be

assigned geographically complementary spectrum particularly where the value of several regions collectively may exceed the sum of the values the bidder would pay for the regions individually. While the SMRA can be modified to some degree, such modifications do not eliminate the risks entirely and could even impose penalties and risks on bidders. Finally, as noted by DotEcon, the SMRA is particularly vulnerable to gaming when a regional structure is used. Therefore ComReg is of the view that an SMRA is also unsuitable for the proposed award process.

5.54 The SCA deals with some of the concerns outlined above. It removes aggregation risks entirely by allowing bidders to bid for a package of lots ensuring the auction will end only if each bidder can be assigned a package in full. However a SCA provides strong incentives for strategic demand reduction and also increases the risk of unsold lots where efficient demand exists for those lots. As noted by DotEcon, when bidders can switch across regions, gaming incentives also increase significantly. In this way a SCA could substantially affect the efficiency of the award outcome. Therefore, ComReg is of the view that a simple clock auction is unsuitable for this award process.

5.3 Packaging of available spectrum

5.55 In Document 14/101, ComReg was of the preliminary view that spectrum should be offered using lot sizes of 2 X 5 MHz or 5 MHz.

5.56 The responses to Document 14/101 and Document 14/126 indicated some support for larger block sizes[94] (10 MHz, 20 MHz and 40 MHz) to provide for higher throughput. ComReg however is of the preliminary view that the CCA described above allows for the aggregation of lots by bidders into packages of spectrum that would constitute larger blocks in line with their respective business plans, without the risk of bidders winning only a subset of this demand and not being able to provide for higher throughput.

5.57 The packaging of spectrum into 5 MHz blocks offers more options for bidders in the award. In particular, the smaller blocks provide greater flexibility for any interested parties to tailor the size of a licence to their particular needs while, at the same time, making it possible to accommodate more users within the available spectrum. While it is unlikely that any bidder will require only 5 MHz of spectrum, as bidders reach their demand limit an additional 5 MHz of spectrum might fall within this demand, whereas a larger block size would fall outside that range and a bidder might have to overstate or hold back this marginal demand. In an award that has potential for a range of bidders

[94] Ripplecom, Joint FWA Operators Response, Huawei, Qualcomm.

seeking different bandwidths this could result in spectrum being inefficiently distributed across bidders or remaining unsold. Further, as noted by DotEcon some bidders may want to acquire spectrum rights of use for an additional 5 MHz block to use it as a guard band in certain regions.

5.58 Additionally, for some bidders who may be only interested in providing a relatively niche fixed wireless service requiring smaller amounts of spectrum, smaller block sizes would allow them to efficiently satisfy their demand while at the same time maintaining a lower overall cost for their spectrum rights of use. The aggregation of spectrum into lots of larger size on the other hand could limit bidders' options, potentially pushing them above their actual demand and possibly leading to an inefficient use of spectrum, along with an increase in the associated costs of acquiring such spectrum rights of use.

5.59 ComReg, therefore remains of the view that spectrum should be offered using lot sizes of 5 MHz because such lot sizes accommodate all types of users and technologies since smaller lots can be aggregated to satisfy larger demands. Further, the use of CCA also addresses the needs of some bidders for larger contiguous spectrum assignments.

5.4 Competition Caps

5.60 Limiting the amount of spectrum that each bidder could acquire through the proposed award process is fundamental in ensuring a pro-competitive outcome. In ComReg's view, the main purpose of a competition cap is to ensure that the distribution of spectrum is determined by competition amongst the bidders, subject to ensuring that extreme outcomes which could harm downstream competition do not emerge from the proposed auction.

5.61 For the avoidance of doubt, ComReg would stress that any proposed competition cap would only apply for the duration of the proposed auction and operators would, subject to the licences granted on award and their conditions, be free to trade, lease and combine rights of use of spectrum following the auction to the extent that such rights of use of spectrum are designated as being tradable or leasable and in line with competition law and the legal framework for electronic communications in Ireland.

5.62 In the present case, ComReg would make the following preliminary high-level observations about determining the appropriate level of any competition cap for the 3.6 GHz band:

- There is tension between allowing bidders the opportunity to obtain sufficiently large contiguous blocks of spectrum to meet their existing

and likely future requirements [95] and simultaneously excluding excessively concentrated outcomes where downstream competition would likely be harmed;

- There are similarly competing short-term and longer term competition considerations. For instance, whilst it may appear appropriate to set relatively tight caps with a view to safeguarding the existing level of competition, the same relatively tight caps (particularly where substitutable spectrum rights may not become available for some time) may adversely affect longer term competitive dynamics such as by potentially restricting the ability of operators to provide higher bandwidth services in response to consumer demands over this period;
- a competition cap that is too restrictive could create artificial excess supply, particularly in a band that has a large amount of spectrum available for release, and this may not result in the efficient use of spectrum;
- In ComReg's view, effective competition does not require symmetric spectrum holdings across a spectrum band or bands. For instance, it is possible, particularly in this band, that different operators might choose to adopt different strategies; some may seek to acquire spectrum rights with which to continue providing the existing or similar levels of service capability, whereas others may seek to acquire greater amounts of spectrum with which to provide higher bandwidth services than presently provided in anticipation of likely future requirements. Such differences are not necessarily incompatible with a competitive market; and
- ComReg observes that there are at least two potential categories of users of 3.6 GHz spectrum, as identified in the response to Document 14/101, mobile operators and fixed wireless operators. As such, the competitive dynamics to be taken into account may vary significantly.

5.63 In relation to the last bullet point, ComReg sets out below some further observations on these two potential uses/categories of users in advance of setting out its current thinking on the appropriate competition cap to apply.

[95] `Noting in that regard that ComReg is proposing a licence duration of 15 years and, in the context of fixed wireless services, it is presently unclear whether additional substitutable spectrum rights for such services - and the corresponding operator and consumer equipment for same - are likely to become available during this time)

Fixed Wireless Operators

5.64 Fixed wireless operators are currently providing fixed wireless services across the State on a local area basis. However and as noted by DotEcon, the downstream competitive environment is more difficult to anticipate, as services based on LTE have yet to emerge. There could likely be a different mix of fixed wireless uses post-award. This includes operators who wish to continue providing their current service offering where the provision of same could be important for those consumers who require a more basic broadband service at a lower price. Alternatively, existing operators or new entrants may wish to offer considerably higher bandwidth fixed broadband service based on LTE equipment. As noted by DotEcon, any such services may, at the margins, also be in competition with fixed line and mobile services.

5.65 Given the lengthy timeframe of the proposed rights of use (i.e. 15 years), it is clearly difficult to anticipate the likely evolution of fixed wireless services, from both the demand and supply side, and the future state of competition. As observed above, while the level of a cap may be suitable for fixed wireless operators in the current environment, at a later point over the duration of the licence a tight spectrum cap might restrict the ability of such operators to offer higher bandwidth services. As a result, an important competitive dynamic across a number of relevant markets may be lost in the future.

5.66 In addition, ComReg notes that other “capacity” bands due for release as described in Document 14/101 (e.g. 2.3 GHz and 2.6 GHz) may be unsuitable for fixed wireless use (for example, given limited operator and consumer equipment availability for such purposes in these bands). Therefore, unlike mobile operators, the extent to which reliance can be placed on future awards of spectrum is more limited. Given the nature of the spectrum for award and the likely mix of bidders across different technologies and uses, competition for spectrum should be maximised by providing bidders utmost flexibility to bid for the packages of spectrum that fit their profile. All things being equal, bidders should be able to be assigned sufficient spectrum with which to launch particular services and the competition cap should reflect this as best as possible.

Mobile operators

5.67 Given the nature of their current position in the market, it appears unlikely that mobile operators would seek to use 3.6 GHz spectrum to offer fixed wireless services. However, it appears more likely that MNOs may wish to use this spectrum to provide additional capacity on their networks in order to improve

user performance in areas where capacity constraints exist and/or for backhaul purposes.

5.68 DotEcon notes that it is implausible that downstream competition between mobile network operators could be significantly affected as there is a large amount of spectrum available to allow for a number of winners, each able to obtain sufficiently large bandwidths. At the same time, ComReg observes that, given the growing demand for spectrum that may arise in the future[96] and potentially over the proposed duration of licences, a competition cap could be warranted to prevent any single bidder from acquiring an unduly large amount of capacity spectrum, particularly in the short to medium term.

5.69 ComReg would also take this opportunity to respond to a number of responses to Document 14/101 which focused on more mobile-centric issues in relation to potential competition caps. First, ComReg notes that a number of respondents (Eircom, ESBN and Vodafone) suggested that ComReg should take account of existing spectrum holdings in designing a suitable spectrum cap whereas 3IHL took the opposite view.

5.70 ComReg observes that the primary issue for consideration in this regard is the relationship between the band/s available for award and existing spectrum holdings. For example, Vodafone notes that the design of caps should take into account the differences between the various bands and that a band specific cap should apply in respect of the 3.6 GHz band.

5.71 In that regard, ComReg observes that there are material differences between the technical characteristics of the 3.6 GHz band and the existing assigned mobile spectrum bands (i.e. 800 MHz, 900 MHz, 1 800 MHz, and 2 100 MHz). For example, Vodafone notes that the propagation characteristics for the 3.6 GHz band make this spectrum significantly less suitable for true mobile applications although there may be future mobile use for small cells. Similarly, 3IHL is of the view that, due to its propagation characteristics, the 3.6 GHz band would have limited value for mobile services and is not substitutable for other bands under consideration (2.6 GHz, 2.3 GHz 1.4 GHz, 700 MHz). Therefore, it is unlikely to be substitutable for existing holdings. Given these differences, ComReg considers that existing spectrum holdings should not count towards any competition cap in this particular award process.

5.72 At the same time, ComReg observes that, for certain uses, the 3.6 GHz band may, over time, become more substitutable for other “mobile bands” - the 2.3

[96] ComReg Document 15/62a A cost benefit analysis of the change in use of the 700 MHz radio frequency band in Ireland

GHz and/or 2.6 GHz bands in particular[97]. Accordingly, ComReg notes that 3.6 GHz holdings obtained under this award process may be taken into account for a competition cap of the award of sufficiently substitutable spectrum bands (for example, 2.3 and/or 2.6 GHz) and ComReg welcomes views from interested parties on this issue.

5.4.1 ComReg proposal on caps

5.73 Having regard to the above, this section discusses ComReg's current thinking and proposals on spectrum caps.

5.74 First, ComReg observes that responses to Document 14/101 strongly indicate that the use of the band is likely to migrate towards the deployment of LTE technology. In terms of the provision of fixed wireless services, the Plum Report[98] published in parallel with this paper provides an assessment of potential spectrum requirements necessary per operator to provide high bandwidth fixed broadband services using a state-of-the-art wireless technology such as LTE-Advanced. In forming its conclusions, Plum considers fixed wireless operators, their network configurations, subscribers and market share.

5.75 Based on its analysis, Plum recommends that a minimum of 100 MHz[99] be made available to operators because this amount would be sufficient to provide a high speed (30 Mbps[100] or more) broadband service with similar contention levels to existing cable services and a similar infrastructure density to existing wireless services. Therefore, a competition cap of at least 100 MHz would appear suitable in light of this recommendation.

5.76 MNOs will likely have a far higher subscriber base and the band is likely to be used to provide enhanced network capacity in areas with dense population. The spectrum required to provide this capacity may vary depending on the business case of the operator. Equally, fixed wireless operators may wish to

[97] A number of respondents to Consultation 14/101 (Vodafone, 3IHL, Ripplecom) indicated that the 3.6 GHz band may not be a substitute for the other bands (2.3 GHz, 2.6 GHz, 1.4 GHz, 700 MHz), however this view was not universally held (Eircom).

[98] Document 15/75, A Report for ComReg, Technical advice concerning potential sub-national rights of use in the 3.6 GHz band. Report 3: Analysis of the potential spectrum requirements for NGA services

[99] The 100 MHz uses an infrastructure density comparable to one of today's mobile cellular networks, and Plum state that this amount of spectrum utilising LTE-A could serve up to 30% of all broadband subscribers in a typical suburban area and up to 50% of all subscribers in more rural areas.

[100] Based on the connectivity speed target set in the European Union (EU) Digital Agenda for Europe, which seeks to ensure every household in the EU has access to at least 30 Mbps by 2020.

provide services greater than the 30 Mbps identified by Plum. Therefore, a cap higher than 100 MHz could also be appropriate to account for these factors.

5.77 DotEcon when assessing the options for such a cap balance two objectives:

- to ensure a minimum number of potential winners in each region, so that at least two or more operators in each region should be able to acquire a usable minimum amount of spectrum; and
- to allow bidders to bid for as much bandwidth as possible to provide high-speed, high-quality services in the downstream market which may in turn be important to effective competition with other operators (possibly using other technologies).

5.78 DotEcon sets out a range of scenarios that balances the two objectives above. Clearly, where large amounts of additional bandwidth are required the extent to which a higher number of potential winners in each region can be provided for is constrained. Therefore, when designing a suitable competition cap a trade-off may necessarily exist between competing objectives.

5.79 If ensuring the possibility of three winners, each with a sufficient amount of spectrum to provide a reasonable level of services (say two 20 MHz contiguous blocks or better)[101], was the key objective, DotEcon consider a cap of 150 MHz would be required. In this respect, ComReg notes where one bidder reaches the cap there would be sufficient spectrum to provide for two additional operators with 100 MHz each (the latter being the level identified by Plum as sufficient to provide a download speed of 30 Mbps[102]). While this would appear to allow a greater number of operators to compete post-award, given the nature of the award spectrum there is no certainty that winning bidders will be competing in the same markets.

5.80 On the other hand, if the key objective was to enable bidders to acquire amounts of spectrum greater than 150 MHz so as to provide even higher bandwidth services (for example, 240 MHz as identified by Imagine in its response to Document 14/101), then a cap at this level (i.e. 240 MHz) would provide for one additional operator with 110 MHz, marginally above the level identified in the Plum report, or multiple operators with lower bandwidths. In

[101] A number of respondents to consultation 14/101 suggested that they would require 20 or 40MHz of spectrum. In line with this, Plum Report 3: Analysis of the potential spectrum requirements for NGA services, Document 15/75, suggests that using multiples of 20MHz blocks can be expected to maximise spectrum efficiency and ensure that there is sufficient capacity at each base station to support multiple simultaneous, high-speed connections.

[102] With similar contention levels to existing cable services and a similar infrastructure density to existing wireless services.

that regard, DotEcon notes that if there was less concern with ensuring three operators with sufficient spectrum, and the focus instead was on ensuring that there is the possibility of an operator obtaining sufficient spectrum to provide enhanced services, then a cap at 240 MHz might be appropriate. Even at these levels, and given the nature of the award spectrum, it is not clear that long-run downstream competition would be materially lessened, particularly when taking a longer-term view of potential competitive dynamics.

5.81 In light of the above and based on the information currently before it, ComReg is of the preliminary view that it is appropriate to consider a competition cap for the 3.6 GHz award within the range of 150 – 250 MHz. In that regard, ComReg observes:

- at the lower end, a cap below 150 MHz may not be sufficient for operators seeking to provide speeds substantially in excess of the 30 Mbps identified by Plum. Further, a cap below 150 MHz might be too restrictive and could create artificial excess supply (with corresponding issues with respect to efficient use of spectrum) and/or an increased likelihood of more symmetric outcomes which could affect competition in the auction;

- the upper bound would provide for one bidder to obtain up to 250 MHz, while also allowing the potential for another bidder to obtain at least 100 MHz (being the level identified by Plum as sufficient to provide a download speed of 30 Mbps). However, such a cap also allows two bidders to obtain the entire 3.6 GHz band, potentially harming competition. Further, a cap greater than 250 MHz would only allow one operator to be capable of providing download speeds of 30 Mbps which may not sufficiently safeguard short-term and longer-term competition;

- its proposal has been largely informed by material more pertinent to fixed wireless services. This is because, amongst other things, there is more certainty around the services likely to be provided by fixed wireless operators in the 3.6 GHz band (in contrast to greater uncertainty about the nature of potential and likely use/s of this spectrum band by MNOs, including corresponding spectrum requirements) and the Plum Report has provided ComReg with an assessment of the potential spectrum requirements necessary for a high speed (30 Mbps or more) broadband service with similar contention levels to existing cable services and a similar infrastructure density to existing wireless services; and

- Notwithstanding the previous bullet point, there is no reason to believe at this stage that a competition cap within this range would not be suitable for both fixed and mobile uses.

5.82 Given the above, ComReg welcomes views and supporting material from all interested parties in relation to its proposals.

5.5 Unsold lots

5.83 The particular approach for dealing with unsold spectrum rights of use will depend on the amount and type of spectrum that is unsold. ComReg is of the view that discretion is required on how to proceed if the issue of unsold spectrum rights of use becomes a reality. This is to avoid providing a negative incentive to bidders to strategically withhold demand during the auction in the hope of being assigned this spectrum on the same or more preferable terms as those offered in the auction in a follow-up process.

5.84 Therefore, for the purpose of this award process, ComReg is of the view that it should retain its discretion regarding how it might treat any unsold spectrum lots depending on the factual circumstances arising from the award process, save that it intends that unsold lots will not be assigned for a reasonable period after the process has ended.

5.6 Frequency Generic V Frequency Specific Lots

5.85 As discussed in Document 14/101 spectrum can be awarded on a frequency-specific or frequency-generic basis. If the lots are awarded on a frequency-generic basis, the award process would feature an assignment stage for determining the specific frequencies assigned to each winner of the frequency generic lots.

5.86 The main reason for using frequency-generic lots is that this can greatly simplify the number of alternative combinations bidders need to consider when determining whether they wish to acquire any spectrum. This is particularly relevant in this award process where a large amount of spectrum (350 MHz) is available for assignment. Where any bidder requires a certain position in the band, it will have an opportunity to reflect that preference in the assignment stage that follows.

5.87 In this award there are different technologies and uses that bidders could deploy in the band and packaging spectrum into fixed frequency lots could disadvantage one business model or group of users over another. By removing the complexity of bidders placing bids in order to target frequency

specific blocks, bidding becomes easier as bidders focus on the size of their preferred package during the main stage, and only consider the position in the band in the assignment round.

5.88 As outlined in Chapter 4, a portion of the band (3 435-3 475 MHz) is in use by State services and these services are likely to continue into the future beyond the anticipated timeframe of the award process. This fragments the 3.6 GHz band and creates non-contiguous lots at the point above and below the 3 435-3 475 MHz portion of the band. ComReg is of the preliminary view that in order to avoid a scenario where a winner of spectrum[103] has no choice but to be awarded non-contiguous spectrum, the 3 410 – 3 435 portion of the band should be offered as a single frequency specific block. This allows bidders certainty that all bids placed on any frequency generic lots are available on a contiguous basis in the assignment phase and no winning bidder will be stranded with non-contiguous lots. Bidders would place bids on the frequency-specific lot in full knowledge of the position of that lot in the band.

5.89 Accordingly, ComReg proposes that two lot categories are defined for this Award Process:

- A single 25 MHz frequency-specific lot using frequency 3 410 MHz – 3 435 MHz; and
- 65 5 MHz frequency-generic lots between the frequency 3 475 MHz – 3 800 MHz.

5.90 In addition, DotEcon advises that it is possible to guarantee that all winners who win the same bandwidth in every region are assigned the same frequency range in all regions.

5.7 Fees

5.91 This section considers matters in relation to fees that would potentially apply to rights of use assigned under the proposed award process. In this section, ComReg:

- assesses the preliminary views set out in Document 14/101;
- considers DotEcon's benchmarking report and recommendations (Document 15/72); and

[103] In the case where all lots are sold, it is possible that one or more winners would be assigned lots that are non-contiguous.

- sets out the proposed upfront SAF and SUF that will be applicable to rights of use awarded under the proposed award process.

5.7.1 Assessment of preliminary views set out in Document 14/101

5.92 Chapter 6 of Document 14/101 considered a number of matters regarding fees in relation to an award of the 2.6 GHz band and other bands that might be included in that award, including the 700 MHz, 1.4, 2.3 and 3.6 GHz bands. Taking into account, amongst other things, DotEcon's recommendations, ComReg set out its then position in relation to the setting of a minimum price for those bands as part of a multi-band spectrum award process. These included:

- the relevance of minimum prices to the proposed award process;
- the possible approaches for setting the minimum price;
- the minimum price structure; and
- the minimum price split.

5.93 ComReg's discussion in Document 14/101 on the above issues centred around its then proposal for a multi-band award process. However, as discussed earlier in Chapter 3 above, it is now ComReg's proposed intention to proceed with a separate award process for the 3.6 GHz band. Given that the 3.6 GHz band formed part of ComReg's consideration of minimum prices in Document 14/101, and given that a number of respondents[104] to Document 14/101 raised specific issues in respect of minimum prices, it is appropriate to consider below whether the preliminary views on minimum prices reached in Document 14/101 are still appropriate for an award of the 3.6 GHz band in a stand-alone award process.

Relevance of minimum prices

5.94 In summary, ComReg was of the view that a minimum price is warranted where there is an opportunity for bidders to obtain access to valuable spectrum at a price below its real economic value[105]. Such an opportunity provides bidders with an incentive to keep the price of spectrum artificially low.

[104] ESBN, Eircom, Imagine, 3IHL and Vodafone.

[105] Three sought clarification on the meaning of the real economic value. In this context, ComReg considers that the price of spectrum should be reflective of its value for an alternative user, who cannot obtain (any or additional) spectrum due to the limited availability of frequencies. Therefore, by real economic value, ComReg means the highest value that spectrum would have to potential alternative acquirers, if it were not assigned to the user actually acquiring it. For example, this value may be realised in a secondary transaction given that spectrum is tradable.

Furthermore, given ComReg's statutory objective of promoting competition, the proposed award process should minimise the opportunity and incentive for participants to engage in any collusive behaviour which could compromise the proposed award process and lead to distortions of competition in downstream markets. A minimum price assists in providing for the efficient assignment and use of spectrum by ensuring that the spectrum is awarded to those users that value it the most.

5.95 In the 3.6 GHz band there is the potential for substantial differences in the business case of interested bidders. The majority of this band is currently licensed to FWALA service providers on a local area basis which has helped facilitate WBB services in small towns and rural areas. MNOs, on the other hand, may find this band more suitable for urban deployment as hot spots or additional mobile capacity and there also remains the possibility for interested bidders to emerge from beyond these groups.

5.96 In its response to Document 14/101, Imagine questions the need for a minimum price in the 3.6 GHz band as it could, in its view, have serious unintended consequences. ComReg, however, considers that the 3.6 GHz band is likely to be valued by bidders, given the various types of potential users. In that regard, it is appropriate to have a minimum price to mitigate the potential for strategic bidding, particularly in light of the regional dimension of the proposed award. The auction design therefore needs to be robust. Minimum prices are also an important tool for reducing the incentives for such behaviour. A suitably considered minimum price should minimise the ability and incentive for any collusive behaviour before or during the award process. ComReg therefore remains of the view that the application of minimum prices is appropriate for the proposed award process.

5.97 Ripplecom suggests that the cost of a licence should be affordable for companies wishing to provide rural broadband services. Service and technology neutral principles will apply in respect of the 3.6 GHz band and ComReg has additionally set in place certain measures to provide for the possibility for the existing licensees to use this spectrum under transition arrangements (see for example the transition proposals as outlined in Chapter 7). The award format offers all bidders the opportunity to acquire spectrum on a regional basis, while offering flexibility over the amount of spectrum required. Finally, as described below, the minimum prices are set within a conservative range and are only modestly above current FWALA fees even accounting for the more valuable nature of this award spectrum.

5.98 Therefore, in respect of the level at which a minimum price should be set, a number of factors which should inform that decision and that are relevant to the proposed award process, including that:

- the minimum price should not be set so high as to choke off demand of serious bidders;
- awarding spectrum below the real economic value would lead to an inefficient assignment which would in turn fail to meet ComReg's statutory objectives;
- the minimum price should not be set so low that there is participation by frivolous bidders; and
- the minimum prices should not facilitate collusive behaviour (whether tacit or explicit) or otherwise fixing demand.

The possible approaches for setting the minimum price

5.99 In their responses to Document 14/101, ESBN and Vodafone expressed concern with ComReg's view that minimum prices should be established in line with an estimate of market value to ensure that spectrum is not assigned at a low value in the event of short run demand and to provide a safeguard against assigning lots to low value users in these scenarios.

5.100 However, as described below, and in Document 14/101, this approach does not set out to predict the final winning price but to derive a conservative lower bound estimate of the minimum price. As a result, the minimum price will be set at the minimum level necessary to ensure the efficient use of the radio spectrum. ComReg is of the view that assigning spectrum at a low value to low value users in the event of short run demand would not to be aligned with the objective of ensuring an efficient use of the spectrum over the whole duration of the licence period. Where short run demand exists, certain bidders could inefficiently hold spectrum for the period between the time that short term demand begins to expire and the end of the licence. In that regard, ComReg remains of the view that the minimum price should be set by reference to a conservative estimate of the market value of the spectrum.

5.101 ComReg considered four possible approaches to determine minimum prices. These were:

- low but non-trivial;
- administrative costs;
- business modelling; and

- benchmarking.

5.102 ComReg considered that minimum prices set by reference to (i) **administrative costs** or (ii) **low but non-trivial** approach are both derived independently of the market value of the spectrum and therefore neither can realistically reflect the economic value to the user.

5.103 Eircom, 3IHL and Vodafone outline that a better approach to setting minimum prices could be to set prices at some discount from an established benchmark or set solely to deter frivolous participation in the award process. In this regard, ComReg continues to hold the view that bidders may have an incentive to bid strategically to keep prices low in certain areas given the regional nature of this particular award. Setting prices at a low but non-trivial price is likely to be substantially below the market value of the spectrum. With prices starting at such levels, bidders have a strong incentive to behave strategically to keep prices at close to that level. Furthermore, as discussed by DotEcon[106], low participation levels[107] could lead to less intense competition if bidders have incentives to bid conservatively to keep prices low. Therefore, ComReg remains of the view that minimum prices should not be set either by reference to administrative costs or according to a low but non-trivial approach.

5.104 **Business modelling** involves creating a model in order to assess bidder's likely willingness to pay. In Document 14/101, ComReg was of the preliminary view that business modelling is inappropriate as an approach to determining minimum prices for the following reasons:

1. there could be a substantial difference in the business case of interested bidders;
2. large information asymmetries exist between the seller and bidder;
3. there is a large amount of uncertainty surrounding the results of the modelling process; and
4. transparency would be difficult.

5.105 As noted earlier, the 3.6 GHz award is likely to see notable differentiation in bidding patterns and by extension the likely business cases. It is therefore difficult to assign a minimum price using business modelling that accurately reflects the likely end use of winning bidders, where those winning bidders are likely to have separate and distinct business models.

[106] Section 6.2, Document 14/102.

[107] This could be more likely to arise in certain regions.

5.106 Furthermore, large information asymmetries remain between the buyer and seller in valuing the relevant spectrum, a factor further exaggerated by the variance in likely bidders. Additionally, small bidders, who may form part of a consortium, would likely be unwilling to share with potential competitors post auction the confidential data required to accurately complete the modelling process. Therefore, there may also be an asymmetry between different buyers.

5.107 **Benchmarking** estimates the value of lots using observed prices in concluded awards, and adjusts to take account of differences between awards and transactions. Consistent with the view expressed in Document 14/101 and having again considered the alternative methods above, ComReg considers that this is also the best approach to setting minimum prices in a standalone 3.6 GHz award process. In particular, it can overcome the information asymmetries apparent in other approaches because it has the advantage of revealing information about the actual willingness to pay for spectrum. In this respect, the minimum price will not act as a basis for bidders to behave strategically but instead will provide for the efficient assignment and use of spectrum by ensuring that spectrum is awarded to those who value it the most.

5.108 ComReg notes that there are limited data points that could be used in order to derive a benchmark for the 3.6 GHz band and an appropriate interpretation needs to be applied to the data. ESBN expressed the view that ComReg should reconsider the use of benchmarking in light of the limited data. However, as set out in the DotEcon Report, the approach recommended is to derive a minimum price benchmark using the 3.6 GHz band, with further data points from the 2.3 GHz and 2.6 GHz bands[108] acting as a reference point to enable a conservative estimate of the full market value of the award spectrum. In addition, DotEcon has estimated the current FWALA fee structure on a similar basis in order to ensure that the minimum price for 3.6 GHz spectrum does not vary significantly and only accounts for the increased value of the award spectrum.

5.109 As noted in Document 14/101, ComReg's proposed approach to benchmarking does not set out to predict the final winning price but to derive a conservative estimate of the minimum price. In this way, the benchmarking approach used by DotEcon minimises the risk of setting a minimum price that chokes off efficient demand and the final price will be determined solely by the competitive interaction of bidders in the proposed award process even where such benchmarking is based on limited data points..

[108] DotEcon take full account of the different technical values due to the more favourable propagation characteristics in the 2.3 and 2.6 GHz bands.

5.110 Therefore, for the reasons stated in Document 14/101 and above, ComReg's preliminary view is that it is appropriate to use benchmarking as an approach to determine a conservative minimum price in the stand-alone 3.6 GHz award process. ComReg remains open to any other approaches, beyond those identified in this section, as to how minimum price levels could be established.

Minimum Price Structure

5.111 In Document 14/101 ComReg outlined its preliminary view that minimum prices should consist of a two-part payment structure composed of an upfront fee ("SAF") and an ongoing stream of indexed Spectrum Usage Fees ("SUFs"). ComReg notes Eircom's suggestion that SUFs not be set due to the presence of a secondary trading regime. However, as discussed in Document 14/101 and its most recent spectrum strategy statement there may be little incentives for spectrum rights of use holders in harmonised bands to trade with competitor firms and initial experience would seem to bear this out. As such, SUFs should be viewed as a complimentary tool in ensuring efficient use rather than a replacement for it. Furthermore as described in below SUFs could encourage the participation of less resourced bidders.

5.112 In Document 14/101, ComReg considered that a two-part payment structure was appropriate for the following reasons:

- paying SUFs on an ongoing basis during the licence period would encourage licence holders to consider the opportunity cost of holding rights of use throughout the period of the licence;
- a real financial outflow (i.e. the SUF) will provide a stronger incentive than an opportunity cost alone (i.e. the revenue forgone from not trading) to use spectrum efficiently;
- SUFs should remain helpful in the event that the secondary trading spectrum market does not function properly;
- SUFs encourage efficient use of the full assignment as opposed to seeking partial transfers from the spectrum trading regime; and
- SUFs encourage those operators who have no desire to retain spectrum but do not wish to trade spectrum, to return it to ComReg.

5.113 ComReg considers that all of these factors are equally relevant in a separate 3.6 GHz Award and that the proposed award process should have a two-part payment structure composed of an upfront SAF and an on-going stream of

indexed SUFs. SUFs would be index-linked to the overall Consumer Price Index ("CPI") as published by the Central Statistics Office of Ireland or its successor to ensure that the real value of the SUF is maintained throughout the entire license period. As the CPI may vary over time, the SUF per Lot may increase or decrease over the duration of the 3.6 GHz Licence based upon the increases or decreases in the CPI for the relevant time period.

Minimum Price Split

5.114 In Document 14/101, ComReg was of the preliminary view that the minimum price should be apportioned on a 50/50 basis for the capacity bands consistent with the approach adopted in the MBSA.

5.115 DotEcon is of the view that considerations affecting this split are similar for this award as for the MBSA.

5.116 As described in Document 14/101 and now more specifically in relation to the 3.6 GHz award, annual fees may encourage efficient use of spectrum by incentivising licensees to hand back part or all of their spectrum holdings in the event that they no longer have use for the spectrum. The introduction of spectrum trading could potentially reduce the importance of SUFs in encouraging the efficient use of spectrum, and therefore a smaller proportion of the minimum price could be accounted for by SUFs. However, as noted in Document 14/101, the spectrum trading regime and SUFs should be seen as complementary and should be helpful in the event the secondary trading market does not function properly[109].

5.117 DotEcon outlines that deferring part of the balance of payments across upfront fees (SAFs) and ongoing payments (SUFs) allows bidders to spread a portion of the cost of licences over the licence duration. This is particularly true for less well-resourced bidders, increasing participation and strengthening competition in the auction. More generally, SUFs incentivise bidders to re-assess their need for spectrum on account of annual fees payable to retain their spectrum holdings. This promotes the continued optimal use of spectrum to the benefit of competition in downstream markets.

5.118 Equally, a larger upfront SAF would make it more likely for a winning bidder to retain spectrum inefficiently since the SAF would act as a larger sunk cost and the lower relative SUF might not be sufficient to encourage either efficient exploitation of the spectrum or the return of unused spectrum. Given that the

[109] As outlined by DotEcon, this may occur due to bargaining inefficiencies, where a deal fails to be agreed even where mutually beneficial, and coordination failures, where an efficiency improvement might involve many parties.

considerations affecting this split are similar to the MBSA, ComReg sees no rationale for reducing the relative importance of the annual fees.

5.119 ComReg considers that a balance is necessary between an upfront SAF that deters frivolous bidding compromising the award process and annual payments that provide ongoing incentives for the return of unused spectrum. Therefore, and taking into account the views expressed by DotEcon, ComReg is of the preliminary view that the minimum price splits for this award should be apportioned on a 50/50 basis.

5.8 DotEcon Benchmarking Approach for Minimum Prices

5.120 DotEcon has developed a benchmarking approach to setting minimum prices. DotEcon outlines three steps used to estimate a suitable benchmark for the 3.6 GHz band. These are:

1. Estimate the minimum price of the 3.6 GHz band using available auction data.
2. Estimate the minimum price of the 2.3 and 2.6 GHz bands in order to derive a value attached to harmonisation and LTE capability.
3. Estimate the value of the 3.6 GHz band taking account of harmonisation and LTE capability.
4. Adjust the minimum price in each region to take account of population flows to each region and the higher density in urban regions.

5.121 As set out in Document 14/101, DotEcon was of the view that minimum prices should be established in line with an estimate of market value since this is best aligned with ensuring the objective of an efficient use of spectrum over the whole duration of the licence. Imagine, 3IHL and Vodafone all expressed concern with the use of the 2.6 GHz band as a reference to determine a minimum price for the 3.6 GHz band. However, the DotEcon report outlines why such a reference point is appropriate and note that while the 2.3 GHz and 2.6 GHz band benchmarks are likely to provide high estimates they are only used to provide useful information about the likely market price of 3.6 GHz spectrum. Furthermore, Vodafone argues that minimum prices should not be set using high prices which it claims occurred in some countries due to artificial spectrum shortage. As described below, DotEcon exclude outliers where the price of spectrum for certain awards passes a threshold above those the price in other comparator countries. In this way, the final benchmark excludes data points that could result in the minimum price becoming artificially high.

5.122 Finally, it should be noted that, the minimum price chosen by ComReg does not aim to predict the final market value of the spectrum, instead it determines a conservative minimum price estimate based on previous experience of bidders willingness to pay in other jurisdictions.

5.123 The benchmarks estimated by DotEcon are presented as average auction prices on a per MHz per capita basis. Individual minimum prices were adjusted for currency differences using Purchasing Power Parity (PPP) exchange rates to account for price differences across countries and converted into a common currency (US Dollar). This is because the dataset includes a wide range of countries far beyond just the Euro area. Prices in US dollars in the year of the award are then adjusted for USD inflation using monthly CPI data published by the US Bureau of Labour Statistics. This establishes comparable prices in real US dollars which is ultimately expressed in Euro.

5.8.1 The 3.6 GHz Band

5.124 DotEcon notes that most of the available international auction benchmarks in respect of the 3.6 GHz band are dated. The use of the band for LTE is a recent development in terms of harmonisation and equipment availability and previous international awards in respect of the band would not have factored this into the final spectrum valuation. Therefore, DotEcon expects the 3.6 GHz benchmarks to provide estimates of the value to existing users of the spectrum, and this may underestimate the value to mobile operators or existing users that wish to migrate their networks to LTE.

5.125 DotEcon outlines that such an underestimate is unavoidable given the increased deployment of LTE in the 3.6 GHz band. The increasing use of these frequencies for LTE is likely to increase demand for the band in the future, as data rates increase rapidly[110], and therefore should be reflected in the value of the 3.6 GHz band for this award process. Therefore, the initial 3.6 GHz benchmarks set out by DotEcon do not take account of the likely future use of the band which ultimately is reflected in its value to users. Specifically, DotEcon note "*it is unlikely that bidders in these awards would have based their valuations for 3.6GHz licences based on the future use of the spectrum for TDD-LTE (and even if such future use were anticipated, it might have been heavily discounted to reflect the uncertainty about this possibility)*". [111]

[110] A cost benefit analysis of the change in use of the 700 MHz radio frequency band in Ireland. – Frontier Economics

[111] Para 17 Document 15/71 DotEcon Benchmarking Report.

5.126 A sample of 23 auctions is available for the 3.6 GHz band, fifteen of these from Europe. The sample average across all regions, adjusting for outliers[112] (Jordan, Switzerland, Bahrain) comes to €0.0158 (per MHz per head of population). However, DotEcon observes the average across all regions is still significantly above auction prices seen in Europe over the last 10 years. Removing non-European auctions, and adjusting for outliers, sees the amount drop to €0.0064/MHz/pop, less than half the wider sample across all regions. DotEcon points out that these benchmarks are unlikely to reflect the value to an operator using the spectrum for LTE, and as such they are likely to underestimate the current market price of 3.6 GHz spectrum.

5.127 ComReg agrees with DotEcon that the 3.6 GHz benchmarks described above may underestimate the potential value of the award spectrum. While the usage at the time of the international benchmarks corresponds to the current use of the band in Ireland, it pre-dates any more advanced use through, for example, the deployment of LTE technologies. Furthermore, the benchmarks would not reflect the greater value of the spectrum since the time of auctions used in the benchmark due to harmonisation of the band and increased equipment availability.

5.8.2 **The 2.3 and 2.6 GHz Bands**

5.128 The approach recommended by DotEcon to account for the additional value likely to be obtained by bidders utilising LTE technology is to draw upon benchmarks of other TDD-LTE bands, including 2.6 GHz band and 2.3 GHz band. Therefore, DotEcon benchmarked the 3.6 GHz, 2.6 GHz and 2.3 GHz bands in order to arrive at the likely market prices of 3.6 GHz spectrum. However, the 2.3 GHz and 2.6 GHz bands are likely to have a higher value compared to the 3.6 GHz band, in that these bands have greater equipment availability and superior propagation. As such 2.3 GHz and 2.6 GHz spectrum benchmarks would need to be adjusted downward to reflect the likely value differences between these bands.

5.129 A sample of 10 auctions is available for the 2.6 GHz band, with 8 from Europe. DotEcon estimates that the average price of 2.6 GHz spectrum amongst the available international benchmarks is €0.0297/MHz/pop. Removing non-European auctions increases the sample average value to €0.0333/MHz/pop.

[112] The DotEcon approach to outliers is to exclude extreme values associated with atypical outcomes. An outlier is a data point far removed from the rest of the sample. DotEcon rule that this occurs if the observation lies more than three standard deviations away from the sample mean and or if the observation lies beyond three times the interquartile range of the sample.

5.130 There is a small sample of available benchmarks (7 auctions) for the 2.3 GHz band including just one in Europe (Norway). DotEcon estimates that the average price of 2.3 GHz spectrum amongst the available international benchmarks, excluding outliers (India), €0.0279/MHz/pop. Restricting the sample to those auctions from 2010, where the winning bidders have subsequently deployed LTE networks in the band, increases the average to €0.1125/MHz/pop.

5.8.3 **Final DotEcon estimate for 3.6 GHz band**

5.131 In noting that the 3.6 GHz band is likely to be worth less than either the 2.3 or 3.6 GHz bands due to a lower technical value, DotEcon is of the view that the estimates for 2.6 GHz and 2.3 GHz suggest that setting a minimum price at €0.03 (per MHz per capita) or above would run some risk of choking off demand in the 3.6 GHz band. In that regard, DotEcon recommends not exceeding a minimum price of €0.03 per pop per MHz.

5.132 DotEcon however are "*reasonably certain that setting the minimum price at the average licence price from international benchmarks for awards of 3.6GHz spectrum (€0.016 per MHz per capita) is unlikely to choke off demand*".[113] DotEcon estimates that, based on current FWALA fees, the NPV of the minimum cost of obtaining national coverage by combining FWALA licences would range from €0.007 to €0.02[114] per MHz per capita. Therefore, a minimum price of about €0.016 would fall within (for smaller channels only) the current range of FWALA licensing fees.

5.133 DotEcon conservatively suggest setting minimum prices in the range of between €0.015 and €0.025, noting that a minimum price of €0.025 would involve a marginally greater risk of choking off demand, but that this might have the advantage of discouraging collusive bidding and gaming behaviour in the auction.

5.134 In consideration of the views provided by DotEcon, ComReg is of the view that the conservative range of €0.015 to €0.025 (per MHz per capita) as recommended by DotEcon is appropriate. This conservative minimum price would run little risk of choking off demand and would satisfy each of the factors relevant to the minimum price as stated in Section 5.7.1 above. ComReg,

[113] Para 63, Benchmarking Report.

[114] This was calculated assuming an indicative 67 licences required to provide sufficient coverage to serve the national population.

however, remains open to receive any further information that may inform how it arrives at its final minimum price.

5.8.4 Population and density adjustment

5.135 DotEcon outlines that experience from international auctions (See Annex 2 of the DotEcon report) suggest that urban regions command a higher spectrum price than less populated regions. Two reasons are outlined for this:

1. Urban areas have a population inflow above the residential population due to commuting into urban centres.
2. Population density is higher in urban areas, which is likely to reduce the unit costs of providing capacity and enhance the value of spectrum.

Population adjustment

5.136 It is necessary to calculate the extent to which the population of each region varies according to commuting patterns of the Irish population. In this regard, the Central Statistics Office has provided data on the communing patterns of the Irish population.[115] This allows the proportion of the population that commutes from each region into each urban centre (the five cities) to be accurately calculated. This approach considers both the flow in an out of each of the five cities in order to calculate the net flows.

5.137 For example, the population of Dublin City and Suburbs is 1,110,627 people. Additionally, 117,764 persons commute to Dublin each day with a further 35,860 travelling outside the region, giving a net flow of 81,904. This represents a 7.4% uplift for the Dublin region. Each region outside of the urban centres are correspondingly adjusted downwards to account for the flow of population outside those regions. This is repeated for each of the cities and regions with adjusted populations as seen below.

5.138 Table 1 below does not include a population adjustment as these regions as set out by the WISPS do not define cities separate from each of the regions[116].

[115] The CSO provided ComReg with a detailed tabulation from Census 2011 outlining the flows of commuters in and out of the five cities, see Annex 6:

[116] If, one was to take Dublin County, for example, as an urban area the population would rise by 6.5% or 82,049.

Density adjustment

5.139 DotEcon observes that there are no simple means to relate population density to unit costs and hence to spectrum valuations. This is made more difficult because this population cost relationship is likely to vary across different operators and uses. However, DotEcon adjust for this effect by using a higher price per MHz per capita, within the conservative range, when calculating the minimum price for regions with a high population density.

5.140 Therefore, in Table 1 below which incorporates the Joint FWA Proposal as described in Chapter 4, €0.0162 is applied to each region outside Dublin County. For Dublin County, €0.25 applies given the high population density associated with that region[117].

5.141 In Table 2, €0.015 applies to all non-urban regions and €0.025 for each of the five major cities.

5.9 Upfront SAF and SUFs for this Award Process

5.142 As outlined in Chapter 4, the proposed award process consists of individual regions which can be combined to form larger sub-national regions or as one national region if desired by winning bidders.

5.143 The minimum fees below in Table 1 and 2 correspond to the regions as set out in Chapter 4. The minimum fee for a 3.6 GHz Licence consists of a minimum Upfront Fee SAF which is paid at the end of the Award Process and annual Spectrum Usage Fees SUFs which are paid prior to the first grant of the 3.6 GHz Licence and then over its duration. These are set out below in Tables 1 and 2 and are calculated using the per MHz per capita benchmarks described above.

[117] 1,378 persons per Km2. See Table 7 DotEcon Report.

Table 1: Minimum Price (5 MHz block), SAF & Annual SUF per each region (1)

Regions	Pop per Region	Minimum Price, €	Minimum SAF, €	SUF[118], €
Borders	449,498	36,000	18,000	1,860
Connaught (less Leitrim)	510,749	41,000	20,500	2,118
Leinster (less Dublin & Louth)	1,108,848	90,000	45,000	4,650
Munster	1,246,088	101,000	50,500	5,218
Dublin County	1,273,069	159,000	79,500	8,215
Total	**4,588,252**	**427,000**	**213,500**	**22,061**

[118] Subject to CPI index link

Table 2: Minimum Price, (5 MHz block) SAF & Annual SUF per each region (2)

Regions	Pop per Region	Adjusted Pop	Minimum Price, €	Minimum SAF, €	SUF[119], €
North East	1,232,502	1,159,458	87,000	43,500	4,495
North-West	626,906	608,768	46,000	23,000	2,377
South-East	446,059	432,824	32,000	16,000	1,653
South-West	753,825	711,786	53,000	26,500	2,738
Dublin City & Suburbs	1,110,627	1,192,531	149,000	74,500	7,698
Galway City & Suburbs	76,778	92,623	12,000	6,000	620
Limerick City & Suburbs	91,454	105,135	13,000	6,500	672
Cork City & Suburbs	198,582	225,086	28,000	14,000	1,447
Waterford City & Suburbs	51,519	59,159	7,000	3,500	362
All Regions	**4,588,252**	**4,588,252**[120]	**427,000**	**213,500**	**22,062**

5.144 ComReg has applied a real discount rate of 7.13%[121] to adjust the Net Present Value (NPV) for a 3.6 GHz Licence with a duration of 15 years. This yields a variety of minimum SAFs for each individual region ranging from €74,500 per lot for Dublin City and Suburbs to €3,500 per lot for Waterford City and Suburbs. The associated SUF varies according to each region ranging from

[119] Subject to CPI index link

[120] The difference between the adjusted population and non-adjusted population is accounted for by the 882 persons commuting outside Ireland.

[121] ComReg, 2014, Cost of Capital, Document 14/136 and D15/14 outlines a nominal discount rate of 8.63%. Inflation rate of 1.5% is used to calculate the real discount rate of 7.13%.

€7,698 plus CPI to €362 The SUFs due will be calculated in advance of the commencement of the licence and each subsequent anniversary.

5.145 In relation to the single 25 MHz frequency-specific lot using the frequency 3 410 MHz – 3 435 MHz as referred to in Section 5.6 above, the same minimum fees (minimum SAF and SUF) in multiples of 5 apply in respect of each of the regions.

5.10 Chapter 5 Consultation Question

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

- a combinatorial clock auction is the preferred auction format;
- a single 25 MHz frequency-specific lot be adopted for frequency 3410 MHz – 3435 MHz;
- Sixty five (65) frequency-generic lots of 5 MHz each should be adopted for frequencies between 3475 MHz – 3800 MHz;
- a competition cap should be set and, further, that such a cap be within the range of 150 MHz to 250 MHz. ComReg is mindful of the alternative uses to which this spectrum can be put and the potential impacts this can have on competitive dynamics in the relevant market concerned (for example fixed of mobile). Accordingly, ComReg welcomes input on any other factors which should be taken into account when establishing the level of any competition cap;
- benchmarking be used as the approach by which to determine a conservative minimum price;
- the minimum price should be apportioned on a 50/50 basis between an up-front payment (SAF) and ongoing annual payments subject to CPI index linking (SUFs); and
- the range €0.015 to €0.025 per MHz per capita is appropriate for the setting of the minimum price, with the higher end of the range applying to urban areas and the lower end applying to regions that do not have specific urban areas identified.

- the population of each of the regions under Option 2 should be adjusted to take account of the commuter flows between the five identified cities and the other applicable regions.

5.147 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory objectives, duties and functions.

Chapter 6

6 Licence Conditions

6.1 Regulation 10(1) of the Authorisation Regulations provides that ComReg may only attach those conditions listed in Part B of the Schedule to the Authorisation Regulations to rights of use for radio frequencies for the provision of electronic communications networks and services.

6.2 In this chapter, ComReg sets out its proposals regarding the appropriate conditions that should be attached to any spectrum rights of use that may be granted under the proposed award process. These conditions are termed licence conditions in this document.

6.3 The licence conditions proposals in this chapter have been guided by, among other things:

- ComReg's statutory functions, objectives and duties, including in particular its obligations under the Authorisation Regulations;
- the rationale and licence conditions proposed in Document 14/101 and the submissions received to this consultation;
- the rationale and licence conditions used previously by ComReg for this band or bands used for similar purposes (e.g. the licence conditions used in the MBSA, FWALA, BWALA, etc.); and
- other relevant information (e.g. the 3.6 GHz EC Decision, the Plum Reports, international practice, etc.)

6.4 The following licence conditions proposals are discussed in this chapter:

- technology and service neutrality;
- non-exclusive assignment of spectrum;
- notification of the termination of a technology;
- coverage and rollout;
- quality of service; and
- technical conditions.

6.1 Technology and Service Neutrality

6.5 Technology and service neutrality is the principle that spectrum rights of use, and the conditions applied thereto, should not preclude the provision of any specific service and/or the use of any technology[122].

6.6 The promotion of technology and service neutrality in the rights of use of spectrum, where possible, is a general principle under the regulatory framework[123]. In Document 14/101, ComReg also noted that the principle of technology and service neutrality was also supported in the various European harmonisation decisions on the bands proposed for inclusion in that proposed award process (including the 3.6 GHz band). ComReg set out its intention to apply a technology and service neutral approach to the licensing of those bands.

6.7 A number of responses to Document 14/101 commented on this proposal as follows:

- Huawei states that "regulators must also facilitate access on a technology-neutral basis, for the delivery of a full range of telecoms services"[124].

- The Joint FWA Operators response states that "although technology and service neutrality is a desirable aim it has been shown that convergence can interfere with such objectives. If LTE and other similar technologies become the dominant technology in the mobile and FWA market and if they are to be deployed to maximum effect, an appropriate regulatory regime should follow"[125].

- Permanet submits that the technology and service neutrality approach taken in relation to the licensing of FWALA "enabled Permanet and others to develop affordable equipment in order to provide affordable, reliable broadband services in rural areas" and "submit that ComReg should ensure that any subsequent scheme for allocation of 3.6GHz spectrum should adhere to this principal [sic]"[126]

[122] Provided, of course, that there is compliance with certain technical pre-conditions of use (normally specified at EU level).
[123] See for example, Regulation 16(1)(a) of the Framework Regulations and Article 2 of the EU multiannual radio spectrum policy programme (RSPP) Decision No 243/2012/EU.
[124] 3.6 GHz band section of the Huawei submission (page 4)
[125] Summary section of the Joint FWA Operators response (page 6)
[126] Page 1 of the Permanet submission

- 3IHL, Viatel and Vodafone all expressed their support for the principle of service and technology neutrality[127].

6.8 ComReg observes that respondents generally agreed that the principle of service and technology should be followed where possible.

6.9 Focusing on the 3.6 GHz band, in addition to the regulatory framework provisions that promote the principle of technology and service neutrality, ComReg notes that the principle of service and technology neutrality is reflected in the 3.6 GHz EC Decision on this band. In particular, technologies that comply with the technical conditions set out in the Annex to the 3.6 GHz EC Decision can be deployed in the band, and these technologies can be used to deploy different types of electronic communications services.

6.10 Having considered responses to Document 14/101 and in line with the Common Regulatory Framework and the 3.6 GHz EC Decision, ComReg is of the view that a service and technology neutral approach should be applied to the licensing of the 3.6 GHz band, such that all technologies and services that comply with the 3.6 GHz EC Decision would be permitted. In addition, ComReg does not see any compelling reasons to require the provision of a particular technology or service.

6.2 Non-exclusive assignment of 3.6 GHz rights

6.11 Wireless telegraphy licences in Ireland are generally issued on a non-exclusive basis. As such, it is standard practice that many spectrum bands licensed to particular licensees are also made available to other wireless telegraphy apparatus on a non-interference and non-protected basis.[128]

6.12 Furthermore ComReg notes that, across Europe, it is generally standard practice for spectrum bands to be made available to other wireless telegraphy apparatus at the same time, provided such apparatus is operated on a non-interference and non-protected basis. This standard practice has also been adopted in a number of the EC Decisions relating to the harmonisation of spectrum bands considered in Document 14/101 (including the 3.6 GHz band).

[127] Page 11 of 3IHL submission, page 4 of the Viatel submission and page 10 of the Vodafone submission

[128] For example, the Liberalised Use licences in the 800 MHz, 900 MHz and 1800 MHz spectrum bands awarded under the MBSA were issued on a non-exclusive basis. This facilitates the use of these spectrum bands by other uses. For example spectrum in the 900 MHz and 1800 MHz bands has been made available to other applications using wireless telegraphy apparatus, such as Short Range Devices (Document 02/71R9), Mobile Communications on Aircraft (MCA) services and Test and Trial apparatus.

6.13 Given these considerations, ComReg proposed in Document 14/101 that all spectrum bands proposed to be included in the award process then proposed (including the 3.6 GHz band) would be assigned on a non-exclusive basis.

6.14 Two responses to Document 14/101 commented on this proposal, which are summarised below:

- Qualcomm states that that "it is neither appropriate, nor supported by the market, to mix different spectrum access method in a given spectrum band" and that "it may be challenging to avoid interference for unlicenced devices to mobile devices operating in spectrum licenced to an MNO"[129]; and

- 3IHL stated that while MBSA "licences were not exclusive, nevertheless licensees have bid for, won, and paid large fees in the expectation that they can operate their service nationally without restriction (other than those specified in the licence), and free from interference", that "any other use of the spectrum must be on a non-interference and non-protected basis" and that "ComReg must be of the opinion that any other use of the licensed spectrum will not impact upon the licensee"[130].

6.15 In relation to these responses, ComReg firstly recalls that Article 2(1) of the 3.6 GHz EC Decision obliges Member States to make available the 3.6 GHz band on a non-exclusive basis.[131] ComReg also observes that this decision is binding on Member States. Given these factors, ComReg confirms that 3.6 GHz rights issued on foot of the proposed award will be assigned on a non-exclusive basis.

6.16 Accordingly, the only remaining issue to be determined is defining the scope of spectrum assignments for other uses of the 3.6 GHz band. In that regard, ComReg notes:

- that while spectrum assignments for other uses of a licensed spectrum band can take the form of licences and licence-exemptions, it is ComReg's general policy that all such spectrum assignments are allowed only on a non-interference and non-protected basis; and

[129] Non-exclusive assignment of Spectrum section of Qualcomm's submission (page 22)
[130] Non-Exclusive section of the 3IHL submission (page 11)
[131] Specifically Article 2.1 of EC Decision2014/276/EU states that:
"Without prejudice to the protection and continued operation of other existing use in this band, Member States shall designate and subsequently make available, on a non-exclusive basis the 3 400-3 800 MHz frequency band for terrestrial electronic communications networks, in compliance with the parameters set out in the Annex."

- in addition these spectrum assignments have generally followed a process where the impact on licensed services would first be considered. This assessment could be carried out at a European level (in bodies such as CEPT. ETSI or the EC [132]) or at a national level (for example, the consideration of Test and Trial licences or other licences types [133]). In relation to Test and Trial licences, ComReg notes that where such licences have been issued for the same spectrum rights of use as assigned to a licensee, they have been granted with the knowledge of the licensee.

6.17 Given the above, ComReg considers that it would be appropriate to permit spectrum in the 3.6 GHz band to be used for other uses on a non-interference and non-protected basis. In this regard, and in the interests of appropriate regulatory consistency, ComReg proposes that the non-exclusivity condition to be attached to 3.6 GHz licences would be substantively the same as the non-exclusive provision included in the Liberalised Use Licences issued under S.I. 251 of 2012.[134]

6.3 The notification of the termination of a technology

6.18 While Regulation 18 of the General Authorisation ("GA") (Document 03/81R4) [135] sets out a number of consumer protection rules that apply to Authorised Persons in the event of a cessation of service[136], ComReg notes that the cessation of services caused by the termination of the use of one

[132] Services such as Short Range Devices, Mobile Communications on board Aircraft (MCA) etc. are harmonised at a European level.

[133] In the UK, Ofcom includes a PMSE access condition in relation to the 2.3 GHz and 3.4 GHz spectrum award http://stakeholders.ofcom.org.uk/binaries/consultations/2.3-3.4-ghz-auction-design/statement/statement.pdf

[134] The following definitions are included in S.I 251 of 2012

"Non-exclusive", in relation to a Licence, means that the Commission is not precluded from authorising the keeping and possession by other persons of other apparatus for wireless telegraphy on a Non-Interference and Non-Protected Basis in one or more of the 800 MHz, the 900 MHz and the 1800 MHz bands;

"Non-Interference and Non-Protected Basis" means that the use is subject to no harmful interference being caused to any Radiocommunication Service, and on which no claim may be made for the protection of apparatus used on this basis against harmful interference originating from Radiocommunication Services;

[135] http://www.comreg.ie/_fileupload/publications/ComReg0381R4.pdf

[136] Amongst other things, Regulation 18 obliges an Authorised Person to:

- notify ComReg of an actual or anticipated cessation of service affecting a substantial number of consumers (Condition 18.2);
- provide ComReg with information which it deems necessary, where ComReg forms the view that there is a reasonable probability of a cessation of service (Condition 18.4); and
- at all times use reasonable endeavours to ensure the effect of any cessation of service is minimised (Condition 18.5).

technology in favour of another is currently not within the scope of the consumer protection provisions of Condition 18 of the GA.

6.19 As the cessation of a technology can result in "consumer disruption" issues, and noting that a similar provision was included in the Liberalised Use Licences issued as a result of the MBSA process, Document 14/101 included a proposed condition which would require a licensee to give 6 months' notice to ComReg of its intention to terminate the provision of services using one technology in favour of another technology.

6.20 One respondent (3IHL) to Document 14/101 commented on this proposal and agreed with the inclusion of such an obligation, but sought some clarification.[137]

6.21 Focusing on the 3.6 GHz band specifically, ComReg considers that the uncoordinated cessation of technologies in this band has the potential to cause significant consumer disruption issues[138].

6.22 To minimise this potential, and in the interests of appropriate regulatory consistency, ComReg proposes to attach a licence condition (in respect of notification of the termination of a technology) to 3.6 GHz rights on substantively the same terms as that imposed on Liberalised Use Licences issued under S.I 251 of 2012.[139]

6.4 Coverage and rollout conditions

6.23 In Document 14/101, ComReg considered that, in general, the reasoning and justification for applying a coverage and rollout obligation in the MBSA process was equally appropriate in respect of the proposed award process. In particular, ComReg noted that there was no guarantee that market forces alone would ensure the efficient use of spectrum and ComReg therefore proposed that a minimum coverage requirement should be attached to the relevant spectrum rights of use.

6.24 In discussing the potential level of any such coverage obligation, ComReg noted that a coverage obligation could be differentiated in terms of the

[137] Page 13 of the 3IHL submission.

[138] As circa 27,000 customers current receive services via technology that uses the 3.6 GHz band.

[139] The following licence condition is included in S.I 251 of 2012

6. It shall be a condition of any Licence to which these Regulations apply, that the Licensee shall:
(12) (a) notify the Commission, not less than 6 months prior to the proposed cessation of use of any terrestrial system listed in Schedule 1 to which the Liberalised Use Licence relates and;
(b) use all reasonable endeavours, to ensure that any adverse effects on users from the cessation of use of a terrestrial system are minimised;

propagation characteristics of the different bands proposed for inclusion in Document 14/101, and in turn the likely application. In particular:

- For frequency bands above 1 GHz (including the 3.6 GHz band) ComReg considered that a less onerous coverage obligation might be applied compared to frequency bands below 1 GHz (i.e. the 700 MHz band);
- For bands which provided 'capacity'[140] ComReg expressed the view that a minimum coverage obligation should apply to ensure the efficient use of the radio spectrum and it noted that this obligation could take the form of a population coverage requirement or another appropriate measure; and
- For bands which might be used for both 'coverage'[141] and 'capacity' purposes, ComReg expressed the view that a more onerous coverage obligation might apply compared to a coverage obligation to a 'capacity'-only band.

6.25 ComReg did not propose any specific level of coverage obligation in Document 14/101, but instead sought views from interested parties on what level of coverage obligation would be justified and proportionate (and in line with ComReg's statutory functions, objectives and duties) in relation to the various spectrum bands.

6.26 In relation to the rollout period to be associated with any coverage obligation imposed, ComReg expressed the view that:

- for the 700 MHz band it would be appropriate to apply rollout obligations equivalent to those implemented in the MBSA process; and
- for the remaining bands (including the 3.6 GHz band) it was minded to apply rollout conditions to be met within 3 to 7 years of licence issue but that this condition could depend on whether or not the new licensee has an existing network.

6.4.1 **Responses to Document 14/101**

6.27 A number of responses to Document 14/101 commented upon the proposed coverage and rollout obligations.

[140] A capacity band is a spectrum band whose propagation characteristics render it unsuitable for its use to serve wide geographical areas, and may be more suitable for urban deployment as hot spots or high capacity infill.

[141] A coverage band is a spectrum band whose propagation characteristics render it suitable to serve wide geographical areas, such as the deployment of macro cells for wide area services.

6.28 Whilst much of the focus of the responses concentrated on the coverage obligations for the 700 MHz band, some responses commented upon matters more relevant to the consideration of potential conditions for the 3.6 GHz band. These responses are outlined below.

- Eircom stated that *"It would be unfair to existing licensees if less onerous obligations applied for the proposed award process just as it would be unfair for new entrants if more onerous obligations applied for the proposed award process. In the interest of a maintaining a level playing field Eircom believes that coverage and rollout obligations should be established for the proposed award process that are consistent with those adopted in the 2012 award process."*[142]

- Ireland Offline stated that it disagrees with the use of population coverage conditions and coverage measurement methodology utilised by ComReg for rights of use released in the MBSA and recommends *"that ComReg adopt area coverage in its RAN licence conditions"*[143]

- 3IHL stated that:

  - *"*[3IHL] *agrees that when this spectrum is awarded, there should be a licence condition to ensure that it is actually used within a reasonable time; however any roll-out obligation must take into account practical considerations including the characteristics of the spectrum itself, and that it will most likely be integrated into networks that already use other bands"*[144] and that *"the mobile spectrum bands above 1 GHz (1.4GHz, 2.3GHz, 2.6GHz) are primarily suitable for providing capacity rather than coverage. There should be either no coverage obligation attached to these bands, or a minimum one designed to ensure allocated spectrum is actually brought into use within a reasonable time"*.

- Viatel *"disagree on setting coverage requirements for the capacity bands (therefore at the exception of the 700 MHz) as this spectrum won't be use[d] to achieved coverage but instead in order to meet specific demand in very dense urban areas"*[145]

[142] Page 8 of Eircom's submission
[143] Conclusions and recommendations sections of Ireland Offline submission (page 11 and 12)
[144] Coverage and rollout section of 3IHL submission (page 12 and 13)
[145] Coverage requirements section of Viatel response (page 4)

- Vodafone *"agree that the reasoning and justification for applying coverage and roll-out obligations still hold and are valid in respect of this award process"* and that "*there may value in setting rollout conditions in parts of the 3.6GHz band if this is going to be used for FWA*" noting however that a *"combination of these rollout conditions and possible regional variations would make an auction very complex"*[146].

- ESBN believed that only the 700 MHz spectrum band should have a high (e.g. 70%) population coverage. Setting the coverage conditions too high for the various other bands in the auction could create a significant barrier to entry for interested parties. In ESBN's view, this could affect the business case for interested users, choking demand which, in turn, could leave spectrum inefficiently unassigned.

6.29 From the responses above, ComReg observes that there appears to be support (with the exception of Viatel)[147] for the principle of applying some coverage and rollout type conditions to the 3.6 GHz spectrum rights of use. For example, each of the MNOs agree in principle on the value of some coverage and/or rollout obligation (e.g 3IHL's suggestion of a minimum one designed to ensure spectrum is actually brought into use within a reasonable time).

6.30 ComReg further observes that measures which ensure the timely efficient use of spectrum may be particularly important in this band where:

- individual bidders may only be interested in deploying services in particular although areas of the country, it seems likely that there would be demand for 3.6 GHz spectrum across Ireland, as currently FWALA base stations are deployed across the country providing services to users;

- ostensibly there are two likely competing uses for spectrum (i.e. fixed and mobile) and the assignment of spectrum to one party may prevent the deployment of services by another party; and

6.31 At the same time, ComReg is mindful of the fact that setting obligations too high may:

- prevent or restrict new entry, where efficient entry would have been likely but for the imposition of an overly high coverage and/or rollout obligation;

[146] Chapter 7, Licence Conditions of the Vodafone submission (page 16)

[147] Whilst Viatel's view that MNOs are more likely to be interested in using this band to meet demand in high demand areas like urban areas may be correct, ComReg observes that the proposed adoption of regional licensing facilitates this demand scenario by allowing the provision of services to urban centres only.

- by artificially excluding efficient entry, reduce competition in the award process, such that bidders might be able to win spectrum at a value less than its opportunity cost leading to an inefficient award outcome; and/or

- result in the inefficient use of spectrum to the extent that such obligations resulted in spectrum remaining unsold.

6.32 Given these considerations, ComReg is minded to explore the imposition of coverage and/or roll-out conditions that would be the minimum necessary to ensure the timely and efficient use of spectrum. This is considered in the following sections.

6.4.2 Some relevant background to potential coverage and/or rollout conditions in the 3.6 GHz band

6.33 Before setting out ComReg's proposals, this section presents relevant background information relating to the current and potential uses of the band, and the coverage and/or roll-out obligations adopted elsewhere in Europe.

The current and potential future uses of the 3.6 GHz band

6.34 In Ireland the 3.6 GHz band is currently used to provide fixed broadband services to approximately 27,000 customers. FWALA licences have been issued to cover most parts of Ireland and this had lead to the deployment of FWA base station infrastructure across the country.

6.35 Existing FWALA services typically use high sites and an external rooftop antenna on the end-user's premises to provide a cell coverage radius ranging from 6 to 20 km. A variety of technologies (e.g. Wireless Docsis 2.0, WiMAX, 802.16 etc.) are currently employed to provide these services, although the respondents to Document 14/101 generally indicated a likely migration toward the LTE technology in the future.

6.36 An alternative use for the 3.6 GHz band could be the provision of a mobile broadband service using LTE technology. In this potential use, the 3.6 GHz band would be used as a 'capacity' band to add additional mobile network capacity in congested areas and dense indoor deployments (e.g. shopping centres). It is envisaged that these services would likely be provided with small cells with a cells radius less than 1 km (and potentially as low as 10 m). MNOs might also use 3.6 GHz spectrum for backhaul purposes.

6.37 The LTE roadmap is discussed in Plum Report 2 Document 15/74 and this notes that 3.6 GHz band is not anticipated to become mainstream for mobile broadband using LTE TDD technology until 2020

Overview of obligations in Europe

6.38 While there is some information on the use of the 3.6 GHz Band across Europe from various sources[148], it is difficult to form strong conclusions on 3.6 GHz band coverage and/or rollout obligations adopted in Europe given the wide variety of same. For example, some countries have not set any coverage obligation (e.g. the UK [149]), whereas other countries have set quite high coverage obligations (e.g. Lithuania has set a 90% population target over 10 years[150]).

6.39 In addition, as the 3.6 GHz Band has primarily been utilised for the provision of fixed wireless services, the relevance of any such legacy obligations could be queried, particularly as new technologies and services can now be employed on foot of the 3.6 GHz EC Decision. Notwithstanding the above, a number of observations can be made.

6.40 The two primary measures used to set a coverage obligation are population coverage or area coverage.[151] In a number of cases, these population / area coverage obligations have also been further defined in terms of the coverage of specific areas/towns/parishes. Additional criteria to these two primary coverage measures may also be defined in relation to the provision of a specific service (e.g. voice or data). These additional criteria include the setting of a field strength, a signal strength, minimum download speeds, minimum throughput[152] etc.

6.41 While these primary coverage measures have been widely used for the setting of a coverage obligation in the spectrum bands for mobile coverage, it is notable that, more recently, some of countries have moved away from the setting of a population or area coverage obligation to a “use-it” or rollout obligation (i.e. an obligation to install a certain number of base stations in one or more defined time periods [153] or per square km [154]). For example, the competitive award process to be conducted by Romania for the 3.6 GHz band indicates that licensees are subject to a rollout obligation based on a specific

[148] Cullen International, ECC Report 231 (March 2015), and RSPG Report 11-393 (November 2011)
[149] Public Sector Spectrum Release: Award of the 2.3 and 3.4 GHz spectrum bands (May 2015)
[150] RSPG Report 11-393 (November 2011)
[151] See for example ECC Report 231 (March 2015)
[152] See Section 4 - Frequency usage conditions of Decision of the President's Chamber of the Bundesnetzagentur für Elektrizität, Gas, Telekommunikation, Post und Eisenbahnen of 28January2015, available at:http://www.bundesnetzagentur.de/SharedDocs/Downloads/EN/BNetzA/Areas/Telecommunications/TelecomRegulation/FrequencyManagement/ElectronicCommunicationsServices/DecisionP2016_pdf.pdf?__blob=publicationFile&v=3
[153] In place in various countries including Croatia, Estonia
[154] In place in Latvia

number of base stations per year. Specifically, a requirement to deploy at least 25 base stations within a year of licence activation, 50 base stations after two years and 100 base stations in four years[155].

6.4.3 ComReg's position Coverage and/or Rollout

6.42 Bearing in mind the previous discussion, the following section sets out ComReg's proposals on a coverage and/or rollout obligation for the 3.6 GHz band.

6.43 A coverage obligation generally takes the form of either a population based[156] or an area/geographic based obligation. Noting the two most likely uses (i.e. mobile and fixed) and their likely deployment scenarios for this band, ComReg presently considers that it is difficult to set a population or area based coverage obligation for this band that would also be technology- and service-neutral.

6.44 In relation to a population-based coverage measure, ComReg observes that the business cases for a fixed and mobile service in this band are likely to differ. The business case for the fixed service may be to provide services in areas of lower population density, whereas mobile services are more likely to be provided in congested or higher density areas. Accordingly, identifying a common population coverage measure for these different services is likely to be difficult to achieve and could cause inefficient investment[157] and/or provide inappropriate incentives[158].

6.45 The setting of a common geographic or area-based coverage measure also appears difficult to identify given, for example, the likely differences in cell sizes between the fixed and mobile service deployments. Accordingly, implementing a common geographic/area based coverage measure may

[155] Source: https://www.telegeography.com/products/commsupdate/articles/2015/05/18/ancom-consults-on-upcoming-3-4ghz-3-8ghz-auction/

[156] For example, ComReg's liberalised use licence conditions set a population based coverage obligation.

[157] For example, the use of a population (or area) coverage obligation may incentivise mobile operators to deploy outdoor base stations with greater cell size which may go against the mobile operator's preferred business plan for the band and the equipment ecosystem.

[158] For example, a population (or area) based coverage obligation may incentivise fixed wireless operators to extend the extent of a base station coverage 'artificially' to fulfil the obligation by placing customers further from the base station, thereby providing coverage over a greater distance but resulting in a lower quality service for those customers.

similarly give rise to inefficient investment[159] and/or provide inappropriate incentives[160].

6.46 Given the issues identified above, ComReg considers that it would be appropriate to move away from the traditional population- or geographic-based coverage measure for the 3.6 GHz band to consider alternative metrics.

6.47 Given the recent adoption of "use-it" or rollout-type obligations in other Member States, and that deployment of base stations at cell sites (be that at a high site, a small cell or other cell site type) is likely to be common to both likely potential uses for this band, ComReg currently considers that it would be more appropriate to design a rollout metric on such a basis.

ComReg's base station rollout proposal

6.48 Having regard to the recent positions adopted elsewhere in Europe, ComReg observes that a rollout measure designed to ensure the timely and efficient use of spectrum could comprise the following two elements:

- The extent of the rollout obligation; and
- A minimum base station capability requirement.

6.49 In general terms, the first element would set out the minimum number of base stations that a licensee would be required to deploy in a licence area. To encourage the efficient use of spectrum across various parts of a licensed area (i.e. a region as proposed by ComReg), this element could also have a geographic element requiring licensees to deploy base stations in a number of distinct areas within the licensed area.

6.50 In general terms, the second element would set a minimum base station capability standard that would encourage licensees to use more efficient equipment and technologies. This element could take the form of setting a minimum data throughput capability of any deployed base station.

The extent of any rollout obligation

6.51 In considering the extent of any rollout obligation, it would seem reasonable to firstly have regard to the extent of the existing infrastructure deployment in the 3.6 GHz band, both in terms of the number of base stations deployed (in this

[159] For example, the cell coverage radius is likely to be less than 1 km for a mobile deployments and the number of base stations required to satisfy a population or geographic based metric of any magnitude may be substantially greater than an operator's business case.

[160] For example, blanket coverage, as incentivised by a geographic coverage metric, is of less importance to fixed services as there is no call or session hand-offs between cells (i.e. no mobility).

case in the context of the regions proposed by ComReg in Chapter 4) and at a more granular level within these regions.

6.52 The table below sets out, in aggregate and anonymised form, an indicative range of FWALA base stations which are currently deployed in each of the proposed licence regions.[161]

Region	**No of BS in region**
North East	43 – 49
South West	33 – 40
North West	28 – 54
South East	16 - 27
Dublin CSO boundary	59 – 63
Waterford CSO boundary	3 – 5
Galway CSO	2 - 8
Limerick CSO	2 – 4
Cork CSO	2 – 4

Table 2. FWALA base stations per region

6.53 From the above, it is apparent that there are considerable variations in the numbers of base stations between both the non-urban regions (16-27 [South East] to 28-54 [North-West]) and the urban-regions (2-4 [Cork and Limerick CSO] to 59-63 [Dublin CSO]). Given these variations, ComReg observes that one could set asymmetric obligations between regions or symmetric obligations that, given the previous discussion, could be based toward the lower end of the range.

6.54 In light of ComReg's preference to set obligations at the minimum necessary to ensure the timely and efficient use of spectrum and bearing in mind the

[161] This information is based on the information provided to ComReg by a number of the existing operators. Ranges are given as ComReg has had to rely on estimates as some licensees either failed to provide information or indicated that the information provided was incomplete.

potential adverse effects on competition and spectrum use in setting too high an obligation previously outlined, it would seem appropriate to set a similar lower-range level of obligation for:

a) the non-urban regions (say between 15 to 25) and

b) the urban areas with the exception of Dublin (say between 2 to 4).

6.55 Given the substantially higher numbers of existing base stations within the Dublin CSO, it would further seem appropriate to set an obligation for Dublin based on that proposed for the non-urban areas (i.e 15 to 25).

6.56 ComReg is of the view that an appropriate level of spectrum use, in terms of infrastructure deployment, should, in addition to the number of base stations, also take into account the geographical spread of those deployments. This may be particularly relevant for the non-urban regions proposed by ComReg given the geographic scale of same.

6.57 In that regard, the figure below present's information on the FWALA base station deployments in Ireland which ComReg has collected from a subset of existing FWALA licensees. This indicates that, within a licence area, base stations are deployed at a number of different locations. This suggests that it may be appropriate to add a geographic element to any base station rollout obligation.

Figure 5. The location of FWALA base stations in Ireland.[162]

6.58 Given the above, and in the interests of providing a proposal which interested parties can comment upon, ComReg's initial proposal for the extent of any base station rollout obligation is as follows:

- for each of the non-urban regions: the deployment of network controlled base stations[163] at 15 to 25 sites and that these sites should be located in 3 to 5 different counties within the region;
- for the Dublin region: the deployment of network controlled base stations at 15-25 sites; and
- for all other urban regions: the deployment of network controlled base stations at 2-4 sites

[162] This information is only based on a subset of FWALA licensees (namely, Eircom, Imagine, Lighthouse, Permanet, Fastcom, Ripplecom, and Viatel.

[163] Network controlled base stations are those under the ownership of the operator and which have backhaul capability over a network connection under the control of the operator. Therefore plug and play type base stations (such as femto cells) or repeaters will not count toward this obligation.

The minimum base station capability requirements

6.59 ComReg observes that both potential uses of the band are migrating towards the use of equipment with similar technology capabilities, which as indicated by Plum Report 2 Document 15/74, is likely to be LTE. It would therefore seem appropriate to set any minimum base station capability requirement based on the capabilities of an LTE base station, while not setting the requirements too high thereby perhaps excluding other technologies.

6.60 In that regard, ComReg notes Plum's observation that deployment of LTE-A equipment could result in an overall "technical spectrum efficient rate" of 4 bps/Hz per sector[164]. As a base station rollout obligation should encourage the efficient use of spectrum, ComReg is of the view that this rate could form the basis for determining a base station's capability criteria.

6.61 ComReg further observes that the technical capability of a base station will also depend on the quantum of spectrum assigned to it and, given this, it would seem appropriate to vary the base station capability requirements applicable to a licensee according to (a) the amount of spectrum assigned to licensee or (b) the amount of spectrum deployed by the licensee on each base station.

6.62 For example, using 4 bps/Hz per sector as the baseline for the setting of this base station capability obligation,

- a licensee assigned 5 MHz of spectrum could be obliged to deploy base stations with a capability of 20 Mbps per sector or greater; and
- a licensee assigned 20 MHz of spectrum could be obliged to deploy base stations with a capability of 80 Mbps per sector or greater.

6.63 For licensees who are assigned greater than 20 MHz, ComReg is aware that base station equipment may have a maximum channel size (e.g. 20 MHz) and this may therefore limit the base station capability obligation to that of a licensee who is assigned 20 MHz. In the example provided above, this would require these licensee to deploy base stations with a capability of 80 Mbps per sector or greater.

The timing of any rollout obligation

[164] 4 bps/Hz is achievable with LTE-A using 16QAM modulation (See section 3.2.1 of Plum Report 3 Document 1575). Other technologies could achieve this throughput rate utilising 64QAM

6.64 Noting that the proposed rollout obligation discussed above is linked to the provision of services based on the capability of a LTE base station (or a technology of a similar capability), and that the timeframe for the widespread availability of LTE equipment in this band is expected to be somewhere around 2020[165], ComReg is of the preliminary view that a roll-out period of between 3 to 5 years would appear appropriate. For example, using 1 August 2017 as the commencement date of a new 3.6 GHz licence this would mean that base stations would need to be operational in the time period 31 July 2020 to 31 July 2022.

The application of the above rollout obligations to a national licence

6.65 As the rollout obligations above have been presented in terms of the obligations in each licence area, where a bidder obtains a national licence (or a multi-region licence), ComReg proposes that the coverage obligation should comprise of the individual coverage obligations within each specific licence area.

6.5 Quality of Service ("QoS")

6.66 In Document 14/101, ComReg proposed the inclusion of a Quality of Service (QoS) in any spectrum rights of use issued. This QoS measure consisted of two parts: a network availability obligation; and a voice call standard obligation.

6.67 The aim of the network availability obligation was to protect end users against unreasonable levels of disruption to their service and safeguard the interests of consumers against operators who might otherwise have unacceptably high levels of network unavailability. For this obligation, ComReg proposed to attach similar QoS licence conditions as were attached to licences awarded under the MBSA process.

6.68 The aim of the voice call standard obligation was to safeguard the interests of consumers against operators who might not otherwise maintain acceptable quality levels for voice calls in line with current expectations. For this obligation, ComReg proposed to attach similar QoS standards for voice calls to those applied in the MBSA and proposed that all relevant non-VoIP 'voice call' services provided to a licensee's customers and provided to third party customers by a licensee, are to be captured under this QoS obligation. In addition it also proposed that managed VOIP call services would also be

[165] See section Plum Report 2 Document 15/74

captured under this QoS obligation as such services are considered to be substitutable with traditional voice call services.[166]

6.69 One response to Document 14/101 was related to QoS and in particular the voice call standard proposal. 3IHL was of the view that it was unclear how such a QoS on non-VoIP calls could be regulated given that all voice services on LTE networks will be VoIP. 3IHL requested ComReg to further break-down the definition of what service should be categorised as falling within this obligation and added that: "Presumably it is if the service falls in the same market as existing "native" voice services and not in the same market as over-the-top voice services which are provided on a best effort basis only."

6.70 In addition, 3IHL added that "If a quality of service obligation is to be imposed, then this voice service will need to take priority for network capacity over other services, including over-the-top voice services."

6.71 No responses were received in relation to the proposed network availability QoS obligation.

6.5.1 ComReg's position on QoS

6.72 From the responses received to Document 14/101, ComReg notes that no respondents disagreed with ComReg's proposal to include a QoS obligation in a spectrum right of use for the bands proposed in Document 14/101 (including 3.6 GHz band), although one respondent, 3IHL, queried how the voice call standard obligation would work in practice.

6.73 In relation to 3IHL's query on how a QoS obligation on non-VOIP calls might be regulated, ComReg would agree with 3IHL's assertion that there are likely to be few, if any, non-VoIP voice services offered by MNOs in this band. In fact it could be argued that MNO's are much more likely to offload any voice traffic (non-VoIP, VoLTE or VoIP) to other licence bands to leave the 3.6 GHz band for pure data services. Should a MNO offload all voice traffic onto other spectrum bands, then it is arguable that any 3.6 GHz band voice call obligation would not apply to that MNO.[167]

6.74 In relation to 3IHL observation about how a MNO might implement provide services of different priority in order to implement a QoS obligation, ComReg observes that the QoS proposal outlined in Document 14/101 would not

[166] See, for example, paragraph 2.6 of Market Review: Retail Access to the Public Telephone Network at a Fixed Location for Residential and Non Residential Customers – Document 14/89.

[167] There may be exceptions to this where for example, third party customers on a MNO network use the 3.6 GHz band to provide voice services.

necessarily require a licensee to implement different QoS priorities for different services. It would be a matter for a licensee to determine how best to meet its obligations, in accordance with any other applicable obligations.

6.75 Should a licensee implement such a prioritisation strategy in the future, this would be a decision of that licensee as opposed to being a regulatory obligation.

6.76 Noting the above, ComReg remains of the view that it may be appropriate to include a QoS obligation in any 3.6 GHz spectrum rights of use issued. The two QoS metrics proposed in Document 14/101 are discussed below.

Network Availability

6.77 As outlined in Document 14/101, a minimum QoS of network availability protects consumers against unreasonable levels of disruption to their service and safeguards the interests of consumers against operators who might otherwise have unacceptably high levels of network unavailability.

6.78 ComReg is of the preliminary view that similar rationale applies in the context of 3.6 GHz band, as this band can be used to provide a variety of end user services, including broadband data and voice services, similar to the other bands proposed in Document 14/101.

6.79 Voice[168] and data[169] services are key services for consumers and a minimum network availability obligation would safeguard the availability and reliability of the networks that are used to provide these services. Provided a network availability obligation is set at an appropriate level to protect consumers, ComReg is of the view that a network availability obligation would be unlikely to result in inefficient operator investment as most operations would likely dedicate some expenditure and deploy infrastructure to also ensure a minimum level of network availability. In this regard, ComReg notes that all three MNOs outline network quality as a key part of their overall offering to consumers.[170] [171] [172] Further with a minimum QoS standard, licensees would

[168] Total network minutes rising above 3 billion minutes per quarter for the first time in Q4 2014

[169] Mobile data services have increased significantly over the last number of years and this trend is expected to continue.. Since Q4 2011 data use per smartphone has increased by on average 87% per year, and data use per Mobile Broadband ('MBB') user has increased by 36% per year. (source ComReg 15/62a)

[170] https://www.meteor.ie/ournetwork/

[171] http://www.vodafone.ie/coverage/mobile-broadband/

[172] http://press.three.ie/press_releases/o2-becomes-three-as-major-rebrand-takes-place/

also be assured that no other licensee could avoid meeting these minimum standards.

6.80 Given the above considerations, and noting that no respondents disagreed with ComReg's proposal in Document 14/101, ComReg proposes the following network availability conditions:

- each licensee is to keep a log of network availability, available for inspection by ComReg;
- each licensee is to ensure that network unavailability is less than 35 minutes per six month period; and
- the calculation of network unavailability will be subject to weighting factors that take account of traffic load variations.

6.81 ComReg's proposal would apply to all wireless service providers with a licence in this band as it is appropriate to protect consumers of all wireless services and not just those of mobile services.

6.82 Further, ComReg proposes that all relevant services provided to a licensee's customers and provided to third party customers by a licensee (e.g. in the case of MVNO, or wholesale arrangements) are to be captured under this QoS obligation. ComReg also proposes that its assessment of this obligation will be made against the aggregate total.

Voice Call Standard

6.83 ComReg considers that there is a possibility that at least some of the rights of use that may be awarded in the proposed award process will be used to provide voice call services[173].Further ComReg is aware that the voice call service remains a priority for consumers as demonstrated by total network minutes rising above 3 billion minutes per quarter for the first time in Q4 2014.

6.84 In a competitive market with low switching costs, QoS standards should be reasonably good as consumers can respond quickly and easily if the QoS does not meet their expectations. However, there are situations even in a competitive market where, due to information asymmetries, the setting of minimum QoS standards may be necessary in order to protect consumers.

[173] While ComReg would agree with 3IHL's assertion that there is likely to be few non-VoIP voice services offered by MNOs in this band, ComReg notes that fixed wireless operators in this band have previously provided voice services using the 3.6 GHz spectrum, and may wish to offer a managed VoIP service in the future, in order to compete with dual play competitors.

Given that two parties are involved in a voice call, a consumer who experiences poor voice call quality cannot determine whether the problem relates to his/her own network or to the network of the person on the other end of the line, and therefore may not be in a position to react to experiencing a poor voice call QoS. Setting a QoS standard for voice calls can safeguard consumers in these circumstances.

6.85 An appropriately defined voice call obligation would not seem to place an onerous burden on operators as, if they choose to deliver voice call services, they would likely have to deliver voice call services of a certain quality in any event in order to meet consumer expectations. Further with a minimum QoS standard, licensees would also be assured that no other licensee could avoid meeting these minimum standards.

6.86 Given these considerations and noting that no respondent disagreed with the setting of a voice call standard (instead 3IHL queried how it might operate in practice) ComReg proposes the following voice call QoS obligations:

- Each licensee would ensure that for each 6 month period Maximum Permissible Blocking Rates are not exceeded;
- Each licensee would ensure that for each 6 month period Maximum Permissible Dropped Call Rates are not exceeded; and
- Each licensee would ensure that for each 6 month period the speech transmission quality meets or exceeds the appropriate standard.

6.87 While ComReg will endeavour to provide further clarity on the how a voice call QoS obligation may operate in due course, similar to the approach set out in Document 14/101, ComReg proposes that all relevant non-VoIP 'voice call' services provided to a licensee's customers and provided to third party customers by a licensee, are to be captured under this QoS obligation. ComReg further proposes that managed VOIP call services would also be captured under this QoS obligation as such services are considered to be substitutable with traditional voice call services[174] and are increasingly used by consumers. ComReg also proposes that any assessment of this obligation will be made against the aggregate total.

[174] See, for example, paragraph 2.6 of Market Review: Retail Access to the Public Telephone Network at a Fixed Location for Residential and Non Residential Customers – Document 14/89.

6.6 Technical conditions

6.88 This section outlines ComReg's technical conditions proposals for the 3.6 GHz band. These proposals are considered in relation to:

- Technical conditions set out in the 3.6 GHz EC Decision;
- TDD inter-network synchronisation; and
- Technical conditions required to ensure co-channel co-existence across regional borders

6.89 In Document 14/101 ComReg did not detail specific technical conditions proposals for the 3.6 GHz band but instead listed the EC/CEPT decisions and technical documents relating to the bands proposed for inclusion in that award that contained relevant material for any subsequent technical conditions proposals. For the 3.6 GHz band the documents listed were:

- 3.6 GHz EC decision;
- ECC Decision (11)06; and
- ECC Report 203

6.90 No responses to Document 14/101 commented on the technical conditions for the 3.6 GHz band.

6.91 In considering below the technical conditions which may be applicable, ComReg assumes that the band will be released on an exclusively TDD basis as proposed in Chapter 4.

6.92 Part B and C of the Annex to the 3.6 GHz EC Decision sets out the technical conditions which are applicable for any new rights of use in the 3.6 GHz band. The technical conditions set out in Part B and C of the Annex take the form of a block edge mask (BEM)[175] for different usage scenarios and channelling arrangements. The 3.6 GHz BEMs definition include:

- In-block power limits;
- Transitional region power limits i.e. power limits for a range of frequencies above and below the block assigned to the operator;

[175] BEMs are made up of a series of power limits both in-block to ensure coexistence between adjacent frequency networks

- Baseline power limits;
- Guard band emission limits (specifically for FDD channelling arrangement); and
- Base station additional baseline power limits for country specific cases; and
- Terminal station BEM in-block power limit.

In-block Power Limits (Base Station Power Limits)

6.93 The 3.6 GHz EC Decision sets out a non-obligatory in-block power limit. If an administration wishes to apply an upper bound power limit, the 3.6 GHz EC Decision states that such a limit must not exceed 68 dBm/5 MHz per antenna. The in-block power limit, if one is set, would be applicable to all base stations within the operators assigned blocks.

6.94 ComReg therefore has a number of options to setting an in-block power limit:

- Set a limit of 68 dBm/5 MHz per antenna;
- Set a limit below 68 dBm/5 MHz per antenna; or
- Do not set a power limit;

6.95 At this time, ComReg is proposing to set an in-block power limit of 68 dBm/5 MHz, given that this limit is considered to be of a magnitude sufficient for the provision of likely services in the band. As far as ComReg is aware, all existing FWALA base stations currently operate well below the proposed in-band limit[176]. Additionally, it is proposed that all base stations would still be subject to baseline power limits, and transitional region power limits where applicable[177].

Transitional region power limits

6.96 For TDD blocks, the transitional region applies in case of synchronised adjacent blocks, and in-between adjacent TDD blocks that are separated by 5 or 10 MHz.

6.97 The transitional limits set out in the 3.6 GHz EC Decision are, as follows:

[176] The information collected from existing operators indicates that the highest power currently in use to be 64 dBm/5 MHz

[177] Transitional region power limits do not apply in the case of unsynchronised TDD networks

- For – 5 to 0 MHz offset from lower block edge or 0 to 5 MHz offset from upper block edge a limit of Min(PMax[178] - 40,21) dBm/5 MHz EIRP per antenna shall apply; and

- For – 10 to – 5 MHz offset from lower block edge or 5 to 10 MHz offset from upper block edge a limit of Min(PMax - 43,15) dBm/5 MHz EIRP per antenna shall apply

6.98 Please see the section on synchronisation (Section 7.6.1) in relation to guard blocks and transitional BEMs as proposed for this award.

Baseline Power Limits

6.99 Baseline power limits apply to synchronised and unsynchronised TDD blocks outside of in-block and transitional frequencies.

6.100 There are two TDD baseline power limit values set out in the 3.6 GHz EC Decision:

- for synchronised TDD blocks a limit of Min(PMax - 43,13) dBm/5 MHz shall apply; and

- for unsynchronised TDD blocks -34 dBm/5 MHz EIRP per cell.

6.101 The TDD inter-network synchronisation section below (Section 7.6.1) sets out further details as to how these limits are proposed to apply to rights of use won in this award process.

Guard band emission limits

6.102 The guard band emission limits set out the in the 3.6 GHz EC Decision apply only to FDD band plan. As set out in the Chapter 4, ComReg is proposing to release the band on a TDD only basis so these limits will not apply.

Base station additional baseline power limits for country specific cases

6.103 The 3.6 GHz EC Decision sets out three options for additional baseline power limits to protect military radiolocation systems operating below 3 400 MHz.

[178] Where PMax is the maximum mean power of the base station in question, measured as EIRP per carrier

6.104 Given that ComReg is already proposing a guard band between 3 400-3 410 MHz, it is not envisaged that extra protection will be required. Therefore, ComReg proposes to not implement further power limits below 3 400 MHz.

Terminal station BEM in-block power limit

6.105 The 3.6 GHz EC Decision sets out a maximum in-block power limit for terminal stations of 25 dBm[179]. The 3.6 GHz EC Decision does allow for Member States to relax the limit under certain circumstances, particularly citing the example of fixed terminal stations.

6.106 Given the prevalence of existing fixed networks in this band in Ireland and as a likely future use of the band, ComReg is of the preliminary view that this limit should be relaxed for future rights of use in the band.

6.107 Plum, in its Report 1 Document 15/73, highlights that it may be appropriate to consider a more relaxed limit for fixed and nomadic user terminals with directional antennas. The report also presents a review of appropriate limits proposed in various reports and recommendations from the ECC, ITU-R and Ofcom.

6.108 Based on the limits set out in these reports, ComReg is minded to set relaxed limits for fixed outdoor terminal equipment. The need to relax this limit is driven primarily by the use of rooftop mounted directional antennas in fixed installations. ComReg is of the opinion that such a relaxed limit should be limited to the gain achievable through directional CPE antennas. ComReg therefore proposes a limit of 37 dBm/5 MHz EIRP (i.e. 25 dBm/5 MHz + 12 dBi[180]). It should be clear that ComReg still intends to apply a power limit of 25 dBm/5 MHz at the antenna port and 25 dBm/5 MHz ERP.[181]

6.109 ComReg has yet to come to a position on whether a relaxed limit is required for nomadic user terminals but welcomes any views on this matter.

[179] This power limit is specified as EIRP for terminal stations designed to be fixed or installed and as total radiated power (TRP) for terminal stations designed to be mobile or nomadic.

[180] It is ComReg's understanding that the majority of FWA CPE directional antennas will have a gain of around 12 dBi

[181] ComReg notes that interference arising from such antennas would be the responsibility of the network operator rather than the end user. Significant interference could arise if such antennas are misaligned and it would be for the network operator to insert whatever contractual provisions in its agreements with end users that it considers necessary in this regard.

6.6.1 TDD inter-network synchronisation

6.110 TDD allows base stations to transmit and receive on the same frequency; synchronised networks aligns all transmit and receive timeslots across the network to removing the risk of network base stations ('BS') transmitting when its neighbouring BS is receiving leading to interference. TDD technology relies upon synchronisation across a network to minimise intra-network interference and maximise frequency re-use.

6.111 Where TDD networks are being operated in the same area on adjacent channels, guard bands are required to minimise the risk of BS to BS interference unless synchronisation is utilised. Where inter-operator synchronisation is utilised, the BS to BS adjacent channel interference path is removed allowing the networks to co-exist without the need for guard bands.

6.112 Given the potential for sub-national licences in the band, co-channel inter-operator synchronisation could also provide significant interference mitigation across regional borders, potentially allowing services to be provided closer to either side of the regional border than with unsynchronised networks.

6.113 Four responses were received to Document 14/101 relating to network synchronisation and guard bands. In general, two respondents highlighted the benefits of synchronisation in terms of spectrum efficiency [182] . Three respondents highlighted the need for guard bands to prevent adjacent channel interference but that guard bands may not be required where networks are synchronised[183]. One respondent also recommends that a common uplink to downlink ratio and other technical characteristics for synchronisation of TDD networks should be clearly set out prior to an award[184]

6.114 Plum, in its Report 1 Document 15/73, discusses the benefits of synchronisation and the use of synchronisation as an interference mitigation measure for cross border coordination.[185] Plum also notes that ComReg may need to consult and decide on an appropriate uplink to downlink ratio (or frame structure) for the use of synchronisation.

6.115 ECC Report 216 sets out practical guidance for TDD inter-network synchronisation[186]. The report outlines the requirements for synchronisation to

[182] page 12 of the ESBN response, page 2 of the Huawei response

[183] Page 6 of the Eircom response, page 12 of ESBN response, page 20 of the Qualcomm response

[184] Page 2 of the Huawei response

[185] Section 2.2.3 on benefits of synchronisation & section 5.1.3 on mitigation measures

[186] http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP216.PDF

be achieved, including cross-technology[187] inter-network synchronisation. In the simplest terms, in order to achieve synchronisation operators must:

- have a common reference phase clock to ensure the alignment of the start of frame
- have compatible frame structures (see frame structures section below)

6.116 Noting the advantages of synchronisation, particularly in relation to spectrum efficiency, the BEMs for the 3.6 GHz band set out in the 3.6 GHz EC Decision are more permissive for synchronised TDD networks and more restrictive for unsynchronised networks as follows:

- The baseline power limit is higher for synchronised TDD network; and
- the transitional region (and associated power limits) applies to adjacent TDD blocks assigned to other operators (i.e. outside an operators assigned block) if networks are synchronised

6.117 Given the benefits of synchronisation, ComReg is of the preliminary view that it should put structures in place to encourage inter-network synchronisation while at the same time maintaining the principle of service and technology neutrality. This can be achieved by:

- Not setting guard bands between assignments: This would require unsynchronised networks to internalise guard bands to meet the relevant technical conditions
- Setting a permissive BEM for synchronised networks and restrictive BEM for unsynchronised networks where the restrictive BEM would assume the internalising of guard bands
- Setting a default frame structure

6.118 ComReg is aware that inter-network synchronisation can only be achieved through coordination between operators and so would encourage operators to utilise ECC Report 216 as guidance in coming to any synchronisation arrangements.

[187] Report 216 focuses on TD-LTE/WiMax synchronisation as these are the most likely TDD MFCN technologies to be deployed

Default Frame Structure

6.119 Compatible frame structures between operators are required to achieve synchronisation. Frame structures define the timeslots for uplink and downlink. To achieve synchronisation these uplink and downlink slots need to be aligned. Technologies such as TD-LTE and WiMax have technology specific suites of predefined frame structures that provide a range of downlink to uplink ratios. The choosing of an appropriate frame structure for an operator would depend on the traffic profile (i.e. downlink to uplink traffic) it intends to carry over the network.

6.120 Setting a default frame structure would allow for regulatory certainty for the first operator to roll out in an area (i.e. where there is no other network to synchronise with) as to the BEM which would apply to it. This would promote speed to market and negate the need for potentially lengthy inter-operator negotiations on the appropriate frame structure.

6.121 There are currently seven TD-LTE frame structures defined by 3GPP. The table below sets out the configuration of each option and the associated UL:DL ratio.

UL-DL Configuration	Subframe number										DL:UL Ratio
	0	1	2	3	4	5	6	7	8	9	
0	D	S	U	U	U	D	S	U	U	U	1:3
1	D	S	U	U	D	D	S	U	U	D	1:1
2	D	S	U	D	D	D	S	U	D	D	3:1
3	D	S	U	U	U	D	D	D	D	D	2:1
4	D	S	U	U	D	D	D	D	D	D	7:2
5	D	S	U	D	D	D	D	D	D	D	8:1
6	D	S	U	U	U	D	S	U	U	D	3:5

Table 3. TD-LTE frame structure options

**where U is for uplink transmission, D is for downlink transmission and S is a "special" subframe used for a guard time*

6.122 ECC Report 216 considers the compatibility between LTE-TDD subframe options and existing WiMAX frame configurations and indicates that the greatest probability of compatibility is with the use of TD-LTE configuration 2 (i.e. a ratio of 3:1).

6.123 Plum in its Report 3 Document 15/75 states that TD-LTE configuration 2 is the most widely deployed configuration at present and in its Report 1 Document 15/73 indicates that configuration 2 could be used as the default frame structure.

6.124 In the UK, Ofcom recently published its decision on the planned release of the 2.3 GHz and 3.4 GHz bands[188], in which it states that it will set configuration 2 as the default frame structure for synchronisation. Those operators utilising configuration 2 would be required to operate under a permissive BEM and those choosing alternative frame structures would be required to operate under a restrictive BEM.

6.125 Appendix B of the Plum Report 2 Document 15/74 includes a summary of the decision and published responses to the prior consultation on Ofcom's PSSR Award of the 2.3 GHz and 3.4 GHz Bands. One respondent to the prior consultation indicated that configuration 2 is being utilised in China to synchronise networks in the 2.3 GHz and 2.6 GHz bands and that operators in Japan intend to synchronise networks in the 3.4-3.6 GHz band utilising configuration 2.

6.126 ComReg is of the preliminary view that the setting of a default frame structure would encourage synchronisation between networks and quicker rollout of services. Additionally the market seems to be converging on the use of configuration 2 for synchronisation. Therefore, ComReg proposes TD-LTE configuration 2 (i.e. 3:1 uplink to downlink ratio) or equivalent frame structure as the default frame structure for TDD networks.

6.6.2 Permissive and Restrictive BEMs

6.127 In respect of BEMs, ComReg proposes that:

- Operators utilising frame structure configuration 2 on their network (and having a common reference phase clock with adjacent channel operators[189]) would be subject to a permissive BEM with the parameters set out in the table below.

[188] Ofcom - Public Sector Spectrum Release: Award of the 2.3 and 3.4 GHz spectrum bands, http://stakeholders.ofcom.org.uk/binaries/consultations/2.3-3.4-ghz-auction-design/statement/statement.pdf

[189] Operators need to ensure the start of frame is aligned with adjacent channel operators above and below its assignment

BEM Element	Frequency Range	Power Limit
In-block	Block assigned to the operator	68 dBm/5 MHz
Transitional Region	-5 to 0 MHz offset from lower block edge 0 to 5 MHz offset from upper block edge	Min(PMax - 40,21) dBm/5 MHz EIRP per antenna
Transitional Region	-10 to -5 MHz offset from lower block edge 5 to 10 MHz offset from upper block edge	Min(PMax - 43,15) dBm/5 MHz EIRP per antenna
Baseline	3 400-3 800 MHz (except for in-block and transitional regions)	Min(PMax - 43,13) dBm/5 MHz

Table 4. Permissive BEM

- Operators utilising alternative frame structures (or failing to synchronise with adjacent channel networks for any other reason) would be subject to the restrictive BEM with the parameters set in the table below. It is important to note that in order to meet the restrictive mask operators would likely have to adopt guard bands within its assignment.

BEM Element	Frequency Range	Power Limit
In-block	Block assigned to the operator	68 dBm/5 MHz
Baseline	3 400-3 800 MHz (except for in-block frequencies)	-34 dBm/5 MHz EIRP per cell

Table 5. Restrictive BEM

6.128 Annex B of the Plum Report 2 Document 15/74 outlines the Ofcom proposals on the release of the '3.4 GHz' band and includes a table (B-1) detailing certain synchronisation exemptions for small cells. Ofcom proposes to exempt small cells (with an EIRP not exceeding 24 dBm) in indoor domestic and other indoor locations[190] from synchronisation restrictions. ComReg is of the view that this proposal may offer a prudent approach in its proposed award process.

6.7 Technical conditions at regional and national borders

6.129 ComReg proposes to set out technical conditions to ensure co-channel co-existence across borders.

6.130 ComReg is proposing releasing the 3.6 GHz band on a sub-national basis so to ensure co-channel co-existence technical conditions must be set at both:

[190] On a non-interference basis

- Borders between licence regions; and
- international borders with the UK

6.131 ECC Recommendation (15)01 sets out recommendations for cross-border[191] coordination for mobile / fixed communications networks (MFCN) in the frequency 3 400-3 600 MHz and 3 600-3 800 MHz bands. Amongst other things, the recommendation sets out that coordination between MFCN systems in border regions should be based on bilateral/multilateral agreements between administrations.

6.132 There is an existing memorandum of understanding ('MOU') on frequency coordination between the Republic of Ireland and the United Kingdom for wireless access services in the frequency band 3 400 to 3 800 MHz[192]. The MOU sets out the criteria for coordination[193], the method to predict propagation of base stations to assess the requirement for coordination and the coordination procedure. The MOU enables coordination between operators to facilitate signals across the border in excess of the coordination threshold.

6.133 ComReg proposes that all operators operating in border regions would be subject to the coordination thresholds and corresponding procedures set out in the MOU.

6.134 Given the proposal to release the band on a sub-national basis, ComReg commissioned Plum to carry out co-channel co-existence studies for the 3.6 GHz band. Publication 15/73 sets out the results of these studies and the resulting recommendations.

6.135 The Plum study considered existing and potential future services operating in the band and presents practical guidance as to how best these services can co-exist on a co-channel basis across licence region borders. The study takes into account equipment characteristics, likely deployment scenarios and the findings of relevant ECC/ITU reports and recommendations in coming to its recommendations with regard to the required protection of co-channel systems across borders.

[191] Cross-border means cross national borders in this instance

[192] See Annex 3 of ComReg Guidelines: http://www.comreg.ie/_fileupload/publications/ComReg0617R6.pdf

[193] A station may be established without co-ordination, provided that the predicted power spectral density (PSD) produced by the station, at a height of 10m above ground at 15km from the border of the border or coast line of the neighbouring country does not exceed 24 dBµV/m in a bandwidth of 1MHz (equivalent to an aperture power of -122 dBW/MHz/m2)

6.136 Plum recommends a coordination threshold level of 32 dBµV/m/5 MHz for 90% of the time and 90% of the locations194.

6.137 ComReg agrees with the findings of Plum and notes that the recommendations are of a similar magnitude to:

- The lower coordination value set out in ECC (15)01; and
- The current FWALA licence signal level limit

6.138 ComReg proposes to adopt the level recommended by Plum as a regional border coordination threshold for new rights of use in the 3.6 GHz band.

6.139 Two respondents to Document 14/101 recommend that sub-national operators in consultation with ComReg should develop a code of conduct and dispute resolution procedure[195].

6.140 ComReg agrees with these suggestions and intends to establish coordination procedures which would facilitate inter-operator coordination agreements. Such procedures are likely to be guided by ECC Recommendation (15)01, the MOU coordination procedures and the FWALA Domestic Frequency Coordination – Code of Practice[196].

6.141 Coordination agreements offer the potential for operators to operate with cross border field strengths of a considerably higher magnitude than the proposed threshold level. If, however, no coordination agreement can be reached between operators, ComReg proposes that the coordination threshold would become a binding field strength limit on licensees at licence region borders.

6.8 Chapter 6 Consultation Question

6.142 Do you agree with ComReg's preliminary views set out in Chapter 6 and, in particular, that:

- the band should be released on a service- and technology-neutral basis;
- rights of use in the band should be awarded on a non-exclusive basis;
- an obligation to notify of the termination of a technology should apply;

[194] This height associated with this level can be 10m when networks are unsynchronised and 3m when they are synchronised

[195] Page 11 of the Joint FWA response, page 5 of the Ripplecom response

[196] http://www.comreg.ie/_fileupload/publications/ComReg0774.pdf

- a rollout obligation should apply for spectrum rights of use in this band and that such an obligation should be based on a minimum number of base stations to be deployed per sub-national region;
- a quality of service obligation should apply in relation to each of network availability and voice call standards;
- licensees should internalise guard-bands as spectrum should be assigned without guard-bands;
- a default TDD frame-structure based on TD-LTE configuration 2 (3:1) should be applied to incentivise inter-network synchronisation;
- a permissive BEM should apply to synchronised networks and a restrictive BEM should apply to unsynchronised networks;
- the terminal station in block power limit set out in the 3.6 GHz EC Decision should be relaxed for fixed outdoor installations;
- at regional borders a coordination threshold should apply to allow for bilateral/multilateral co-existence agreements; and
- where agreement in cross-border coordination fails to be met, the coordination threshold limit should be set as a binding licence condition.

6.143 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory functions, objectives and duties.

Chapter 7

7 Transitional issues

7.1 Background

7.1.1 The need for transition activities in the 3.6 GHz band

7.1 The 3.6 GHz Band has been harmonised within Europe with the 2008 3.6 GHz EC decision[197], which was amended in 2014 by the 2014 3.6 GHz EC Decision[198] (together the "3.6 GHz EC Decision"). In line with the 3.6 GHz EC Decision, from 30 June 2015 onwards, EU Member States ("MS") are required to apply the technical conditions set out in the annex to that decision to any new 3.6 GHz rights issued.

7.2 As discussed in ComReg's draft RIA set out in Chapter 3 of this document, ComReg considers that it is not appropriate to issue new liberalised 3.6 GHz rights based on the existing FWALA licensing scheme because:

- the existing 3.6 GHz FWALA band plan[199] does not comply with the harmonised band plan channelling arrangements as set out in 3.6 GHz EC Decision ; and
- more generally the FWALA licensing scheme is no longer suitable to efficiently facilitate the full suite of wireless services that could be provided under the 3.6 GHz EC Decision[200].

[197] COMMISSION DECISION of 21 May 2008 on the harmonisation of the 3 400-3 800 MHz frequency and for terrestrial systems capable of providing electronic communications services in the Community http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:144:0077:0081:EN:PDF

[198] COMMISSION IMPLEMENTING DECISION of 2 May 2014 on amending Decision 2008/411/EC on the harmonisation of the 3 400-3 800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014D0276&from=EN

[199] See ComReg's FWALA guidelines, ComReg Document 06/17R7 http://www.comreg.ie/_fileupload/publications/ComReg0617R7guidelines.pdf

[200] Recital 5 of EU Decision 2014/276/EU discusses the mandate given to CEPT by the Commission to develop technical conditions with a view to accommodating *'developments in wireless broadband access technology, in particular large channel bandwidths, while ensuring efficient spectrum use'*; and

7.3 In addition, the draft RIA identifies that it would not be appropriate to renew or extend existing FWALA licences in the 3.6 GHz band generally.[201]

7.4 The above factors mean overall that, irrespective of the assignment process chosen (whether auction or administrative assignment), or its outcome (whether an existing 3.6 GHz licensee (an "Existing Licensee") wins rights of use in respect of more or less 3.6 GHz spectrum than it currently holds or may win no such rights of use), some or all of the Existing Licensees will be required to make adjustments to their existing networks ("Transition Activities"). These Transition Activities will be necessary in order to comply with the outcome of the proposed award process should the Existing Licensees wish to continue to provide services following the cessation of the FWALA licensing scheme on 31 July 2017.

7.5 ComReg observes that the potential for transitional issues to arise in respect of existing 3.6 GHz rights is recognised in 3.6 GHz EC Decision[202] which allows Member States to define transition arrangements for same provided two conditions are met:

- only 3.6 GHz rights of use existing at the date of adoption of the 2014 3.6 GHz EC Decision (i.e. 2 May 2014) qualify for any transition arrangement; and

- any transition arrangement does not prevent the use of the 3.6 GHz band in line with the technical conditions as set out in the Annex to the 3.6 GHz EC Decision.

7.6 This chapter sets out ComReg's current thinking on how best to address issues arising from these Transition Activities in accordance with EC Decision 2014/276/EU and ComReg's statutory functions, objective and duties, and is structured as follows:

Recital 7 of EU Decision 2014/276/EU encourages implementation of the results of that work by CEPT to enable *'rapidly growing market demand for high-speed wireless broadband services and the current low level of use of the 3 400-3 800 MHz frequency band for wireless broadband services'.*

[201] This view is without prejudice to any objectively justified and proportionate short term continuation of existing rights of use to address transition issues arising from the proposed award, including those as proposed in this chapter.

[202] Specifically, Article 2(1) of EC Decision 2014/276/EU states that:

"Moreover, Member States need not apply the parameters laid down in the Annex in respect of rights of use for terrestrial electronic communications networks in the 3 400-3 800 MHz frequency band existing at the date of adoption of this decision, to the extent that the exercise of those rights does not prevent the use of that band according to the Annex."

- it firstly outlines the potential transition issues that may be required in the 3.6 GHz band and considers the tools that might be required to address same; and
- in light of these considerations, then sets out ComReg's current proposals.

7.2 The potential transition issues in the 3.6 GHz band

7.7 As of April 2015 there were 199 FWALA licences which had been issued to 15 separate Existing Licensees. While there are certain areas of Ireland where spectrum in the 3.6 GHz Band remains unassigned, in general spectrum rights across the band have been assigned on a local area basis to these Existing Licensees. The locations of the licence areas are spread throughout the country.

7.8 Approximately 27,000 broadband customers are served via the 3.6 GHz band and in some areas of Ireland the Existing Licensee may be the only provider of fixed wireless broadband services, or the provider of the best available broadband service, as other service providers (e.g. satellite broadband providers) may not be able to provide a sufficiently comparable service in terms of download/upload speeds, latency, price etc. These areas are likely to be in the more sparsely populated areas of Ireland and this characteristic increases the potential impact of disruption to existing consumer services in the 3.6 GHz band in these areas.

7.9 Given the large number of variables associated with the Existing Licensees[203] and the large number of possible award process outcomes, it is not possible at this stage to set out a detailed discussion on the specific Transition Activities that may be required for the 3.6 GHz band or the potential scale of these. However it is possible to outline three high level transition issues and to discuss the potential measures that could be implemented to address same.

7.2.1 Transition Issue 1: The orderly transition to the outcome of the award process

7.10 The first transition issue is the transition to the outcome of the award process. There are a number of factors that are likely to determine the nature and extent of Transition Activities required of Existing Licensees generally.

7.11 These factors include:

[203] These variables include the number of licences held by each Existing Licensee, its existing frequency assignment and the areas served using these licences.

- The outcome of the award process which would determine the amount of spectrum, the frequency assignment in the 3.6 GHz band and the geographic location of the spectrum rights.

- In relation to the former, ComReg observes that an Existing Licensee could win rights of use in respect of more or less 3.6 GHz spectrum than it presently holds and, in particular, may win no such rights of use. In the event that an Existing Licensee did not win any or sufficient spectrum with which to maintain existing service levels, then relevant considerations include the options available to it to minimise the impact on existing consumer services such as by providing services using licence-exempt spectrum or alternative spectrum bands, and/or by concluding commercial agreements with other operators (including winners of new 3.6 GHz rights) such that the Existing Licensee could continue to provide a consumer service (e.g. transfer or leasing arrangements). ComReg also observes that the ability of consumers to obtain a comparable service from alternative providers will be relevant.

- Even where an Existing Licensee wins rights of use in respect of the same or more spectrum that it presently holds, it may be at a different frequency assignment in the 3.6 GHz band compared to its existing assignment, and thus Transition Activities may be required to reconfigure its network to operate in the new location. In that regard, ComReg notes that the ability of Existing Licensees' equipment [204] to readily operate in different frequency assignments to those in which it currently operates will be a relevant factor.

- Given the current intention to grant rights of use in respect of the entire 3.6 GHz Band across the State, using regional licences, Existing Licensees' systems may need to be modified to mitigate interference with systems operated by other licensees in regions or to comply with requirements in relation to signal levels at regional borders.

The formulation of a transition plan in the 900 MHz and 1 800 MHz bands in the MBSA process and relevance of ComReg's approach to same for the 3.6 GHz band

7.12 ComReg notes that it faced similar transition issues in the context of its MBSA process where existing 900 MHz and 1 800 MHz licensees also faced the

[204] This includes both the Base Station ("BS") network and Consumer Premises Equipment ("CPE").

prospect of (a) winning more or less spectrum than they then held or no spectrum, (b) winning spectrum rights in a different part of the band and (c) requiring a reasonable time period within which to make the necessary adjustments to their networks to comply with the outcome of that award process.

7.13 Other similarities between the MBSA process and the current proposed award process include that:

- Transition Activities will inevitably be required by some or all of the Existing Licensees in the 3.6 GHz band;
- there is the potential for disruption to existing services to arise from possible award outcomes and from the carrying out of Transition Activities, albeit on a substantially smaller scale for the 3.6 GHz band[205] when compared to the number of GSM consumers in the 900 MHz and 1 800 MHz bands who potentially could have experienced a disruption to their services; and
- new liberalised services (e.g. mobile services) may be introduced in the 3.6 GHz band following the introduction of new liberalised spectrum rights of use.

7.14 To address these transition issues in the 900 MHz and 1 800 MHz bands, ComReg defined a transition plan[206] in order to facilitate an orderly and timely transition to the outcome of the award process.

7.15 The first step in this process was the identification and finalisation of transitional arrangements and rules prior to the running of the award which would apply to address the specific Transition Activities arising from the outcome of the award. These were developed in line with ComReg's statutory objectives and were informed by a number of high level considerations including:

- Technical analysis of the actions and likely timeframes required to carry out the various Transition Activities. This analysis was based upon

[205] ComReg estimates that there are circa 27,000 subscribers currently served by the 3.6 GHz band. At the time of the MBSA transition there were circa 5.6 million mobile subscribers who would have use of GSM services in the 900 MHz and 1800 MHz bands - a factor circa 200 times greater than the current FWALA subscribers who use the 3.6 GHz band.

[206] ComReg Document 13/19 http://www.comreg.ie/_fileupload/publications/ComReg1319.pdf

independent expert advice from Red-M and Vilicom[207], with input from interested parties including the existing GSM Licensees.

- Introducing liberalised licences as soon as possible and not unnecessarily delaying the delivery of future liberalised services.

- Minimising the potential for disruption to existing consumer services.

7.16 Once the outcome of the MBSA process was known (and thus the specific nature and extent of the Transition Activities for the existing licensees was understood), the second step in this process was the determination by ComReg of a transition plan to be complied with by those existing licensees in the carrying out of their respective Transition Activities ("transition plan"). This transition plan was determined following input from the existing licensees and new licensees in terms of proposals by them to address their respective Transition Activities

7.17 In ComReg's view, the transition plan and its rules achieved its objectives because the Transition Activities were carried out in an orderly and timely manner thereby limiting any delays to the introduction of new services to the minimum time necessary. In that regard, ComReg notes that:

- For Time Slice 1 ("TS1") of the MBSA process, the Transition Activities of the GSM licensees were completed 2-5 months after the results of the MBSA process were finalised.[208] The timely completion of these Transition Activities minimised any delay to the introduction of new liberalised services, and ComReg notes that new liberalised services (UMTS in the 900 MHz band and LTE in the 1 800 MHz band) were introduced in these bands shortly after the finalisation of the Transition Activities.

- For Time Slice 2 ("TS2) of the MBSA process the Transition Activities are currently underway and ComReg would expect these to be completed in advance of the commencement date of TS2 thus causing no delay to the use of liberalised use spectrum rights of use in TS2.

7.18 In addition, no significant consumer service issues were notified to ComReg as a result of the implementation of the transition process.

[207] See ComReg Documents 12/22, 11/57, 10/105b, and 10/71c.

[208] The final results of the MBSA award were published on 5 December 2012 (ComReg Document 12/131) and the Transition Activities for TS1 were completed between January and April 2013 (see paragraph 1.3 of ComReg Document 13/55).

7.19 Given the above, ComReg considers that the formulation and implementation of a transition plan for the 3.6 GHz band to be an important measure by which to ensure:

- an orderly and timely transition to the outcome of the award process;
- the commencement of liberalised licences as soon as practicable, thereby not unnecessarily delaying the delivery of future liberalised services to end consumers; and
- the minimisation of the potential for significant disruption to existing consumer services.

7.20 ComReg notes that these principles accord with Article 2(1) of the 2014 3.6 GHz EC Decision which provides scope for transition arrangements provided that existing rights of use do not prevent the use of the 3.6 GHz band in line with the technical conditions as set out in the Annex to the decision (i.e. they do not unnecessarily delay the introduction of new services). ComReg's transition plan proposals are set out in Section 8.3.1 below

7.2.2 Transition issue 2: The proposed 3.6 GHz transition plan is not completed before the expiry of existing FWALA licences on 31 July 2017

7.21 The second transition issue relates to the timing of the transition plan activities, particularly where such activities would need to be carried out after the expiry of the existing licences on 31 July 2017.

7.22 Where Transition Activities in the transition plan can be carried out before 31 July 2017, ComReg observes that suitable amendments to existing FWALA licences (e.g. a modification of the quantum of the frequency assignment and its location within the band and/or the geographic dimension of existing licence) may be sufficient to facilitate Existing Licensees in making the necessary adjustments networks in advance of the commencement of new licences on 1 August 2017. ComReg therefore considers that no additional transition tools would be required for this eventuality.

7.23 Where, however, Transition Activities in the transition plan cannot be carried out before 31 July 2017, ComReg observes that an appropriate continuation of relevant Existing Licensees' rights of use would be required to facilitate the carrying out of these transition plan activities. In that regard, ComReg notes that this could be implemented by way of the issue of a short-term transition licence to relevant Existing Licensees that would provide them with

appropriate protection same during this period.[209] ComReg observes that, in the MBSA process, a short-term interim licence was issued to facilitate the carrying out of transition activities in the 900 MHz band.[210]

7.24 ComReg believes that the ability to issue a short-term transition licence to protect the Existing Licensees for this eventuality is an important tool by which to facilitate the timely and orderly completion of the transition plan and, further, that such a measure would accord with Article 2(1) of the 2014 3.6 GHz EC Decision by constituting an appropriate transition mechanism which would also minimise the delay to the introduction of liberalised licences and the potential for disruption to existing consumer services. ComReg's proposal for a "Transition Protected Licence" is set out in Section 8.3.2 below.

7.2.3 Transition Issue 3: Maximising benefits to user and ensuring the efficient use of spectrum during the transitional period

7.25 In some areas of Ireland the Existing Licensee in the 3.6 GHz band may be the only provider of fixed wireless broadband services, or the provider of the best available broadband service. This includes services provided by Eircom with its 3.6 GHz FWALA licence in the Black Valley area.[211] Accordingly the cessation of these services following the expiry of the existing FWALA licences has the potential to cause consumer disruption.

7.26 Furthermore, it is not clear when new licensees will begin to provide services as the demand and timeline for the introduction of new services into the 3.6

[209] ComReg emphasises that any decision that it may make to grant short term licences will be made in light of its statutory functions, objectives and duties and the factual matrix as it impacts on all stakeholders. No party should rely on the fact that ComReg is contemplating granting short term licences, or may ultimately grant same, as an indication that ComReg will consider granting such licences in a similar scenario in future.

[210] See ComReg Document 13/05

[211] In 2010, ComReg issued Eircom with a FWALA licence in the 3.6 GHz band, *"authorising the use of the precise amount of spectrum that is required to continue the provision of services to customers receiving WiMax/broadband services in the Black Valley Area."* (see ComReg Information Notice 10/64). ComReg understands that residents in this area do not have access to any other communications service other than the one provided by Eircom using this 3.6 GHz FWALA licence under its Access at a Fixed Location Universal Service Obligation (AFL USO). Eircom's current AFL (Access at a Fixed Location) designation ends at the end of December 2015 and ComReg is planning to issue a consultation on this matter in the coming weeks.

At this stage, ComReg observes that there are a number of potential options by which a Universal Service Provider (USP) could continue to meet its obligations, including by:

- Obtaining new 3.6 GHz rights in the proposed award;
- Providing services in the relevant area through access to alternative spectrum rights (e.g. 10.5 GHz and 26 GHz and unlicensed spectrum rights in the 2.4 GHz and 5.8 GHz bands); and/or
- availing of the proposed Transition Unprotected Licence as described below.

GHz Band is less clear than was the case for more developed spectrum bands, such as the 900 MHz and 1 800 MHz bands. In addition, ComReg notes that any new services may initially only be provided in parts of the service area of a new licence. These factors, combined with the quantity of spectrum in this band, mean that some new liberalised rights of use in the 3.6 GHz Band may be unused for a period of time or at least in certain areas.

7.27 Given these factors, the outcome of the 3.6 GHz award process could give rise to a situation where an Existing Licensee does not obtain sufficient (or any) new 3.6 GHz spectrum rights of use with which to continue to provide its existing fixed broadband service, while a new 3.6 GHz licensee may not be immediately providing services with its liberalised 3.6 GHz rights in its licence area or in certain parts of this area.

7.28 Further, in the areas of the State where an Existing Licensee may be the only provider of broadband access services (or where existing alternative providers may not provide sufficiently comparable services), an outcome as outlined above could result in a 'gap' in the provision of broadband access services to end-users for a short-term transitional period. This transitional period would arise from the expiry of relevant Existing Licensees' licences until the commencement of services by new 3.6 GHz licensees, or the deployment of sufficiently comparable broadband services via other platforms (e.g. fibre, other spectrum etc.), in the relevant service area.

7.29 While the scenarios outlined above, if they arise, are only likely to be of a short-term transitory nature, they could nevertheless raise material issues in the context of ComReg's objectives in relation to:

i. maximising benefits to users/safeguarding competition; and

ii. ensuring the efficient use of spectrum during this transitional period.

7.30 In relation to (i), it is apparent that allowing a situation whereby an Existing Licensee is not in a position to continue to provide services to existing customers for a transitional period (particularly where it may be the only provider of said services) does not further ComReg's objectives in this regard.

7.31 In relation to (ii), it is also clear that not allowing an Existing Licensee to make use of an extension of the existing rights of use under certain conditions[212] during this transitional period would be unlikely to encourage/ensure the

[212] Primarily where such use would not prejudice any winning bidder in the proposed assignment process.

efficient use of said spectrum rights, particularly if these spectrum rights are not being used by the new licensee.

7.32 In considering whether there is a need to propose a transition tool to address this issue, ComReg is cognisant that:

- it should firstly consider whether market mechanisms would be sufficient/likely to overcome this potential outcome; and
- any transition proposals should not create disincentives for Existing Licensees in terms of their participation in the proposed award process and/or seeking to come to a commercial arrangement with winners of new rights of use (i.e. via a spectrum transfer or lease).

Would market mechanisms be likely to address the 3.6 GHz band unique transitional issue?

7.33 Ideally ComReg would let market mechanisms resolve these additional transitional issues.

7.34 In that regard, a spectrum transfer or leasing arrangement would be an appropriate means by which the Existing Licensee and the new licensee could resolve these transitional issues in a mutually-beneficial manner. The Existing Licensee would have an economic incentive to obtain 3.6 GHz rights of use to continue to provide existing services for as long as possible, or economically viable, and the new licensee would have an economic incentive to obtain a commercial return on its spectrum rights in a particular region that it may not use for some time.

7.35 In relation to a potential spectrum transfer, ComReg observes that the 3.6 GHz band is a band to which Spectrum Transfer Regulations[213] apply and therefore regulatory mechanisms already exist to facilitate a transfer.

7.36 In relation to spectrum leasing, ComReg notes that spectrum leasing will be permitted in the 3.6 GHz band subject to procedures that ComReg intends to put in place prior to the expiry of existing licences in July 2017. ComReg will consult on its spectrum leasing procedures in due course and would, of course, welcome the views of all interested parties on same.[214]

[213] http://www.comreg.ie/_fileupload/publications/ComRegSI34of2014.pdf

[214] ComReg notes that spectrum leasing will be the subject of a separate consultation and that accordingly, comments in relation to same may, or may not, be responded to in the response to this consultation. All interested parties will have an opportunity to submit comments in relation to spectrum leasing in a further consultation and no party will be disadvantaged in relation to that consultation by not responding to this consultation.

7.37 In relation to spectrum transfer and leasing, ComReg observes that there may be reasons why parties might not reach an apparently mutually-beneficial outcome, notwithstanding the availability of these market-based mechanisms. Examples of such reasons could include but may not be limited to: information asymmetry, transaction costs (particularly where value of a transfer/lease may be relatively low) and uncertainty about important contractual terms. ComReg observes that even though several spectrum trading (transfer and/or lease) schemes are available, both within Ireland and across Europe, the small number of spectrum transfers/leases suggest that there could be significant impediments to market-clearing.

7.38 Accordingly, it appears appropriate for ComReg to consider whether to put in place award process measures that could facilitate a more effective functioning of these market mechanisms. In that regard, ComReg observes that:

- its regional area licence proposals as set out in Chapter 4, while not unduly disturbing Existing Licensees' areas (or population centres), would mean that parties may be able to rely upon objective data by which to determine an appropriate valuation of a transfer/lease of 3.6 GHz spectrum (e.g. population of an Existing Licensees' area versus the population of the new licence region); and

- allowing a new licensee to meet some or all of its coverage obligations by way of coverage obtained via a leasing arrangement could incentivise the new licensee to lease spectrum rights to the Existing Licensees for a specific period. While this measure is not currently proposed in the rollout obligations proposals as set out in Chapter 6, it may be appropriate to propose this depending on interesting parties views and ComReg's rollout obligation proposals and the issues raised in this chapter.

7.39 Notwithstanding the above, ComReg is of the view that there remains a residual possibility that market mechanisms would not entirely resolve the transitional issues identified above.

7.40 Given the potential competition, end-user and spectrum efficiency issues identified above, and that market mechanisms may not entirely resolve the transitional scenario, ComReg proposes to implement a transition measure to address same on the basis that such a measure should not prevent a new licensee from using its new spectrum rights of use (in accordance with Article 2(1) of the 2014 3.6 GHz EC Decision). ComReg sets out its proposal for a "Transition Unprotected Licence" in Section 8.3.3 below

7.2.4 Summary

7.41 Given the above, ComReg considers that it should define transition arrangements and rules for the 3.6 GHz Band with which to address the three transition issues discussed above. ComReg's specific proposals are set out in the following section.[215]

7.42 Before turning to these proposals, ComReg would reiterate that it is not possible to define specific transition activities for each Existing Licensee, nor transition plans to address same, in advance of knowing the outcome of the proposed award. Accordingly, the remainder of this chapter focuses on ComReg's proposed arrangements and rules with which to address the specific transition scenarios arising from the outcome of the proposed 3.6 GHz award. Details such as the likely time required to carry out specific transition activities will be considered and determined at a later date when further information is available. That said, ComReg will be guided by its experience with transition activities and timelines based on its MBSA process and the further information that will become available over this consultation process.

7.3 The 3.6 GHz Transitional proposals

7.43 ComReg's transitional proposals consist of three tools:

- The formulation of a 3.6 GHz Band Transition Plan;
- The issue of "Transition Protected Licences"; and
- The issue of "Transition Unprotected Licences".

7.3.1 Transition Proposal 1: The formulation of a Transition Plan

7.44 The transition plan proposal outlined in this section would apply to all Existing Licensees and covers all outcomes from the proposed award process including the scenarios where:

- an Existing Licensee, whether individually or as part of a consortium, wins some 3.6 GHz spectrum rights in the award process. The amount of spectrum rights won could be in respect of more or less than the spectrum currently assigned to it, and the frequency assignment could be in a different part of the 3.6 GHz band to that of its current assignment; and

[215] For the avoidance of doubt, ComReg's complete transition proposal consists of the transition proposals of each category combined.

- an Existing Licensee, whether individually or as part of a consortium, does not win any 3.6 GHz spectrum in the award process.

7.45 ComReg is of the view that it is important that all Existing Licensees are involved in the process to determine a 3.6 GHz transition plan as this would allow each Existing Licensee the opportunity of providing transition proposals to ComReg that reflect the specifics of its transition activities. This in turn would enable the formulation and implementation a well-informed and robust transition plan by ComReg thereby facilitating an orderly and timely transition.

7.46 To determine a transition plan, a number of steps are likely to be required including:

- The collection of information from Existing Licensees to inform ComReg's transition proposals, rules and transition plans.
- The setting of transition plan rules in advance of the award process.
- The determination and implementation of this plan, including the potential for Transition Protected Licences to be issued.

Collection of information from Existing Licensees to inform ComReg's transition proposals, rules and transition plans

7.47 Whilst the precise nature and extent of transition activities for an Existing Licensee (including the time required by an Existing Licensee to complete its transition) would only be known following the outcome of the proposed award, it is nevertheless important for ComReg to obtain information from Existing Licensees (and potentially other interested parties) in advance so as to inform ComReg's transition proposals and rules for the 3.6 GHz band and to enable it to act in a timely manner.

7.48 Accordingly, ComReg proposes that:

- between now and the start of the proposed award process, all Existing Licensees consider and, where practicable, make preparations for transition activities which might be required of them. As noted above, ComReg observes that there are a number of issues that an Existing Licensee can consider in seeking to mitigate the scale and time of any transition activity required; and
- during this consultation process and prior to the award process itself, ComReg will in the first instance request information from Existing Licensees on their transition considerations which may include (but is not

limited to) the likely transition activities required, timeframes and milestones.

The setting of transition plan rules in advance of the award process

7.49 In order to define a 3.6 GHz transition plan, it is first necessary to define transition rules in advance of the award process[216]. The transition rules proposed below would define:

- The parties who would be obliged to comply with the rules;
- The elements of a transition plan;
- The process for defining a transition plan; and
- Consequential outcomes such as the delayed commencement of a new licence.

All Existing Licensees and any bidder in the 3.6 GHz award process would be obliged to comply with the transition rules

7.50 Using the information available to it and in advance of the award process, ComReg would set out transition plan rules for the award process. Similar to the MBSA process[217] ComReg proposes that all Existing Licensees and any participant in the 3.6 GHz award process would be obliged to comply with the transition plan rules defined for the 3.6 GHz band. In particular:

- ComReg proposes that the acceptance of the transition plan rules would be a condition of entry to the proposed 3.6 GHz award process; and
- If an Existing Licensee is not a bidder in the award process and further chooses not to accept the transition plan rules which ComReg defines for the 3.6 GHz band, then it would not be in a position to avail of the transition plan proposals described in this section or the Transition Protected Licence. For the avoidance of doubt, such an Existing Licensee would remain entitled to fully enjoy its existing 3.6 GHz rights of use until licence expiry and, as discussed below, such an Existing Licensee would also be eligible to apply for a Transition Unprotected Licence.

[216] In the MBSA process, the transition rules are set out in Section 3.8 of the Multi Band Spectrum Release, Information Memorandum" ComReg Document 12/52; http://www.comreg.ie/_fileupload/publications/ComReg1252.pdf

[217] See paragraph 3.156 of ComReg Document 12/52;

The elements of a transition plan and the process for determining it.

7.51 A transition plan for the 3.6 GHz band is likely to consist of similar elements to the transition plan determined for the MBSA process[218], insofar as it is likely to involve:

- the identification of all transition activities to be undertaken by the Existing Licensees and the order in which each activity would be taken;
- the setting of milestone dates for each transition activity identified;
- where the transition activities of one Existing Licensee is dependent upon the transition activities of another, this would be clearly identified such that any consequential delays by one party due to the delay of another party can be clearly attributable to the responsible party;
- a robust and transparent mechanism to allow ComReg (including any of its agents or servants), Existing Licensees, winning bidders and other appropriate interested parties to monitor compliance with the transition activity milestones;
- the completion of transition activities prior to a deadline date as set by ComReg in the transition plan; and
- attribution and acceptance of liability for liquidated damages payable by the Existing Licensee(s) to ComReg in the event of non-compliance by it/them with the transition activity milestones identified in the plan, where such Existing Licensee(s)' actions or omissions caused the non-compliance with the relevant milestone date (see further below).

The process to determine a 3.6 GHz Transition Plan

7.52 In determining the transition plan for the 3.6 GHz band ComReg proposes to use a similar process to that used in the MBSA process[219]. In summary this would involve:

- the setting of transition arrangements and rules by ComReg in advance of the award process, which among other things could specify the end-date for the completion of transition activities in advance of determining the transition plan;

[218] See paragraph 3.158 of ComReg 12/52

[219] See paragraphs 3.157 to 3.163 of ComReg Document 12/52.

- the opportunity for Existing Licensees and winning bidders to collectively formulate an industry transition project proposal for ComReg to consider, and in the absence of collective formulation, to make one, or more submissions to ComReg as to the appropriate provisions for such a plan;

- the setting of the final transition plan, containing milestones and completion dates, by ComReg having considered the proposal(s) which have been received;

- the subsequent monitoring and reporting, against the progress of the relevant transition activity and the progress of the Existing Licensees against these milestones; and

- the completion of all of the transition activities by the existing licensees in accordance with the milestones determined by ComReg as set out in the final transition plan.

The potential for delays to the commencement date of new spectrum rights of use and the acceptance of liquidated damages.

7.53 As a consequence of the transition plan activities and as discussed further below in ComReg's Transition Protected Licence proposal, it is possible that some existing licences could be extended for a short period of time beyond the end date of the FWALA licensing scheme on 31 July 2017 for transition purposes, and any such short-term extension could delay the availability of spectrum rights to the winning bidders in the 3.6 GHz award process.[220] To address this possibility, ComReg proposes to adopt similar rules to those used in the MBSA process insofar as:

- Bidders in the proposed award process would be obliged to accept that the commencement date of any new spectrum rights of use won in the 3.6 GHz award process could be delayed due to that the transition activities of Existing Licensees. Similar to the MBSA, ComReg would propose a pro-rata refund of licence fees for any such delayed commencement.[221]

- Each Existing Licensee would be obliged to accept the prospect of paying liquidated damages to ComReg in respect of non-compliance by it with the

[220] In the MBSA process a short-term licence extension was provided to two of the existing GSM licensees for a maximum period of 3 months beyond the 1 February 2013 commencement date of TS1 (see document 13/05). This resulted in a delay in the availability of some the new spectrum rights of use issued.

[221] See section 2.2.6 of ComReg Document 12/52.

transition plan. In ComReg's view, the paying of liquidated damages and the prospect of such payments are appropriate (i) to reflect any potential losses to ComReg and (ii) to incentivise the completion of Transition Activities in an effective and timely manner, and ComReg would propose to adopt liquidated damages proposals similar to those used in the MBSA process[222].

7.3.2 Transitional Proposals 2: A Transition Protected Licence

7.54 As discussed earlier, where the transition plan activities of an Existing Licensee are likely to occur after the end date of the FWALA licensing scheme on 31 July 2017, ComReg proposes to allow the Existing Licensees to apply for a Transition Protected Licence in order to facilitate the timely and orderly completion of its transition plan activities.

7.55 While ComReg does not know the extent of the transition plan activities at this point in time, ComReg believes that any Transition Protected Licence would be of a short-term nature in order to not unnecessarily delay the introduction of new licences.

7.56 In addition, ComReg believes the terms and conditions associated with this Transition Protected Licence would be the same as those in the existing Licence with the exception of the duration as discussed above, and the frequency assignment which could be modified to facilitate the completion of the 3.6 GHz transition plan.

7.3.3 Transitional Proposal 3: A Transition Unprotected Licence

7.57 ComReg is of the view that it is appropriate to propose a transitional measure to address the unique circumstances identified in relation to the 3.6 GHz band which are of a short-term transitory nature and could raise issues in the context of ComReg's objectives in relation to:

i. maximising benefits to users/safeguarding competition; and

ii. ensuring the efficient use of spectrum during this transitional period.

7.58 ComReg is conscious that any regulatory mechanism proposed must not provide perverse incentives for the Existing Licensees in terms of the nature and extent of their participation in the proposed award or in terms of coming to a market-based resolution of the transition scenario identified. In addition, ComReg is conscious that its proposed regulatory measure must also be

[222] See section 3.8.2 of ComReg Document 12/52.

permissible in law[223], including by furthering ComReg's statutory objectives and according with its regulatory principles. ComReg has taken these considerations into account in designing the transition proposal outlined below.

7.59 At a high level, ComReg's proposal consists of allowing the Existing Licensee under certain pre-conditions the possibility of obtaining a Transition Unprotected Licence on the same terms and conditions as to its existing licence (with the exception of the items discussed below) for a maximum period of not more than 2 to 5 years.

Pre-conditions to be eligible to obtain a Transition Unprotected Licence

7.60 The pre-conditions necessary to be eligible to obtain a Transition Unprotected Licence would be that the Existing Licensee:

i. has agreed to be bound by the transition plan arrangements and rules for the 3.6 GHz band; and

ii. must hold a General Authorisation.

Proposed condition – issued on the same terms and conditions as the existing licence (with some exceptions)

7.61 By proposing to issue a Transition Unprotected Licence on the same terms and conditions as the existing licence, the Existing Licensee would only be able to obtain a Transition Unprotected Licence in the same local area, for the same amount or a lower amount of spectrum, and for the equipment with the same functionality as currently licensed under its existing licence. In addition the Existing Licensee would only be able to offer fixed services.

7.62 Where the Existing Licensee is also a holder of new spectrum rights of use, the existing Licensee would also be eligible to apply for a Transition Unprotected Licence provided the combined spectrum holdings under its new 3.6 GHz licence and the Transition Unprotected Licence do not exceed the total amount of spectrum in its existing licence.

7.63 ComReg is of the preliminary view that this provision is appropriate as it is suitable for addressing the transition issue identified without going beyond what would be necessary to address the issue, while at the same time providing an incentive to the Existing Licensee to either obtain new rights of

[223] For example, Part B of the Authorisation Regulations lists the categories of conditions that can be attached to a spectrum right of use.

use in the award process or to come to a commercial agreement with a new licensee if it wishes to operate new equipment (e.g. to offer new services).

Proposed condition – issue on a non-protected non-interference basis

7.64 To protect the rights of winning bidders, ComReg proposes that any Transition Unprotected Licence would be issued on a non-protected non-interference basis. In this manner an Existing Licensee using Transition Unprotected Licence would not be able to claim protection and thus prevent the introduction of services by the new licensee.[224] Should an Existing Licensee be operating on a Transition Unprotected Licence in a new licensee's service area, ComReg is aware that some notification procedures may be required between the new licensee and the existing licensee in order to ensure orderly customer migration while not unduly preventing the new licensee from deploying services. Such processes will be considered at a later stage.

Proposed condition – the frequency assignment in the 3.6 GHz band

7.65 In relation to the frequency assignment in the 3.6 GHz band that could be assigned in the Transition Unprotected Licence, there are two potential options.

i. One option would be to limit the Transition Unprotected Licence frequency assignment to the same frequency assignment as detailed in the existing licence. While this option would ensure the status quo in terms of maintaining the terms and conditions of the existing licence, it may not result in the most efficient use of spectrum. For example under certain scenarios an existing licensee may not be able to provide services using the Transition Unprotected Licence frequency assignment (e.g. the new licensee has launched services) while other frequency assignments in the 3.6 GHz band could remain unused and potentially available for use.

ii. Another option would be to allow the Existing Licensee the possibility of choosing and modifying its Transition Unprotected Licence frequency assignment. While this option could increase the efficient use of spectrum as it would allow the Existing Licensee to use another unused frequency assignment to provide services, it may be impractical to

[224] ComReg observes that such an approach would accord with Article 2(1) of EC Decision 2014/76/EU.

implement [225] and it could somewhat disincentivise the Existing Licensee in terms of the nature and extent of their participation in the proposed award or in terms of coming to a market-based outcome.

7.66 ComReg recognises that there are pros and cons to each of the above options and it is not in a position at this stage to indicate a preferred proposal. It will be further informed by responses to this consultation.

Proposed condition – the duration of the licence

7.67 A key issue for consideration with any Transition Unprotected Licence is its duration.

7.68 At the outset ComReg is of the view that the Transition Unprotected Licence should have a fixed maximum duration between 2 to 5 years. In arriving at this view, ComReg is aware that:

- A maximum duration provides clarity to the Existing Licensees that the Transition Unprotected Licence arrangements will cease after a certain period of time. This provides incentives to the Existing Licensee in terms of the nature and extent of their participation in the proposed award or in terms of coming to a market-based outcome. Further ComReg notes the shorter the maximum licence duration the greater the incentive; and

- The coverage and roll-out proposal as set out in Chapter 6 proposes a roll-out period of 4 to 6 years and this could incentivise the new licensee to provide services by this roll-out time-period

7.69 A further consideration is whether the duration of a Transition Unprotected Licence would be terminated prior to the fixed maximum duration. The termination could be linked to certain events such as:

i. Fixed broadband services of a comparable nature being provided in the service area of the Existing Licensee [226]. Whilst consumer disruption issues would be mitigated by the ability of consumers to migrate to the new supplier, the cessation of a Transition Unprotected Licence linked to this event may not promote efficient spectrum use where the

[225] For example it may not be possible for the Existing Licensee to adjust its equipment to (both BS and CPI) to operate on the alternative frequency assignment.

[226] Note, these services do not necessarily need to be provided by a new licensee but could also be provided by other means (e.g. fibre, other spectrum etc.)

Existing Licensee could continue to use what would otherwise be fallow spectrum to provide a service.

ii. Services in the 3.6 GHz band are provided by a new licensee in the same spectrum and in the same service area of the Existing Licensee. Depending on the preferred option chosen in relation to the Transition Unprotected Licence frequency assignment as discussed above, under one option this event could result in the termination of the Transition Unprotected Licence, while under the other option the Existing Licence may be able to request a modification to its Transition Unprotected Licence frequency assignment in order to use an alternative unused frequency assignment elsewhere in the 3.6 GHz band;

7.70 ComReg recognises that there are pros and cons to each of the above options and it is not in a position at this stage to indicate a preferred proposal. It will be further informed by responses to this consultation.

Proposed condition – the licence fees

7.71 A further condition to be considered in relation to Transition Unprotected Licence is the appropriate level of licence fees. Again there are a number of options including:

i. Using the existing FWALA fees;

ii. Using the existing FWALA fees updated to present day prices using the overall Consumer Price Index (CPI) as published by the Central Statistics Office. Noting that the FWALA fees were set in March 2003, a CPI adjustment of 18.05% would need to be applied to the FWALA fees to update them to present day prices[227]; or

iii. Using a pro-rata adjustment of the fees paid for new liberalised spectrum rights of use. The pro-rata adjustment would take account of the quantum of spectrum, the proportion of new region encompassed by existing FWALA area, etc.

[227] This CPI adjustment is based on the change in the overall CPI index between March 2003 and May 2015 using the December 2001 base reference data available on the Central Statistics Office (CSO) website.

7.72 In relation to option (iii) ComReg is of the preliminary view that this would not be appropriate as the Transition Unprotected Licence would not allow the Existing Licensee the possibility of providing new liberalised services (e.g. mobile services) and therefore it would not be appropriate that the transition fees would be based on the fees paid for new liberalised spectrum rights of use.

7.73 Considering the remaining two options above, ComReg is of the preliminary view that it would be appropriate to use option (ii) as the FWALA fees were set almost 12 years ago in 2003 and so do not reflect present day prices.

7.4 Chapter 7 Consultation Question

7.74 Do you agree with ComReg's preliminary views set out in Chapter 7 and, in particular, with the following proposals:

- Transition Proposal 1: the formulation of a transition plan for the 3.6 GHz band;
- Transition Proposal 2: the Transition Protected Licence; and
- Transition Proposal 3: the Transition Unprotected Licence.

7.75 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory functions, objectives and duties.

Chapter 8

8 Submitting Comments and Next Steps

8.1 Submitting Comments

8.1 All input and comments are welcome. However, it would make the task of analysing responses easier if comments were referenced to the relevant question / section / paragraph number in each chapter and annex in this document.

8.2 Please also set out your reasoning and all supporting information for any views expressed.

8.3 The four week period for comment will run until 17:00 on Friday 7 August 2015, during which time ComReg welcomes written comments on any of the issues raised in this paper.

8.4 Responses must be submitted in written form (post or email) to the following recipient, clearly marked —Submissions to ComReg 15/70:

Mr. Joseph Coughlan

Commission for Communications Regulation

Irish Life Centre

Abbey Street

Freepost

Dublin 1

Ireland

Email: marketframeworkconsult@comreg.ie

8.5 We would request that electronic submissions be submitted in an unprotected format so that they can be included in the ComReg submissions document for electronic publication.

8.6 ComReg appreciates that respondents may wish to provide confidential information if their comments are to be meaningful. In order to promote openness and transparency, ComReg will publish all respondents' submissions to this consultation as well as all substantive correspondence on matters relating to this document, subject to the provisions of ComReg's guidelines on the treatment of confidential information[228]. In that regard, respondents are requested to provide both a confidential and non-confidential version of their submission to the consultation, providing supporting reasoning as to why they consider material to be confidential. Alternatively, respondents are requested to place confidential material in a separate annex to their response, again providing supporting reasoning in that annex as to why such material is confidential.

8.2 Next Steps

8.7 Following receipt and consideration of submissions in response to this, and other relevant material, ComReg intends to publish a response to consultation together with a draft decision and draft information memorandum.

8.8 While ComReg cannot provide further clarity on the overall timelines at this juncture, as this will depend on the nature of responses received among other things, ComReg would reiterate that it remains conscious of the expiry of existing 3.6 GHz licences in July 2017 and is working towards providing clarity on the future of the 3.6 GHz band as far as possible in advance of this date.

8.9 Subject to the above, ComReg would endeavour to issue its response to this consultation by the end of 2015.

[228] Document 05/24 - Response to Consultation - Guidelines on the treatment of confidential information - March 2005.

Annex 1: Glossary

A1.1 Definitions

A 1.1 The definitions in this glossary shall apply to this document as a whole.

A 1.2 Where a term in this glossary is defined by reference to a definition in a section or paragraph and an explanation of that term is provided in this glossary, the latter explanation is for convenience only and reference should be made to the appropriate part of the document for the definitive meaning of that term in its appropriate context.

A 1.3 Any reference to any provision of any legislation shall include any modification re-enactment or extension thereof.

A 1.4 Terms defined in this consultation paper shall, unless the context otherwise requires or admits, have the meaning set out below:

700 MHz band	The frequency range 694 – 790 MHz
800 MHz band	The frequency range 790 – 862 MHz
900 MHz band	The frequency range 880 – 915 MHz paired with 925 – 960 MHz
1.4 GHz band	The frequency range 1452 - 1492 MHz
1 800 MHz band	The frequency range 1 710 – 1 785 MHz paired with 1 805 – 1 880 MHz
2.3 GHz band	The frequency range 2 300 – 2 400 MHz
2.6 GHz band	The frequency range 2 500 – 2 690 MHz
3.6 GHz band	The frequency range 3 400 – 3 800 MHz. However for the purposes of this award the 3.6 GHz band herein should, unless the context requires otherwise, be read as excluding the portion of the band which is in use by State services and the 10 MHz guard band between 3 400-3 410 MHz. Hence, the 3.6 GHz band contains a total of 350 MHz of spectrum available for

	award.
10.1 GHz band	The frequency range 10.0 – 10.154 GHz
10.5 GHz FWALA band	The frequency range 10.154 – 10.672 GHz
26 GHz FWALA band	The frequency range 24.549 – 25.781 GHz
26 GHz band	The frequency range 24.773 – 26.453 GHz
Award Process	The overall process through which it is intended that rights of use of the Award Spectrum will be granted in the event that at least one Applicant submits a valid Application, which by definition must include a valid Bid.
CPI	Consumer Price Index published by the Central Statistics Office.
Capacity band	A spectrum band whose propagation characteristics render it unsuitable for its use to serve wide geographical areas, and may be more suitable for urban deployment as hot spots or high capacity infill.
Complementarity	The term can be taken as referring to spectrum bands where the value attributed by an interested party to spectrum in one band is enhanced by having or winning rights of use of spectrum in another band in relation to the proposed award process.
Coverage band	A spectrum band whose propagation characteristics render it suitable to serve wide geographical areas, such as the deployment of macro cells for wide area services.
EC 2.6 GHz Decision	Refers to EC Decision 2008/477/EC. See Section A1.3 below for further details

3.6 GHz EC Decision	Refers to EC Decision 2014/276/EU. See Section A1.3 below for further details
ECC 1.4 GHz Decision	Refers to ECC Decision (13)03. See Section A1.3 below for further details
ECC 2.3 GHz Decision	Refers to ECC Decision (14)02. See Section A1.3 below for further details
General Authorisation	An authorisation for an undertaking to provide an electronic communications network or service under and in accordance with Regulation 4 of the Authorisation Regulations.
IMT	International Mobile Telecommunications, is an ITU global standard for mobile telecommunications.
MBSA Process	MBSA or the MBSA Process refers to the Multi-Band Spectrum Award process whose final results were announced in ComReg Document 12/131 on 5 December 2012
Minimum Price	The price per Lot in a Lot Category at the beginning of the Award Process. This price is the combination of the Reserve Price and SUF.
MMDS	Multipoint Microwave Distribution System, means a system of wireless telegraphy apparatus used for the retransmission of programme services on a point to multipoint basis at frequencies of 1 gigahertz or above;
NRA	National Regulatory Authority
Paired spectrum	Typically refers to the use of frequency bands (or sub-bands) in a duplex arrangement to provide symmetrical two-way communications.

RIA	Regulatory Impact Assessment, an analysis of the likely effect of, and necessity of, a proposed new regulation or regulatory change. Such assessments are carried out in accordance with Document 07/56a - Guidelines on ComReg's approach to Regulatory Impact Assessment - August 2007.
Rurtel	Rural Telecommunications, a legacy rural wireless fill-in service by Eircom designed in promoting and accelerating the penetration of broadband services in rural areas.
Reserve Price	The minimum Bid for a Lot for such a Lot to be assigned.
Spectrum right of use	Authorisation to use certain radio frequencies subject to such conditions and restrictions as may be prescribed in a licence or by any Regulations made by ComReg under Section 6 of the Act of 1926.
Spectrum Usage Fees (SUFs)	Fees, typically annual, which a Winning Bidder must pay in respect of spectrum rights of use assigned in the Award Process.
Substitutability	The term can be taken as referring to spectrum bands which can serve the same purpose for interested parties and so those parties are relatively indifferent to switching between those bands in relation to the proposed award process.
The Minister	Minister for Communications, Energy and Natural Resources
UHF band	The band 470 to 790 MHz.
Unpaired spectrum	Typically refers to the use of frequency bands (or sub-bands) using time division multiplexing technology to provide two-way communications.
WAPECS	Wireless Access Policy for Electronic Communications Services, is a framework for the provision of electronic communications

	services (ECS) within a set of frequency bands to be identified and agreed between European Union Member States in which a range of ECS may be offered on a technology and service neutral basis, provided that certain technical requirements to avoid interference are met, to ensure the effective and efficient use of the spectrum, and the authorisation conditions do not distort competition
Winning Bidder	A Bidder that wins at least one Lot in an Award Process.
WBB	Wireless broadband

A1.2 European and Governmental Bodies, Regulatory and Standardisation Organisations

3GPP	The 3rd Generation Partnership Project
ComReg	Commission for Communications Regulation
CEPT	Conférence européenne des Administration des postes et des télécommunications. In English, European Conference of Postal and Telecommunications Administrations
DCENR	Department of Communications, Energy and Natural Resources
EC	European Commission
ECC	Electronic Communications Committee (of CEPT)
ECO	European Communications Office
EU	European Union
ITU	International Telecommunication Union
RSPG	Radio Spectrum Policy Group

A1.3 Primary and Secondary Legislation

S.I.	Statutory Instrument
2002 Act	The Communications Regulation Act 2002 (No. 20 of 2002), as amended[229]
Authorisation Regulations	European Communities (Electronic Communication Networks and Services) (Authorisation) Regulations 2011 (S.I. No 335 of 2011)
Broadcasting Act 2009	Broadcasting Act 2009 (No. 18 of 2009).
Commission Directive 2002/77/EC	A European Commission Directive on competition in the markets for electronic communications networks and services
EC Decision 2008/477/EC	European Commission Decision on the harmonisation of the 2 500-2 690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community
EC Decision 2009/766/EC	European Commission Decision on the harmonisation of the 900 MHz and 1 800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community
EC Decision 2011/251/EU	European Commission Decision, amending Decision 2009/766/EC, on the harmonisation of the 900 MHz and 1 800 MHz frequency bands for terrestrial systems capable of providing pan-

[229] Includes the Communications Regulation (Amendment) Act 2007 and the Communications Regulation (Premium Rate Services and Electronic Communications Infrastructure) Act 2010.

	European electronic communications services in the Community.
EC Decision 2014/276/EU	European Commission Decision on amending Decision 2008/411/EC on the harmonisation of the 3 400-3 800 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community.
European Parliament and Council Decision 243/2012/EU	European Parliament and Council Decision establishing a multi-annual radio spectrum policy programme.
ECC Decision (13)03	Electronic Communications Committee decision to harmonise the use of the frequency band 1452-1492 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL).
ECC Decision ECC/DEC(14)02	Electronic Communications Committee decision to harmonised technical and regulatory conditions for the use of the band 2 300-2 400 MHz for Mobile/Fixed Communications Networks (MFCN).
Framework Regulations	European Communities (Electronic Communications Networks and Services) (Framework) Regulations 2011 (S.I. No 333 of 2011)
Specific Regulations	Specific Regulations has the same meaning as set out in Regulation 2 of the Framework Regulations

A1.4 Glossary of Technical Terms

3G	Third Generation Mobile System (e.g. UMTS)
BEM	Block Edge Mask
CCA	Combinatorial clock auction
CPI	Consumer Price Index
DTT	Digital Terrestrial Television
ECS	Electronic Communications Service as defined under the Framework Regulations
EMC	Electro Magnetic Compatibility
E-UTRA	Evolved Universal Terrestrial Radio Access
FDD	Frequency Division Duplex
FWA	Fixed Wireless Access
GHz	Gigahertz (1 000 000 000 Hertz)
Guard-band	An unused spectrum bandwidth separating channels to prevent interference
GSA	The Global mobile Suppliers Association
GSM	Global System for Mobile Communications
GSMA	GSM Association
Hertz	Unit of Frequency

H3GI	Hutchison 3G Ireland
kHz	Kilohertz (1 000 Hertz)
LTE	Long Term Evolution of 3G
LTE Advanced / LTE+	An evolution of LTE, having the capability to provide 4G services.
Meteor	Meteor Mobile Communications
MFCN	Mobile/fixed communications networks
MHz	Megahertz (1 000 000 Hertz)
MNO	Mobile Network Operator
MVNO	Mobile Virtual Network Operator (a licensed mobile operator with no spectrum assignment and with or without network infrastructure)
MoU	Memorandum / Memoranda of Understanding
PMSE	Programme Making and Special Events
PPDR	Public Protection and Disaster Relief
QoS	Quality of Service
Restricted block	A spectrum block to which restricted conditions apply.
SAF	Spectrum Access Fee
SBC	Sealed-bid combinatorial (auction)

SCA	Simple clock auction
S-DAB	Satellite Digital Audio Broadcasting
SDL	Supplementary Downlink
SMRA	Standard simultaneous multiple-round ascending (auction)
SUF	Spectrum Usage Fee
T-DAB	Terrestrial Digital Audio Broadcasting
TDD	Time Division Duplex
TD-LTE	Time Division – Long Term Evolution
UE	User Equipment
UMTS	Universal Mobile Telecommunications System.
UMTS-TDD	Universal Mobile Telecommunications System – Time Division Duplex
UTRA	Universal Terrestrial Radio Access
Vodafone	Vodafone Ireland Limited
WDMDS	Wideband Digital Mobile Data Services
WiMAX	Worldwide Interoperability for Microwave Access

Annex 2: Legal Framework and Statutory Objectives

A 2.1 The Communications Regulation Acts 2002-2011[230] (the "2002 Act"), the Common Regulatory Framework (including the Framework and Authorisation Directives [231] as transposed into Irish law by the corresponding Framework and Authorisation Regulations[232]), and the Wireless Telegraphy Acts1926 to 2009[233] set out, amongst other things, powers, functions, duties and objectives of ComReg that are relevant to the management of the radio frequency spectrum in Ireland and to this preliminary consultation.

A 2.2 Apart from licensing and making regulations in relation to licences, ComReg's functions include the management of Ireland's radio frequency spectrum in accordance with ministerial Policy Directions under Section 13 of the 2002 Act, having regard to its objectives under Section 12 of the 2002 Act, Regulation 16 of the Framework Regulations and the provisions of Article 8a of the Framework Directive. ComReg is to carry out its functions effectively, and in a manner serving to ensure that the allocation and assignment of radio frequencies is based on objective, transparent, non-discriminatory and proportionate criteria.

A 2.3 This annex is intended as a general guide as to ComReg's role in this area, and not as a definitive or exhaustive legal exposition of that role. Further, this annex restricts itself to consideration of those powers, functions, duties and objectives of ComReg that appear most relevant to the matters at hand and generally excludes those not considered relevant

[230] The Communications Regulation Act 2002, the Communications Regulation (Amendment) Act 2007, the Communications Regulation (Premium Rate Services and Electronic Communications Infrastructure) Act 2010 and the Communications Regulation (Postal Services) Act 2011.

[231] Directive No. 2002/21/EC of the European Parliament and of the Council of 7 March 2002 (as amended by Regulation (EC) No. 717/2007 of 27 June 2007, Regulation (EC) No. 544/2009 of 18 June 2009 and Directive 2009/140/EC of the European Parliament and Council of 25 November 2009) (the "Framework Directive") and Directive No. 2002/20/EC of the European Parliament and of the Council of 7 March 2002 (as amended by Directive 2009/140/EC) (the "Authorisation Directive")

[232] The European Communities (Electronic Communications Networks and Services) (Framework) Regulations 2011 (S.I. No. 333 of 2011) and the European Communities (Electronic Communications Networks and Services) (Authorisation) Regulations 2011 (S.I. No. 335 of 2011) respectively.

[233] The Wireless Telegraphy Acts 1926 to 1988 and Sections 181 (1) to (7) and (9) and Section 182 of the Broadcasting Act 2009.

(for example, in relation to postal services, premium rate services or market analysis). For the avoidance of doubt, however, the inclusion of particular material in this Annex does not necessarily mean that ComReg considers same to be of specific relevance to the matters at hand.

A 2.4 All references in this annex to enactments are to the enactment as amended at the date hereof, unless the context otherwise requires.

A2.1 Primary Objectives and Regulatory Principles under the 2002 Act and Common Regulatory Framework

A 2.5 ComReg's primary objectives in carrying out its statutory functions in the context of electronic communications are to:

- promote competition[234];
- contribute to the development of the internal market[235];
- promote the interests of users within the Community[236];
- ensure the efficient management and use of the radio frequency spectrum in Ireland in accordance with a direction under Section 13 of the 2002 Act[237]; and
- unless otherwise provided for in Regulation 17 of the Framework Regulations, take the utmost account of the desirability of technological neutrality in complying with the requirements of the Specific

[234] Section 12 (1)(a)(i) of the 2002 Act.

[235] Section 12 (1)(a)(ii) of the 2002 Act.

[236] Section 12(1)(a)(iii) of the 2002 Act.

[237] Section 12(1)(b) of the 2002 Act. Whilst this objective would appear to be a separate and distinct objective in the 2002 Act, it is noted that, for the purposes of ComReg's activities in relation to electronic communications networks and services ("ECN" and "ECS"), Article 8 of the Framework Directive identifies "*encouraging efficient use and ensuring the effective management of radio frequencies (and numbering resources*)" as a sub-objective of the broader objective of the promotion of competition.

Regulations [238] in particular those designed to ensure effective competition [239].

A2.1.1 Promotion of Competition

A 2.6 Section 12(2)(a) of the 2002 Act requires ComReg to take all reasonable measures which are aimed at the promotion of competition, including:

- ensuring that users, including disabled users, derive maximum benefit in terms of choice, price and quality;
- ensuring that there is no distortion or restriction of competition in the electronic communications sector; and
- encouraging efficient use and ensuring the effective management of radio frequencies and numbering resources.

A 2.7 In so far as the promotion of competition is concerned, Regulation 16(1)(b) of the Framework Regulations also requires ComReg to:

- ensure that elderly users and users with special social needs derive maximum benefit in terms of choice, price and quality, and
- ensure that, in the transmission of content, there is no distortion or restriction of competition in the electronic communications sector.

A 2.8 Regulation 9(11) of the Authorisation Regulations also provides that ComReg must ensure that radio frequencies are efficiently and effectively used having regard to Section 12(2)(a) of the 2002 Act and Regulations 16(1) and 17(1) of the Framework Regulations. Regulation 9(11) further provides that ComReg must ensure that competition is not distorted by any transfer or accumulation of rights of use for radio frequencies, and, for this purpose, ComReg may take appropriate measures such as mandating the sale or the lease of rights of use for radio frequencies.

A2.1.2 Contributing to the Development of the Internal Market

[238] The 'Specific Regulations' comprise collectively the Framework Regulations, the Authorisation Regulations, the European Communities (Electronic Communications Networks and Services) (Access) Regulations 2011 (S.I. No. 334 of 2011), the European Communities (Electronic Communications Networks and Services) (Universal Service and Users' Rights) Regulations 2011 (S.I. 337 of 2011) and the European Communities (Electronic Communications Networks and Services) (Privacy and Electronic Communications) Regulations 2011 (S.I. No. 336 of 2011).

[239] Regulation 16(1)(a) of the Framework Regulations.

A 2.9 Section 12(2)(b) of the 2002 Act requires ComReg to take all reasonable measures which are aimed at contributing to the development of the internal market, including:

- removing remaining obstacles to the provision of electronic communications networks, electronic communications services and associated facilities at Community level;
- encouraging the establishment and development of trans-European networks and the interoperability of transnational services and end-to-end connectivity; and
- co-operating with electronic communications national regulatory authorities in other Member States of the Community and with the Commission of the Community in a transparent manner to ensure the development of consistent regulatory practice and the consistent application of Community law in this field.

A 2.10 In so far as contributing to the development of the internal market is concerned, Regulation 16(1)(c) of the Framework Regulations also requires ComReg to co-operate with the Body of European Regulators for Electronic Communications (BEREC) in a transparent manner to ensure the development of consistent regulatory practice and the consistent application of EU law in the field of electronic communications.

A2.1.3 Promotion of Interests of Users

A 2.11 Section 12(2)(c) of the 2002 Act requires ComReg, when exercising its functions in relation to the provision of electronic communications networks and services, to take all reasonable measures which are aimed at the promotion of the interests of users within the Community, including:

- ensuring that all users have access to a universal service;
- ensuring a high level of protection for consumers in their dealings with suppliers, in particular by ensuring the availability of simple and inexpensive dispute resolution procedures carried out by a body that is independent of the parties involved;
- contributing to ensuring a high level of protection of personal data and privacy;

- promoting the provision of clear information, in particular requiring transparency of tariffs and conditions for using publicly available electronic communications services;
- encouraging access to the internet at reasonable cost to users;
- addressing the needs of specific social groups, in particular disabled users; and
- ensuring that the integrity and security of public communications networks are maintained.

A 2.12 In so far as promotion of the interests of users within the EU is concerned, Regulation 16(1)(d) of the Framework Regulations also requires ComReg to:

- address the needs of specific social groups, in particular, elderly users and users with special social needs, and
- promote the ability of end-users to access and distribute information or use applications and services of their choice.

A2.1.4 Regulatory Principles

A 2.13 In pursuit of its objectives under Regulation 16(1) of the Framework Regulations and Section 12 of the 2002 Act, ComReg must apply objective, transparent, non-discriminatory and proportionate regulatory principles by, amongst other things:

- promoting regulatory predictability by ensuring a consistent regulatory approach over appropriate review periods;
- ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services;
- safeguarding competition to the benefit of consumers and promoting, where appropriate, infrastructure-based competition;
- promoting efficient investment and innovation in new and enhanced infrastructures, including by ensuring that any access obligation takes appropriate account of the risk incurred by the investing undertakings and by permitting various cooperative arrangements between investors and parties seeking access to diversify the risk of investment, while ensuring

that competition in the market and the principle of non-discrimination are preserved;

- taking due account of the variety of conditions relating to competition and consumers that exist in the various geographic areas within the State; and

- imposing ex-ante regulatory obligations only where there is no effective and sustainable competition and relaxing or lifting such obligations as soon as that condition is fulfilled.

A2.1.5 BEREC

A 2.14 Under Regulation 16(1)(3) of the Framework Regulations, ComReg must:

- having regard to its objectives under Section 12 of the 2002 Act and its functions under the Specific Regulations, actively support the goals of BEREC of promoting greater regulatory co-ordination and coherence; and

- take the utmost account of opinions and common positions adopted by BEREC when adopting decisions for the national market.

A2.1.6 Other Obligations Under the 2002 Act

A 2.15 In carrying out its functions, ComReg is required amongst other things, to:

- seek to ensure that any measures taken by it are proportionate having regard to the objectives set out in Section 12 of the 2002 Act;[240]

- have regard to international developments with regard to electronic communications networks and electronic communications services, associated facilities, postal services, the radio frequency spectrum and numbering[241]; and

- take the utmost account of the desirability that the exercise of its functions aimed at achieving its radio frequency management objectives does not result in discrimination in favour of or against particular types of technology for the provision of ECS.[242]

[240] Section 12(3) of the 2002 Act.

[241] Section 12(5) of the 2002 Act.

[242] Section 12(6) of the 2002 Act .

A2.1.7 Policy Directions[243]

A 2.16 Section 12(4) of the 2002 Act provides that, in carrying out its functions, ComReg must have appropriate regard to policy statements, published by or on behalf of the Government or a Minister of the Government and notified to the Commission, in relation to the economic and social development of the State. Section 13(1) of the 2002 Act requires ComReg to comply with any policy direction given to ComReg by the Minister for Communications, Energy and Natural Resources ("the Minister") as he or she considers appropriate, in the interests of the proper and effective regulation of the electronic communications market, the management of the radio frequency spectrum in the State and the formulation of policy applicable to such proper and effective regulation and management, to be followed by ComReg in the exercise of its functions. Section 10(1)(b) of the 2002 Act also requires ComReg, in managing the radio frequency spectrum, to do so in accordance with a direction of the Minister under Section 13 of the 2002 Act, while Section 12(1)(b) requires ComReg to ensure the efficient management and use of the radio frequency spectrum in accordance with a direction under Section 13.

A 2.17 The Policy Directions which are most relevant in this regard include the following:

Policy Direction No.3 on Broadband Electronic Communication Networks

A 2.18 ComReg shall in the exercise of its functions, take into account the national objective regarding broadband rollout, viz, the Government wishes to ensure the widespread availability of open-access, affordable, always-on broadband infrastructure and services for businesses and citizens on a balanced regional basis within three years, on the basis of utilisation of a range of existing and emerging technologies and broadband speeds appropriate to specific categories of service and customers.

A 2.19 ComReg is conscious that the three year objective described in this policy direction has now expired making this direction less relevant currently.

Policy Direction No.4 on Industry Sustainability

A 2.20 ComReg shall ensure that in making regulatory decisions in relation to the electronic communications market, it takes account of the state of the industry and in particular the industry's position in the business cycle and

[243] ComReg also notes, and takes due account of, the Spectrum Policy Statement issued by the Department of Communications Energy and Natural Resources in September 2010.

the impact of such decisions on the sustainability of the business of undertakings affected.

Policy Direction No.5 on Regulation only where Necessary

A 2.21 Where ComReg has discretion as to whether to impose regulatory obligations, it shall, before deciding to impose such regulatory obligations on undertakings, examine whether the objectives of such regulatory obligations would be better achieved by forbearance from imposition of such obligations and reliance instead on market forces.

Policy Direction No.6 on Regulatory Impact Assessment

A 2.22 ComReg, before deciding to impose regulatory obligations on undertakings in the market for electronic communications or for the purposes of the management and use of the radio frequency spectrum or for the purposes of the regulation of the postal sector, shall conduct a Regulatory Impact Assessment in accordance with European and International best practice and otherwise in accordance with measures that may be adopted under the Government's Better Regulation programme.

Policy Direction No.7 on Consistency with other Member States

A 2.23 ComReg shall ensure that, where market circumstances are equivalent, the regulatory obligations imposed on undertakings in the electronic communications market in Ireland should be equivalent to those imposed on undertakings in equivalent positions in other Member States of the European Community.

Policy Direction No.11 on the Management of the Radio Frequency Spectrum

A 2.24 ComReg shall ensure that, in its management of the radio frequency spectrum, it takes account of the interests of all users of the radio frequency spectrum.

General Policy Direction No.1 on Competition (2004)

A 2.25 ComReg shall focus on the promotion of competition as a key objective. Where necessary, ComReg shall implement remedies which counteract or remove barriers to market entry and shall support entry by new players to the market and entry into new sectors by existing players. ComReg shall have a particular focus on:

- market share of new entrants;
- ensuring that the applicable margin attributable to a product at the wholesale level is sufficient to promote and sustain competition;
- price level to the end user;
- competition in the fixed and mobile markets;
- the potential of alternative technology delivery platforms to support competition.

A2.2 Other Relevant Obligations under the Framework and Authorisation Regulations

A2.2.1 Framework Regulations

A 2.26 Regulation 17 of the Framework Regulations governs the management of radio frequencies for electronic communications services. Regulation 17(1) requires that ComReg, subject to any directions issued by the Minister pursuant to Section 13 of the 2002 Act and having regard to its objectives under Section 12 of the 2002 Act and Regulation 16 of the Framework Regulations and the provisions of Article 8a of the Framework Directive, ensure:

- the effective management of radio frequencies for electronic communications services;
- that spectrum allocation used for electronic communications services and issuing of general authorisations or individual rights of use for such radio frequencies are based on objective, transparent, non-discriminatory and proportionate criteria; and
- ensure that harmonisation of the use of radio frequency spectrum across the EU is promoted, consistent with the need to ensure its effective and efficient use and in pursuit of benefits for the consumer such as economies of scale and interoperability of services, having regard to all decisions and measures adopted by the European Commission in accordance with Decision No. 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the EU.

A 2.27 Regulation 17(2) provides that, unless otherwise provided in Regulation 17(3), ComReg must ensure that all types of technology used for electronic communications services may be used in the radio frequency bands that are declared available for electronic communications services in the Radio Frequency Plan published under Section 35 of the 2002 Act in accordance with EU law.

A 2.28 Regulation 17(3) provides that, notwithstanding Regulation 17(2), ComReg may, through licence conditions or otherwise, provide for proportionate and non-discriminatory restrictions to the types of radio network or wireless access technology used for electronic communications services where this is necessary to—

- avoid harmful interference,
- protect public health against electromagnetic fields,
- ensure technical quality of service,
- ensure maximisation of radio frequency sharing,
- safeguard the efficient use of spectrum, or
- ensure the fulfilment of a general interest objective as defined by or on behalf of the Government or a Minister of the Government in accordance with Regulation 17(6).

A 2.29 Regulation 17(4) requires that, unless otherwise provided in Regulation 17(5), ComReg must ensure that all types of electronic communications services may be provided in the radio frequency bands, declared available for electronic communications services in the Radio Frequency Plan published under Section 35 of the Act of 2002 in accordance with EU law.

A 2.30 Regulation 17(5) provides that, notwithstanding Regulation 17(4), ComReg may provide for proportionate and non-discriminatory restrictions to the types of electronic communications services to be provided, including where necessary, to fulfil a requirement under the International Telecommunication Union Radio Regulations ("ITU-RR").

A 2.31 Regulation 17(6) requires that measures that require an electronic communications service to be provided in a specific band available for electronic communications services must be justified in order to ensure the fulfilment of a general interest objective as defined by or on behalf of the Government or a Minister of the Government in conformity with EU law such as, but not limited to—

- safety of life,
- the promotion of social, regional or territorial cohesion,
- the avoidance of inefficient use of radio frequencies, or
- the promotion of cultural and linguistic diversity and media pluralism, for example, by the provision of radio and television broadcasting services.

A 2.32 Regulation 17(7) provides that ComReg may only prohibit the provision of any other electronic communications service in a specific radio spectrum

frequency band where such a prohibition is justified by the need to protect safety of life services. ComReg may, on an exceptional basis, extend such a measure in order to fulfil other general interest objectives as defined by or on behalf of the Government or a Minister of the Government.

A 2.33 Regulation 17(8) provides that ComReg must, in accordance with Regulation 18, regularly review the necessity of the restrictions referred to in Regulations 17(3) and 17(5) and must make the results of such reviews publicly available.

A 2.34 Regulation 17(9) provides that Regulations 17(2) to (7) only apply to spectrum allocated to be used for electronic communications services, general authorisations issued and individual rights of use for radio frequencies granted after the 1 July 2011. Spectrum allocations, general authorisations and individual rights of use which already existed on the 1 July 2011 Framework Regulations are subject to Regulation 18.

A 2.35 Regulation 17(10) provides that ComReg may, having regard to its objectives under Section 12 of the 2002 Act and Regulation 16 and its functions under the Specific Regulations, lay down rules in order to prevent spectrum hoarding, in particular by setting out strict deadlines for the effective exploitation of the rights of use by the holder of rights and by withdrawing the rights of use in cases of non-compliance with the deadlines. Any rules laid down under this Regulation must be applied in a proportionate, non-discriminatory and transparent manner.

A 2.36 Regulation 17(11) requires ComReg to, in the fulfilment of its obligations under that Regulation, respect relevant international agreements, including the ITU Radio Regulations and any public policy considerations brought to its attention by the Minister.

A2.2.2 Authorisation Regulations

Decision to limit rights of use for radio frequencies

A 2.37 Regulation 9(2) of the Authorisation Regulations provides that ComReg may grant individual rights of use for radio frequencies by way of a licence where it considers that one or more of the following criteria are applicable:

- it is necessary to avoid harmful interference,
- it is necessary to ensure technical quality of service,
- it is necessary to safeguard the efficient use of spectrum, or

- it is necessary to fulfil other objectives of general interest as defined by or on behalf of the Government or a Minister of the Government in conformity with EU law.

A 2.38 Regulation 9(10) of the Authorisation Regulations provides that ComReg must not limit the number of rights of use for radio frequencies to be granted except where this is necessary to ensure the efficient use of radio frequencies in accordance with Regulation 11.

A 2.39 Regulation 9(7) also provides that:

- where individual rights of use for radio frequencies are granted for a period of 10 years or more and such rights may not be transferred or leased between undertakings in accordance with Regulation 19 of the Framework Regulations, ComReg must ensure that criteria set out in Regulation 9(2) apply for the duration of the rights of use, in particular upon a justified request from the holder of the right.

- where ComReg determines that the criteria referred to in Regulation 9(2) are no longer applicable to a right of use for radio frequencies, ComReg must, after a reasonable period and having notified the holder of the individual rights of use, change the individual rights of use into a general authorisation or must ensure that the individual rights of use are made transferable or leasable between undertakings in accordance with Regulation 19 of the Framework Regulations.

Publication of procedures

A 2.40 Regulation 9(4)(a) of the Authorisation Regulations requires that ComReg, having regard to the provisions of Regulation 17 of the Framework Regulations, establish open, objective, transparent, non-discriminatory and proportionate procedures for the granting of rights of use for radio frequencies and cause any such procedures to be made publicly available.

Duration of rights of use for radio frequencies

A 2.41 Regulation 9(6) of the Authorisation Regulations provides that rights of use for radio frequencies must be in force for such period as ComReg considers appropriate having regard to the network or service concerned in view of the objective pursued taking due account of the need to allow for an appropriate period for investment amortisation.

Conditions attached to rights of use for radio frequencies

A 2.42 Regulation 9(5) of the Authorisation Regulations provides that, when granting rights of use for radio frequencies, ComReg must, having regard to the provisions of Regulations 17 and 19 of the Framework Regulations, specify whether such rights may be transferred by the holder of the rights and under what conditions such a transfer may take place.

A 2.43 Regulation 10(1) of the Authorisation Regulations provides that, notwithstanding Section 5 of the Wireless Telegraphy Act,1926, but subject to any regulations under Section 6 of that Act, ComReg may only attach those conditions listed in Part B of the Schedule to the Authorisation Regulations. Part B lists the following conditions which may be attached to rights of use:

- Obligation to provide a service or to use a type of technology for which the rights of use for the frequency has been granted including, where appropriate, coverage and quality requirements.
- Effective and efficient use of frequencies in conformity with the Framework Directive and Framework Regulations.
- Technical and operational conditions necessary for the avoidance of harmful interference and for the limitation of exposure of the general public to electromagnetic fields, where such conditions are different from those included in the general authorisation.
- Maximum duration in conformity with Regulation 9, subject to any changes in the national frequency plan.
- Transfer of rights at the initiative of the rights holder and conditions of such transfer in conformity with the Framework Directive.
- Usage fees in accordance with Regulation 19.
- Any commitments which the undertaking obtaining the usage right has made in the course of a competitive or comparative selection procedure.
- Obligations under relevant international agreements relating to the use of frequencies.
- Obligations specific to an experimental use of radio frequencies.

A 2.44 Regulation 10(2) also requires that any attachment of conditions under Regulation 10(1) to rights of use for radio frequencies must be non-discriminatory, proportionate and transparent and in accordance with Regulation 17 of the Framework Regulations.

Procedures for limiting the number of rights of use to be granted for radio frequencies

A 2.45 Regulation 11(1) of the Authorisation Regulations provides that, where ComReg considers that the number of rights of use to be granted for radio frequencies should be limited it must, without prejudice to Sections 13 and 37 of the 2002 Act:

- give due weight to the need to maximise benefits for users and to facilitate the development of competition, and
- give all interested parties, including users and consumers, the opportunity to express their views in accordance with Regulation 12 of the Framework Regulations.

A 2.46 Regulation 11(2) of the Authorisation Regulations requires that, when granting the limited number of rights of use for radio frequencies it has decided upon, ComReg does so *"…on the basis of selection criteria which are objective, transparent, non-discriminatory and proportionate and which give due weight to the achievement of the objectives set out in Section 12 of the 2002 Act and Regulations 16 and 17 of the Framework Regulations."*

A 2.47 Regulation 11(4) provides that where it decides to use competitive or comparative selection procedures, ComReg must, inter alia, ensure that such procedures are fair, reasonable, open and transparent to all interested parties.

Fees for spectrum rights of use

A 2.48 Regulation 19 of the Authorisation Regulations permits ComReg to impose fees for rights of use which reflect the need to ensure the optimal use of the radio frequency spectrum.

A 2.49 ComReg is required to ensure that any such fees are objectively justified, transparent, non-discriminatory and proportionate in relation to their intended purpose and take into account the objectives of ComReg as set out in Section 12 of the 2002 Act and Regulation 16 of the Framework Regulations.

Amendment of rights and obligations

A 2.50 Regulation 15 of the Authorisation Regulations permits ComReg to amend rights and conditions concerning rights of use, provided that any such amendments may only be made in objectively justified cases and in a proportionate manner, following the process set down in Regulation 15(4).

A2.3 Other Relevant Provisions

Wireless Telegraphy Act, 1926 (the "1926 Act")

A 2.51 Under Section 5(1) of the 1926 Act, ComReg may, subject to that Act, and on payment of the prescribed fees (if any), grant to any person a licence to keep and have possession of apparatus for wireless telegraphy in any specified place in the State.

A 2.52 Section 5(2) provides that, such a licence shall be in such form, continue in force for such period and be subject to such conditions and restrictions (including conditions as to suspension and revocation) as may be prescribed in regard to it by regulations made by ComReg under Section 6.

A 2.53 Section 5(3) also provides that, where it appears appropriate to ComReg, it may, in the interests of the efficient and orderly use of wireless telegraphy, limit the number of licences for any particular class or classes of apparatus for wireless telegraphy granted under Section 5.

A 2.54 Section 6 provides that ComReg may make regulations prescribing in relation to all licences granted by it under Section 5, or any particular class or classes of such licences, all or any of the following matters:

- the form of such licences,
- the period during which such licences continue in force,
- the manner in which, the terms on which, and the period or periods for which such licences may be renewed,
- the circumstances in which or the terms under which such licences are granted,
- the circumstances and manner in which such licences may be suspended or revoked by ComReg,
- the terms and conditions to be observed by the holders of such licences and subject to which such licences are deemed to be granted,

- the fees to be paid on the application, grant or renewal of such licences or classes of such licences, subject to such exceptions as ComReg may prescribe, and the time and manner at and in which such fees are to be paid, and

- matters which such licences do not entitle or authorise the holder to do.

A 2.55 Section 6(2) provides that Regulations made by ComReg under Regulation 6 may authorise and provide for the granting of a licence under Section 5 subject to special terms, conditions, and restrictions to persons who satisfy it that they require the licences solely for the purpose of conducting experiments in wireless telegraphy.

Broadcasting Act 2009 (the "2009 Act")

A 2.56 Section 132 of the 2009 Act relates to the duties of ComReg in respect of the licensing of spectrum for use in establishing digital terrestrial television multiplexes and places an obligation on ComReg to issue:

- two DTT multiplex licences to RTÉ by request (see Sections 132 (1) and (2) of the 2009 Act); and

- a minimum of four DTT multiplex licences to the BAI by request (see Sections 132 (3) and (4) of the 2009 Act) for the provision of commercial TV content.

Article 4 of Directive 2002/77/EC (Competition Directive)

A 2.57 Article 4 of the Competition Directive provides that:

"Without prejudice to specific criteria and procedures adopted by Member States to grant rights of use of radio frequencies to providers of radio or television broadcast content services with a view to pursuing general interest objectives in conformity with Community law:

- Member States shall not grant exclusive or special rights of use of radio frequencies for the provision of electronic communications services.

- The assignment of radio frequencies for electronic communication services shall be based on objective, transparent, non-discriminatory and proportionate criteria."

Radio Spectrum Policy Programme

A 2.58 On 15 February 2012, the European Parliament adopted the five-year Radio Spectrum Policy Programme which establishes a multi-annual radio spectrum policy programme for the strategic planning and harmonisation of the use of spectrum. The objective is to ensure the functioning of the internal market in the Union policy areas involving the use of spectrum, such as electronic communications, research, technological development and space, transport, energy and audiovisual policies.

A 2.59 Among the activities being undertaken in the context of the RSPP is a comprehensive inventory of spectrum use in the range 400 MHz to 6 GHz in order to identify developing and potentially significant uses of that spectrum.

Annex 3: Relevant EC/CEPT Decisions and technical documents

A 3.1 This Annex sets out, in the following table, all pertinent documentation, at an EC and CEPT level, relating to the bands referenced in this consultation:

Spectrum Band	Document Title	Description and link
2.6 GHz band	EC Decision 2008/477/EC ('the EC 2.6 GHz Decision')	The EC Decision sets out the harmonisation of the band for ECS including frequency arrangements and technical conditions: http://eur-lex.europa.eu/legal-content/EN/ALL/;ELX_SESSIONID=FVBRTYsPmkGjHrBJPN7YtpGn59B1tdKm9mJhZVVQZV4BJpnnQGGQ!-462921947?uri=CELEX:32008D0477
	ECC Decision (05)05	Harmonises the utilisation of spectrum for IMT-2000/UMTS systems operating within the band http://www.erodocdb.dk/docs/doc98/official/pdf/ECCDec0505.pdf
	ECC Report 131	Derivation of a block edge mask (BEM) for terminal stations in the 2.6 GHz frequency band (2 500-2 690 MHz): http://www.erodocdb.dk/docs/doc98/official/pdf/ECCRep131.pdf
2.3 GHz band	EC Mandate to CEPT -	EC Mandate to CEPT to develop harmonised technical conditions for the 2 300-2 400 MHz ('2.3 GHz') frequency band in the EU for the provision of wireless broadband electronic communications services; http://www.cept.org/Documents/fm-52/17474/FM52(14)17_Mandate-to-CEPT-on-2300-2400-MHz
	ECC Decision (14)02 ('the ECC 2.3 GHz Decision')	This ECC Decision harmonises the band for the for Mobile/Fixed Communications Networks (MFCN) including frequency arrangements and technical conditions; http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC1402.PDF
	ECC Report 172	Derives technical conditions and frequency arrangements for Broadband Wireless Systems Usage in the band: http://www.erodocdb.dk/docs/doc98/official/pdf/ECCRep172.pdf
	ECC Report 205	Sets out an approach to licenced shared access ('LSA') particularly in relation to the 2.3 GHz band:

Spectrum Band	Document Title	Description and link
		http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP205.PDF
1.4 GHz band	EC Mandate to CEPT - RSCOM13-67rev3	EC mandate to CEPT to perform technical studies in the 1 452-1 492 MHz frequency band for its use for wireless broadband electronic communications services in the EU: http://www.cept.org/Documents/fm-51/17426/FM51(14)Info-40_EC-Mandate-to-CEPT-on-the-band-1452-1492-MHz
	ECC Decision (13)03	Harmonises the use of the band for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL) including frequency arrangements and technical conditions: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC1303.PDF
	ECC Report 202	Derives the out of band emission limits for Mobile/Fixed Communication Networks (MFCN) Supplemental Downlink (SDL) operating in the band: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP202.PDF
	ECC Report 188	Presents an analysis of the most suitable use for the band in Europe: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP188.PDF
3.6 GHz band	EC Decision 2014/276/EU ('the EC 3.6 GHz Decision')	Amends EC Decision 2008/411/EC on the harmonisation of the 3 400-3 800 MHz frequency band for terrestrial systems capable of providing electronic communications services. The decision includes the setting of preferred frequency arrangements and technical conditions for the band: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2014.139.01.0018.01.ENG
	ECC Decision (11)06	Harmonises the frequency arrangements and technical conditions for mobile/fixed communications networks (MFCN) operating in the bands 3 400-3 600 MHz and 3 600-3 800 MHz: http://www.erodocdb.dk/docs/doc98/official/pdf/ECCDec1106.pdf
	ECC Report 203	Derives modified BEM to facilitate the deployment of broadband fixed, mobile and nomadic communications systems in the band: http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP203.PDF
700 MHz	EC Mandate	EC Mandate to CEPT to develop harmonised technical

Spectrum Band	Document Title	Description and link
	to CEPT	conditions including frequency arrangements for the band: http://ec.europa.eu/information_society/newsroom/image/11_march%202013_5787.pdf
	EC Draft CEPT Report 53	Draft Report A from CEPT to the European Commission in response to the EC Mandate. This document when finalised will include channelling arrangements and technical conditions: http://www.cept.org/ecc/tools-and-services/ecc-public-consultation

Annex 4: International updates 3.6GHz band

CULLEN INTERNATIONAL

Regulation of the 3.4–3.6 and 3.6–3.8 GHz bands

Last update: April/June 2015

On May 2, 2014 the Commission adopted implementing decision 2014/276/EU to set new, more detailed harmonised conditions for the 3.4–3.8 GHz band. Whereas the previous decision of 2008 only harmonised power limits, the 2014 conditions divide the whole 3.4–3.8 GHz band in blocks of 5 MHz and define the power limits in form of block edge masks (BEM) that are suitable for LTE.

In the 3.4–3.6 GHz sub-band the preferred duplex mode is time division duplex (TDD), which means that the entire 200 MHz of the band should be awarded as unpaired blocks of 5 MHz. However, member states may also decide to implement frequency division duplex (FDD), which means that the paired blocks of 2x5 MHz will be awarded. If FDD is used, the uplink shall use 3410–3490 MHz and the downlink 3510–3590 MHz. Parts of the sub-band (3400–3410, 3490–3510 and 3590–3600 MHz) would remain unused as guard bands.

In the 3.6–3.8 GHz sub-band only TDD should be used.

Member states have to implement the new harmonised conditions by June 30, 2015 and must report to the Commission on the implementation until September 30, 2015.

This table shows the current licensing situation and member states' preparations to implement the newly harmonised conditions, in particular whether member states:

- have already amended the frequency plan to implement the new conditions (in particular the block sizes of 5 MHz and the block edge masks);
- plan to use TDD or FDD in the lower sub-band;
- plan to refarm existing licences (e.g. by changing the block sizes to multiples of 5 MHz, re-arranging the position within the band, switching from FDD to TDD, and/or changing power limits to harmonised BEMs); and
- plan to award new licences in unused parts of the sub-bands, based on the newly harmonised conditions.

Data for all countries was updated in April 2015, additional comment for some countries added in June 2015.
More detailed information is available in Cullen International's Radio Spectrum Service.

Country	Regulation of the 3.4–3.6 GHz band			Regulation of the 3.6–3.8 GHz band		
	Current licences (summarised) **Expiry dates**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**	**Current licences (summarised)**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**
AT	Regional licences 2019	No	No	Mostly unused	No	No
BE	Regional and local licences 2019, 2021	No	No	Land stations for fixed satellite service	No	No
CH	One regional licence Dec. 2015	Not applicable (no EU member state)	No	Unused	Not applicable (no EU member state)	No
CZ	417 local licences 2020 / unlimited	Yes	No	Unused, to be auctioned	Yes	Yes See below

Country	Regulation of the 3.4–3.6 GHz band			Regulation of the 3.6–3.8 GHz band		
	Current licences (summarised) Expiry dates	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**	**Current licences (summarised)**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**
				CTO consulted until May 5, 2015 on the tender conditions. According to CTO's consultation: • The whole 200 MHz would be offered in five abstract lots of 40 MHz, all for TDD under the newly harmonised conditions. • CTO proposed to conduct a simultaneous multiple round auction SMRA. • Licensees would be obliged to cover certain numbers of municipalities and districts, depending on the amount of spectrum they will win. For details, see the tables in chapter 7.4 of the proposed tender conditions. • Licence would expire on Dec. 31, 2030 (after about 15 years)		
DE	Regional licences 2021	No	No	Point-to-point links and satellite ground stations	No	No
ES	Three national licences 2020	No	No	Radio links (scheduled to end in 2018) and a limited number of satellite station services. Use of the band for ECS is foreseen in the national frequency plan (note UN107) but no licences yet awarded.	Yes In April 2015 the Ministry of Industry (spectrum NRA) reviewed the national frequency plan to allow for the use of the band for ECS in accordance with decision 2014/276/EU. Existing licences in the band must migrate to other bands, and no new licences for radio links will be granted.	Yes The Ministry of Industry (spectrum NRA) has opened a public consultation ending on June 21, 2015 on the future award of the band for ECS in accordance with Commission decisions
FI	Several local licences Dec. 2016	No	No	Radio links for the transport of TV signals	No	No published plans, but the frequency allocation table says that the band is under review
FR	Two national and several regional licences	No	No	Unused	No	No

Country	Regulation of the 3.4–3.6 GHz band			Regulation of the 3.6–3.8 GHz band		
	Current licences (summarised) **Expiry dates**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**	**Current licences (summarised)**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**
	2018/2026					
HU	Five national licences 2016	No	No NMHH held a public hearing on the band in Dec. 2014, but has not yet announced concrete plans for future awards.	Unused	No	No NMHH held a public hearing on the band in Dec. 2014, but has not yet announced concrete plans for future awards.
IE	Many regional licences July 2017	No	Yes ComReg is preparing a new award of the entire band.	Many regional licences July 2017	No	Yes ComReg is preparing a new award of the entire band.
IT	14 ‘macro regional’ and 21 regional licences 2023 Band partly used by ministry of defence	Proposed The ministry consulted on amendments in 2014, but has not yet published a decision.	No	Information not available	Proposed The ministry consulted on amendments in 2014, but has not yet published a decision.	No
NL	Ministry of defence	No	No	Unused	No	Yes No new licences issued in preparation to include mobile broadband in this band
PL	17 regional licences 2020 to 2026	No	No	3 national and 62 regional licences 2020 to 2026	No	Yes In Sep. 2014, UKE offered a small slice of spectrum, but no applications were submitted.
PT	Regional licences 2024/2025	No	Yes ANACOM launched in April 2015 a public consultation on availability of spectrum in the band.	Regional licences 2025	No	Yes ANACOM launched in April 2015 a public consultation on availability of spectrum in the band.

Country	Regulation of the 3.4–3.6 GHz band			Regulation of the 3.6–3.8 GHz band		
	Current licences (summarised) **Expiry dates**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**	**Current licences (summarised)**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**
RO	7 national licences Dec. 2015 New award proposed	Proposed	Yes See below	1 national licence Dec. 2015 New award proposed	Proposed	Yes See below
	In April 2015 ANCOM adopted a strategy to award 16 paired blocks of 2x5 MHz in the 3.4–3.6 GHz band and 36 unpaired 5 MHz blocks in the 3.6–3.8 GHz band. The new licences would have a duration of ten years from January 2016 to December 2025. ANCOM intends to conduct an auction, but has not yet published detailed auction rules or planned licence conditions.					
SE	2 national licences 2017 10 regional licences 2023	No	Yes PTS is currently analysing what would be the best approach to award the remaining 12 regional licences in the 3.4–3.6 GHz band and two local licences in the 3.6–3.8 GHz band	1159 local licences 2022	No	No The remaining local/regional licences in the 3.5 GHz band would be awarded based on first-come-first-served principle until expiry of the existing licences
SI	4 regional licences 2021	No	No	1 regional licence 2022	No	No
SK	2 national licences of 2x14 MHz will expire in 2025 Other licences expire in August 2015, new award pending	Yes	Yes New award pending	Three national licences of 40 MHz	Yes	Yes New licences awarded in 2015 (Flash) Remainder of the band to be awarded later
	RA published a call for tender in February 2015, then cancelled the tender for lack of demand. RA published a new call for tender in June 2015, with reduced reserve prices. RA offers three national licences, two with 2x20 MHz (that can be used as 2x20 MHz FDD or 40 MHz TDD) and one with 20 MHz (TDD). The three lots will be awarded by a simultaneous multiple round auction (SMRA). Winners will have to offer at least one access point in each of the 79 districts within 24 months, and will have to cover at least three administrative units with less than			RA auctioned three national licences of 40 MHz in January 2015. The auction design differed from typical multiple round spectrum auctions. The auction had one round of 120 minutes, with possible extensions. If a bidder increased his bid within 10 minutes before the scheduled end of the auction, the time was extended by 10 minutes. However, only 60 such extensions were possible and the auction therefore was to end after 12 hours at the latest. Winners have to offer at least one access point in each of the 79 districts within 24 months, and have to cover at least three administrative units with less than 3000		

Country	Regulation of the 3.4–3.6 GHz band			Regulation of the 3.6–3.8 GHz band		
	Current licences (summarised) **Expiry dates**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**	**Current licences (summarised)**	**Frequency plan amended to implement decision 2014/276/EU?**	**Preparations for refarming or award of new licences?**
	3000 inhabitants within 36 months. Special obligations apply for Bratislava and Kosice. Licences will expire on August 31, 2025 (after about ten years)			inhabitants within 36 months. Special obligations apply for Bratislava and Kosice. Licences will expire on December 31, 2024 (after about ten years).		
UK	UK Broadband holds a national licence of 2x20 MHz with indefinite duration	Proposed UK Broadband already uses its licence for LTE-TDD	Yes See below	UK Broadband holds a national licence with indefinite duration: 3605–3689 / 3925–4009 MHz. With regard to 3605–3689 MHz the licence was amended in 2009. The band is also used for satellite ground stations and fixed links.	Proposed UK Broadband already uses the 3605–3689 MHz of its licence for LTE-TDD	No
	Ofcom is consulting until June 26, 2015 on a planned award of the 2.3 and 3.4 GHz bands. Ofcom intends to award the available spectrum in the 3.4–3.6 GHz band as lots of 5 MHz for TDD in a simultaneous multiple round auction. Some of the spectrum might be held back for a later award. Licences would be non-exclusive for an indefinite period with a 20 year initial term and free from coverage obligations.					

Annex 5: Maps of the CSO boundaries for the urban regions

A4.1 Introduction

A 5.1 As explained in Chapter 4 – Key Aspects of Proposed Award Spectrum, the CSO boundaries of the five city and suburb areas are proposed as defining the urban regions for the award.

A 5.2 This annex provides the definition of how the CSO establish this boundary and also illustrates the boundary.

A4.2 Definition of the CSO boundary

A 5.3 Where urban areas have extended beyond the legally defined town boundary, the CSO draws up new boundaries defining the suburban areas of Cities/Boroughs and environs of other legal towns for census purposes. In line with recommendations set by the United Nations, suburbs/environs were defined as the continuation of a distinct population cluster outside its legally defined boundary in which no occupied dwelling is more than 100 metres distant from the nearest occupied dwelling. In applying the 100-metre criterion, industrial, commercial and recreational buildings and facilities are not regarded as breaking the continuity of a built-up area. New suburbs or environs are defined only where there are at least twenty occupied dwellings outside the legal boundary within the new limit. Other information based on OSi mapping and orthogonal photography are also taken into account when extending boundaries. Boundary extensions are generally made to include the land parcel on which a dwelling was built or using other physical features such as roads, paths etc.

A4.3 Illustrations of the CSO boundaries and the Legal boundary for each city

A 5.4 In the following illustrations, the outer boundary (black) is the CSO boundary and the inner boundary (blue) is the legal boundary for each city. The boundaries are sourced from the CSO.

A 5.5 Five figures are illustrated below,

- Figure 1: Dublin
- Figure 2: Cork

- Figure 3: Limerick
- Figure 4: Galway
- Figure 5: Waterford

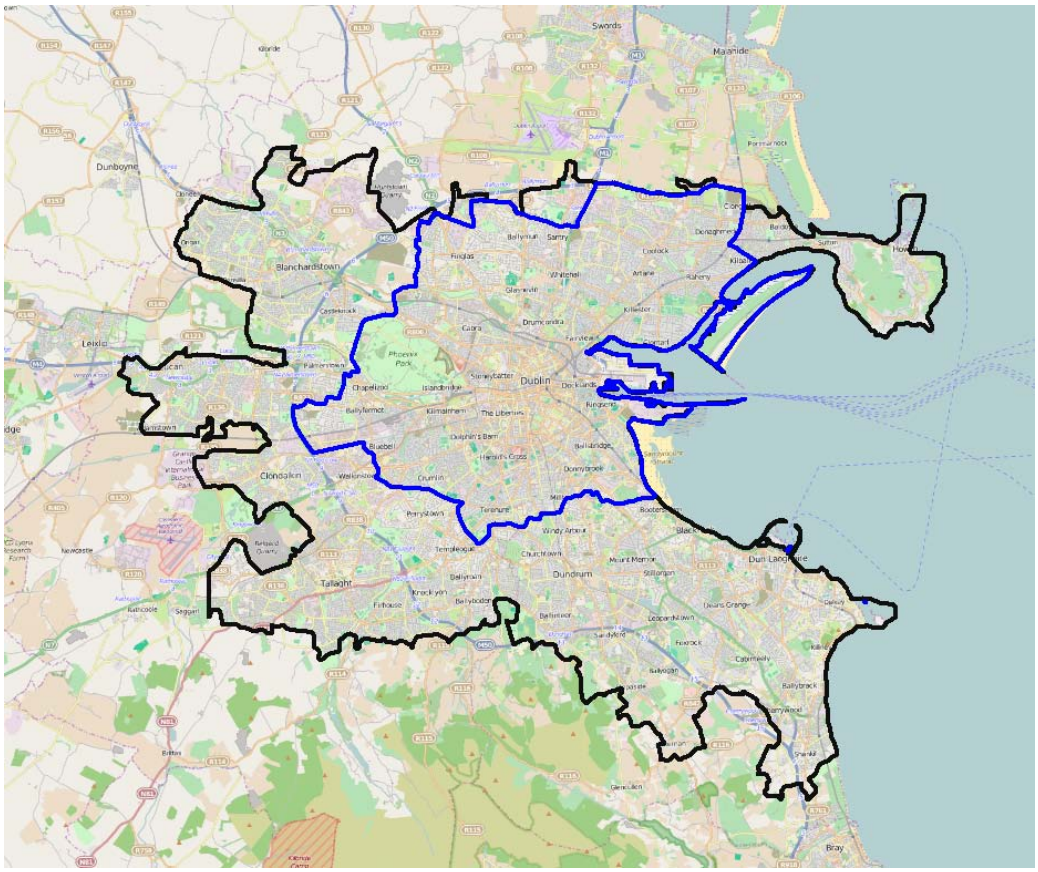

Figure A1: Dublin: CSO and Legal boundaries

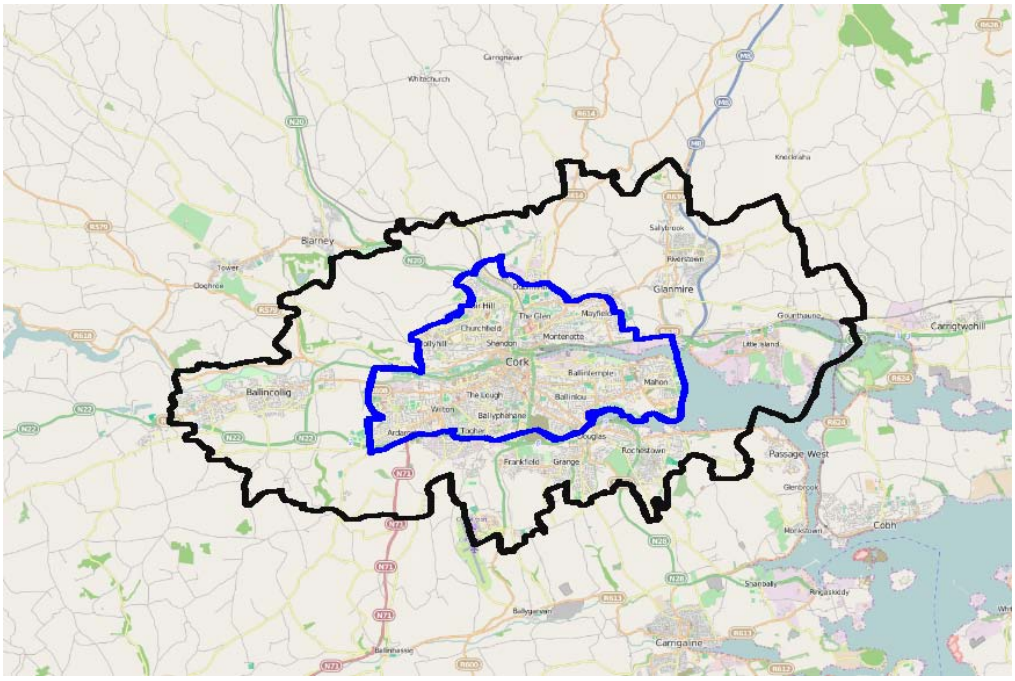

Figure A2: Cork: CSO and Legal boundaries

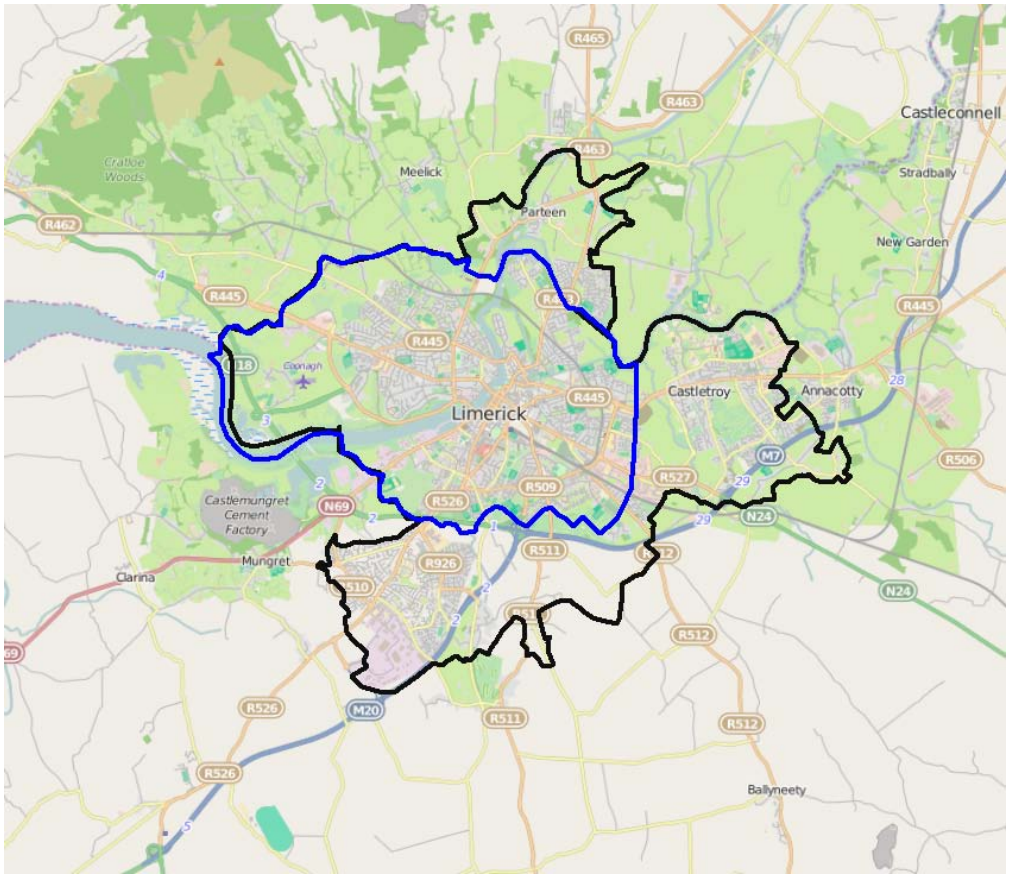

Figure A3: Limerick: CSO and Legal boundaries

Figure A4: Galway: CSO and Legal boundaries

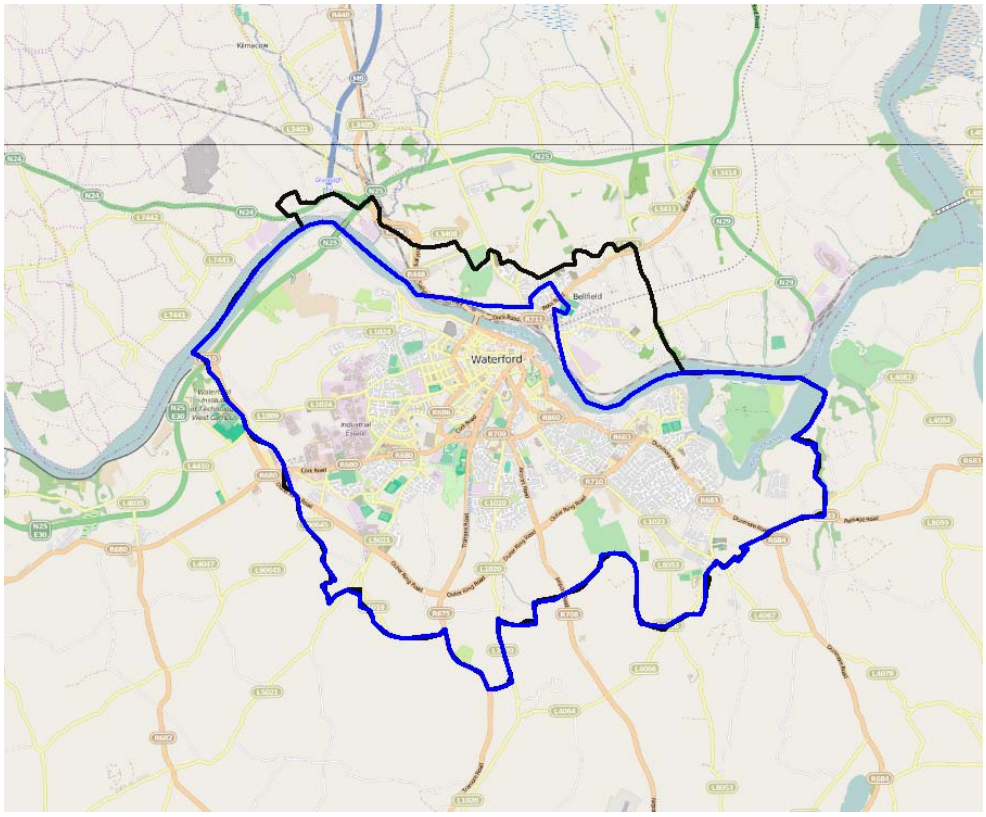

Figure A5: Waterford: CSO and Legal boundaries

Annex 6: CSO data on population flows

	Population	*Inflow*	*Outflow*	*Net*	*Adjusted Population*
North East					
Cavan	73,183	147	1,093	-946	72,237
Monaghan	60,483	83	529	-446	60,037
Longford	39,000	74	496	-422	38,578
Louth	122,897	597	4,321	-3,724	119,173
Meath	184,135	2,702	19,942	-17,240	166,895
Westmeath	86,164	410	2,336	-1,926	84,238
Offaly	76,687	143	1,627	-1,484	75,203
Laois	80,559	186	2,886	-2,700	77,859
Kildare	210,312	5,896	25,404	-19,508	190,804
Dublin (rest of county)	162,442	20,454	31,361	-10,907	151,535
Wicklow	136,640	3,614	17,355	-13,741	122,899
Total	123,502	34,306	107,350	-73,044	1,159,458
North West					
Donegal	161,137	74	410	-336	160,806
Leitrim	31,798	11	270	-259	31,539
Sligo	65,393	96	381	-285	65,108
Roscommon	64,065	111	771	-660	63,405
Mayo	130,638	232	1,601	-1,369	129,269
Galway (Rest of country)	173,875	3,724	18,953	15,229	158,646
Total	626,906	4,248	22,386	-18,138	608,768
South East					
Wexford	145,320	485	3,251	-2,766	142,554
Carlow	54,612	200	1,274	-1,074	53,538
Kilkenny	95,419	965	3,755	-2,790	92,629
Waterford (Rest of county)	62,276	1,211	6,421	-5,210	57,066
South Tipperary	88,432	575	1,970	-1,395	87,037
Total	446,059	3,436	16,671	-13,235	432,824
South West					
North Tipperary	70,322	319	2,894	-2,575	67,747
Limerick (Rest of county)	100,355	2,442	11,741	-9,029	91,326
Kerry	145,502	212	1,207	-995	144,507
Cork (Rest of county)	320,450	8,639	35,214	-26,575	293,875

	Population	*Inflow*	*Outflow*	*Net*	*Adjusted Population*
Clare	117,196	272	5,627	-2,865	114,331
Total	753,825	14,374	56,413	-43,039	711,786
Five Cities					
Dublin City and Suburbs	1,110,627	117,764	35,860	81,904	1,192,531
Cork City and Suburbs	198,582	36,519	10,105	26,504	225,086
Limerick City and Suburbs	91,454	20,086	6,405	13,681	105,135
Galway City and Suburbs	76,778	20,560	4,715	15,845	92,623
Waterford City and Suburbs	51,519	10,646	3,006	7,640	59,159
Outside ROI			882	882	882
Total	**4,588,252**				**4,588,252**

Source: Central Statistics Office, ComReg

Annex 7: Consultation Questions

A7.1 Chapter 4 Consultation Questions

A 7.1 Do you agree with ComReg's preliminary views set out in Chapter 4 and, in particular, that:

- the band plan for the 3 400-3 600 MHz sub-band should be TDD (in line with the preference expressed in the 3.6 GHz EC Decision);
- regions should be established in line with the principles identified by ComReg;
- the regions identified in Option 2 should be used for the proposed award; and
- a licence duration of 15 years should apply to the 3.6 GHz band.

A 7.2 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory functions, objectives and duties.

A7.2 Chapter 5 Consultation Questions

A 7.3 Do you agree with ComReg's preliminary views set out in Chapter 5 and, in particular, that:

- a combinatorial clock auction is the preferred auction format;
- a single 25 MHz frequency-specific lot be adopted for frequency 3410 MHz – 3435 MHz;
- Sixty five (65) frequency-generic lots of 5 MHz each should be adopted for frequencies between 3475 MHz – 3800 MHz;
- a competition cap should be set and, further, that such a cap be within the range of 150 MHz to 250 MHz. ComReg is mindful of the alternative uses to which this spectrum can be put and the potential impacts this can have on competitive dynamics in the relevant market concerned (for example fixed of mobile). Accordingly, ComReg welcomes input on any other factors which should be taken into account when establishing the level of any competition cap;

- benchmarking be used as the approach by which to determine a conservative minimum price;
- the minimum price should be apportioned on a 50/50 basis between an up-front payment (SAF) and ongoing annual payments subject to CPI index linking (SUFs); and
- the range €0.015 to €0.025 per MHz per capita is appropriate for the setting of the minimum price, with the higher end of the range applying to urban areas and the lower end applying to regions that do not have specific urban areas identified.
- the population of each of the regions under Option 2 should be adjusted to take account of the commuter flows between the five identified cities and the other applicable regions.

A 7.4 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory objectives, duties and functions.

A7.3 Chapter 6 Consultation Questions

A 7.5 Do you agree with ComReg's preliminary views set out in Chapter 6 and, in particular, that:

- the band should be released on a service- and technology-neutral basis;
- rights of use in the band should be awarded on a non-exclusive basis;
- an obligation to notify of the termination of a technology should apply;
- a rollout obligation should apply for spectrum rights of use in this band and that such an obligation should be based on a minimum number of base stations to be deployed per sub-national region;
- a quality of service obligation should apply in relation to each of network availability and voice call standards;
- licensees should internalise guard-bands as spectrum should be assigned without guard-bands;
- a default TDD frame-structure based on TD-LTE configuration 2 (3:1) should be applied to incentivise inter-network synchronisation;

- a permissive BEM should apply to synchronised networks and a restrictive BEM should apply to unsynchronised networks;
- the terminal station in block power limit set out in the 3.6 GHz EC Decision should be relaxed for fixed outdoor installations;
- at regional borders a coordination threshold should apply to allow for bilateral/multilateral co-existence agreements; and
- where agreement in cross-border coordination fails to be met, the coordination threshold limit should be set as a binding licence condition.

A 7.6 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory functions, objectives and duties.

A7.4 Chapter 7 Consultation Question

A 7.7 Do you agree with ComReg's preliminary views set out in Chapter 7 and, in particular, with the following proposals:

- Transition Proposal 1: the formulation of a transition plan for the 3.6 GHz band;
- Transition Proposal 2: the Transition Protected Licence; and
- Transition Proposal 3: the Transition Unprotected Licence.

A 7.8 Please provide a detailed explanation of your views, with supporting material, having regard to ComReg's statutory functions, objectives and duties.