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Further Consultation on the Release of the 410 – 415.5 / 420 – 425.5 MHz Sub-band

Consultation

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Content

Annex

Section Page

Table of Figures

Section Page

Table of Tables

Section Page

Chapter 1

1 Introduction

1.1 In the Radio Spectrum Management Strategy Statement 2016 – 2018[1] ComReg observed that a number of potential uses for the 410 – 414 MHz / 420 – 424 MHz band required consideration and stated it would commence a consultation process on the future use of the band as part of its radio spectrum work plan for 2016 – 2018[2].

1.2 In July 2017, ComReg commenced a public consultation ("Consultation 17/67")[3] on the award of spectrum rights of use in 410 – 415.5 MHz / 420 – 425.5 MHz sub-band ("the 400 MHz band"). This preliminary consultation explored, at a high level, a number of possible uses for the 400 MHz band and how it might be awarded. There were 12 respondents to Consultation 17/67 and in December 2017, ComReg published its Response to Consultation document (ComReg 17/105)[4] within which ComReg set out its preliminary views on certain issues raised pursuant to Consultation 17/67.

1.3 Based on the responses received to the Radio Spectrum Management Strategy Statement 2016 – 2018 and the apparent level of interest shown in the 400 MHz band, ComReg, in Consultation 17/105, considered that there is sufficient justification to further develop the proposed award of spectrum rights of use in the 400 MHz band.

1.4 The purpose of this document is to set out ComReg's further proposals and preliminary views on the proposed process for granting new spectrum rights of use in the 400 MHz band, and the conditions that may be attached to any future licences.

1.5 In arriving at the 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 1. ComReg has had regard to all relevant information available to it including:

- submissions received to Consultation 17/67;

[1] ComReg Document 16/49 - Radio Spectrum Management Strategy 2016 to 2018 – Published 21 June 2016.
[2] ComReg Document 16/50 - Radio Spectrum Management Strategy 2016 to 2018 – Published 21 June 2016.
[3] ComReg 17/67 – Consultation on Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published 31 July 2017.
[4] ComReg 17/105 – Response to Consultation on the Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published 8 December 2017.

- the independent expert advice and recommendations of its economic and award design consultant, DotEcon Limited ("DotEcon")[5] and the independent expert advice from its technical consultant Plum Consulting London LLP ("Plum")[6]; and

- international developments including work in the Electronic Communications Committee, the European Telecommunications Standards Institute and the International Telecommunications Union concerning the use of the 400 MHz band.

1.6 The document is structured as follows:

- **Chapter 2** sets out a brief background on the 400 MHz band in Ireland and relevant documents to the process thus far;

- **Chapter 3** sets out a draft Regulatory Impact Assessment on options for assigning new rights of use in the 400 MHz band;

- **Chapter 4** discusses the proposed award format and spectrum fees

- **Chapter 5** details key aspects of the proposed award spectrum

- **Chapter 6** details how to submit comments and next steps in the process

- **Annex 1** details the Legal Basis

- **Annex 2** details the proposed Interference Mitigation

- **Annex 3** the 400MHz Band Plan

- **Annex 4** relevant ECC Decisions

[5] ComReg Document 18/92a DotEcon Limited - Award of licences for the use of radio frequencies in the 400 MHz band – Published alongside this Document.
[6] ComReg Document 18/92b Plum Consulting London LLP - Potential use of the 400 MHz band in Ireland – Published alongside this Document.

Chapter 2

2 Developments in the 400 MHz Band

2.1 Introduction

2.1 This chapter provides an overview of relevant ComReg publications and international developments relating to the 400 MHz band.

ComReg publications relating to the proposed 400 MHz band award

Document 17/67

2.2 ComReg's Consultation Document 17/67 explored, at a high level and amongst other things, the likely demand for the 400 MHz band along with possible uses and how spectrum rights of use might be assigned.

Document 17/105

2.3 In Document 17/105, ComReg considered there to be sufficient justification to further develop the proposed release of spectrum rights of use, summarised the views of submissions received to Consultation 17/67, set out ComReg's preliminary views on certain issues raised pursuant to Consultation 17/67, and outlined ComReg's intention to form a preliminary view on the matters discussed in the next consultation phase having considered the responses along with expert advice. These issues were as follows:

- whether or not to make 400 MHz spectrum available on a national basis;
- to have no restriction on bandwidth, but to allow licensees to use their blocks with whatever bandwidth they wish;
- licence duration;
- to make the spectrum available for FDD operation only;
- the possibility of introducing a Block Edge Mask;
- permitting potential Third Party Use in the band;
- lot size;

- award type and fees; and
- roll-out and usage obligations.

2.2 International Developments in relation to the 400 MHz band

International Developments in the ITU

2.4 In addition to the work being carried out at a CEPT[7] level (discussed below), there is also work being carried out by the Radiocommunications sector of the International Telecommunications Union ("ITU"). ComReg is aware of a draft revision of ITU-R SM.2351-2[8] developed by CEPT FM 54 and proposed by the United Kingdom[9] on Smart Grid utility management systems. In that draft revision, PMR and PAMR are noted as possible methods to provide Smart Grid. It is also noted that according to the proposed revision that 2 × 3 MHz is required in the 400 MHz frequency band for the provision of Smart Grids. The draft revision will be considered further at the next meeting of ITU Working Party 1A (WP 1A)[10] (May 2019).

European Developments in CEPT

2.5 ComReg notes that there are a number of Electronic Communications Committee[11] ("ECC") Decisions that currently apply to the 400 MHz band. These are set out in Annex 4.

2.6 The current ECC work programme includes a work item to develop a new ECC Decision for land mobile systems[12] that includes the band at issue in this consultation. This has resulted in draft ECC Decision (19)02[13]. It is intended that this new ECC Decision will replace ECC Decision (04)06 and ECC Decision (06)06. Draft ECC Decision (19)02 specifies the Least Restrictive Technical Conditions for

[7] CEPT is the European Conference of Postal and Telecommunications Administrations.
[8] https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-SM.2351-2-2017-PDF-E.pdf
[9] https://cept.org/Documents/fm-54/41892/temp1_draft-revised-cept-contribution-for-report-sm-2351-2
[10] Working Party 1A examines spectrum engineering techniques including unwanted emissions and technical aspects of sharing.
[11] The ECC is a Committee of CEPT (European Conference of Postal and Telecommunications Administrations) that considers and develops policies on electronic communications activities in the European context, taking account of European and International legislation and regulations
[12] ECC work item FM54_02 (FM_31) on a new ECC Decision for land mobile systems in the frequency ranges 68 – 87.5 MHz, 146 – 174 MHz, 406.1 – 410 MHz, 410 – 430 MHz, 440 – 450 MHz, and 450 – 470 MHz.
[13] https://www.cept.org/files/9522/Draft%20new%20ECC%20Decision%20(19)02%20for%20PC.docx

narrowband and wideband land mobile systems operating within a number of frequency ranges including the 410 – 430 MHz frequency range. This work item is currently available for public consultation and has a target date for adoption of 1 March 2019.

2.7 CEPT Working Group Spectrum Engineering ("WGSE")[14] was tasked by CEPT to carry out compatibility and sharing studies complementary to ECC Report 240[15] for Broadband PPDR ("BB-PPDR") systems operating in the frequency band 410 – 430 MHz. This has resulted in the development of ECC Report 283[16]. ECC Report 283 provides results of compatibility and sharing studies related to the introduction of broadband and narrowband systems in the bands 410 – 430 MHz and 450 – 470 MHz.

2.8 Work item FM54_05[17] specifies that ECC Decision (16)02[18] should be reviewed and updated to include 410 – 430 MHz as an optional European harmonised band for (BB-PPDR). The target date for completion of this work item[19] is 5 July 2019[20].

2.9 ComReg is aware that CEPT project team FM 54[21] have been working on draft ECC Report 292 that examines the usage and availability of bands used for land mobile systems[22] and discusses the trend towards PMR/PAMR systems using bandwidths greater than 200 kHz, including the introduction of 1.25 MHz, 1.4 MHz, 3 MHz and 5 MHz channels for PMR based on the LTE standard.

[14] WGSE is responsible for developing technical guidelines and sharing and compatibility arrangements for radio spectrum use by various radiocommunications services using the same or different frequency bands respectively.
[15] https://www.ecodocdb.dk/download/1886c872-fec6/ECCREP240.PDF
[16] https://www.ecodocdb.dk/document/6033
[17] FM54 Work Programme is available at https://eccwp.cept.org/default.aspx?groupid=55&go=true
[18] https://www.ecodocdb.dk/download/1cadc836-23e4/ECCDEC1602.pdf
[19] https://cept.org/Documents/fm-54/46027/temp5_draft-revised-ecc_dec_-16-02-bb-ppdr
[20] This revised version has been approved for public consultation by Working Group Frequency Management ("WGFM") at WGFM#92 in Vilnius, Lithuania, 24 – 28 September 2018. WGFM is responsible for developing strategies, plans and implementation advice for the management of the radio spectrum.
[21] Project Team FM 54 was established in February 2014 and is responsible for Private and Professional Land Mobile Systems.
[22] https://www.cept.org/Documents/fm-54/46049/temp1rev4_draft-ecc-report-292-after-editorial-work-for-pc

European Developments in ETSI

ESTI[23] Technical Report TR 103 401[24] and current work item 'DTR/ERM-562'[25] identify the future requirements for Smart Grids that are necessary to meet Europe's need for the reliable provision of utilities. ETSI emphasises that almost all of Europe's businesses are dependent on reliable provision of utilities to enable them to supply the goods and/or services to Europe's citizens and consumers. ETSI examines Smart Grid systems and other radio systems suitable for utility operations, and the long-term spectrum requirements for electricity, gas and water Smart Grids. ETSI is of the view that 2 × 3 MHz of spectrum is required in the 400 MHz band for Smart Grid use.

2.10 ComReg notes that within Europe there is a view that Smart Grids are required to improve the efficiency of utility networks (electricity, gas and water). ComReg also notes that both Germany and Poland are or have made spectrum available for the use of critical infrastructure (Smart Grid). ComReg is of the preliminary view that there is a likely requirement for Smart Grid to achieve national and international policy goals.

[23] The European Telecommunications Standards Institute ("ETSI"), produces globally-applicable standards for Information and Communications Technologies, including fixed, mobile, radio, converged, broadcast and internet technologies. ETSI are officially recognised by the European Union as a European Standards Organization.
[24] https://www.etsi.org/deliver/etsi_tr/103400_103499/103401/01.01.01_60/tr_103401v010101p.pdf
[25] ETSI work item 'DTR/ERM-562' – https://bit.ly/2phCuSi

Chapter 3

3 Draft Assignment RIA

3.1 Introduction and background

3.1 In 2005 ComReg conducted an auction for the award of three national licences for the provision of Wideband Digital Mobile Data Services ("WDMDS") in the frequency ranges 410 – 414 MHz paired with 420 – 424 MHz and 872 – 876 MHz paired with 917 – 921 MHz[26]. No commercial services were successfully deployed in those frequency ranges and rights of use expired on 31 December 2017.

3.2 In the Radio Spectrum Management Strategy Statement 2016 to 2018 ComReg observed that a number of potential uses for the 410 – 414 MHz / 420 – 424 MHz band required consideration and stated it would commence a consultation process on the future use of the band as part of its radio spectrum work plan for 2016 to 2018[27].

3.3 In 2017, ComReg published Consultation Document 17/67[28] which noted that a Regulatory Impact Assessment ("RIA") would form part of future consultations on the 400 MHz band depending on the nature of measures proposed by ComReg. In that regard, the RIA presented in this chapter examines how rights of use in the 400 MHz band should be awarded.

3.4 This chapter concludes with ComReg's assessment of the preferred option arising from the RIA ("**Preferred Option**") against ComReg's statutory remit in managing the radio spectrum, including its relevant functions and objectives and the regulatory principles with which it must abide (see Annex 1).

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

3.6 All references to "the 400 MHz band" refer to 410 – 415.5 MHz / 420 – 425.5 MHz sub-band.

[26] ComReg Document 05/80 – Information Memorandum: Process for the award of national licences for the provision of WDMDS – published 20 October 2005. Note: this document is not publicly available as it was only accessible through purchase. However, the majority of details in the Information Memorandum are covered at a high level in ComReg Document 05/79 – Information Notice.
[27] ComReg Document 16/50 - Radio Spectrum Management Strategy 2016 to 2018 – Published 21 June 2016.
[28] ComReg Document 17/67 - Consultation on Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published 31 July 2017.

3.2 RIA Framework

3.7 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

3.8 As set out in ComReg's RIA Guidelines[29], 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; and
- Step 5: Assess the impacts and choose the best option.

3.9 In the following sections ComReg identifies the relevant stakeholder groups, specific policy issues to be addressed and relevant objectives (that is, Step 1 of the RIA process).

3.10 This is followed by the identification of the fundamental policy issues and ComReg's consideration of same in accordance with the four remaining steps of ComReg's RIA process.

Policy Issues and Objectives (RIA Step 1)

3.11 Document 17/67 explored, at a high level, a number of possible uses for the 400 MHz band and how it might be assigned. In response to the concerns expressed by

[29] ComReg Document 07/56a – Guidelines on ComReg's approach to Regulatory Impact Assessment – Published 10 August 2007.

eir Group[30] [31], ComReg noted in its Response to Consultation[32] that the award for 400 MHz spectrum would be conducted in a manner which respects the principles of service and technology neutrality. Further, ComReg noted that it would form a preliminary view on the matters discussed in the next consultation phase having considered the responses along with other relevant evidence including any expert advice it may obtain in the intervening period. In particular, ComReg stated that it would prepare a draft RIA on the assignment process for the 400 MHz band which would be informed by the various responses received to Document 17/67.

3.12 In that regard, and in light of certain matters raised by respondents, ComReg commissioned Plum to, among other things, analyse the potential uses of the 400 MHz band as identified in ComReg Consultations 17/67 and 17/105, identify other possible uses, and assess the amount of spectrum and associated technical requirements that may be needed to provide for those uses. The Plum Report is published alongside this consultation document[33].

3.13 Among other things, Plum assessed four broad categories of potential uses for the 400 MHz band, namely, Private/Professional Mobile Radio ("PMR"), Public Protection and Disaster Relief ("PPDR"), Smart Meters, and Smart Grids (See Table 3.3 of Plum Report). For each identified use, they assessed a number of factors including:

a) the applicable technology(s) and future availability;

b) the minimum spectrum block requirements; and

c) the availability of alternative frequency bands and/or solutions.

3.14 In relation to (a) and (b) this information is relevant to the Award Design and is addressed separately in Chapter 4.

3.15 In relation to (c), Plum concludes that PMR and PPDR have alternative frequencies and or solutions available that can be used to deliver those services. For instance, a significant number of alternative bands are available for PMR[34], PPDR and

[30] Eircom Limited (trading as "eir" and "open eir") and Meteor Mobile Communications Limited ("MMC") (collectively referred to as "eir Group").
[31] ComReg Document 17/105s – Non-Confidential Submissions to ComReg Document 17/67 on the Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published 8 December 2017.
[32] ComReg Document 17/105 – Response to Consultation on the Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published 8 December 2017.
[33] ComReg Document 18/92b Plum Consulting London LLP - Potential use of the 400 MHz band in Ireland.
[34] For example, 440 – 450 MHz for land mobile, 455 – 456 MHz for PMR, digital land mobile civil, 456 – 469 and 460 – 470 MHz or land mobile for Government service, commercial and local authorities, and 459 – 460 MHz for land mobile. PMR / PAMR already supported in licensed bands.

TETRA Enhanced Data Services ("TEDS")[35], and Smart Meters[36]. However, Plum outlines that there are no alternative spectrum rights of use sufficient to provide for Smart Grid. In particular, for applications to connect to sub-stations, pumping stations and alternative energy sources, sub 1 GHz spectrum is required to achieve geographic coverage at locations in remote rural locations.

3.16 In that regard, the only alternative suitable frequency range is the 450 – 470 MHz band which is currently assigned for and used extensively by PMR (Business Radio) and is not suitable because the quantity of contiguous spectrum (that is, 2 × 3 MHz) required for Smart Grid use, as identified by Plum, is not available in the 450 – 470 MHz band, as illustrated in Figure 1 below.

[35] For example, 380 – 385 paired with 390 – 395 MHz for the emergency services, and 385 – 389.9 paired with 395 – 399.9 MHz for a civil network. Current TETRA network 380 – 385 / 390 – 395 MHz.

[36] For example, Smart Meters can be provided over licence exempt bands such as 868 MHz). Also, Smart Meters can be provided over MNO networks (for example, NB-IoT in LTE spectrum bands) and licence exempt bands such as 868 MHz.

Figure 1. 450 – 470 MHz band overview

3.17 Rather, the 450 – 470 MHz band is used for a large number of licence types including, Business Radio, Paging, Third Party Business Radio, Data/Telemetry, PMSE and Community Repeaters. Business Radio currently uses most of the available spectrum, with 586 individual frequency assignments in the 450 – 470 MHz band. Plum also note that due to the nature of Smart Grid networks (that is, long distances and rural locations) there is a need for spectrum around 400 MHz and use of other bands would not be optimal.

3.18 Further, Plum sees little demand for the 400 MHz band for the other uses identified, due to the sufficiency of existing spectrum in other frequency bands, and the availability of alternative spectrums, should the need arise. For example, Plum maintains that the majority of use cases already have access to spectrum and networks are rolled out and, in some cases such as PPDR, further harmonised frequency bands are being identified. There are also alternative solutions emerging for such use cases such as provision of PPDR[37] and Smart Metering over MNO networks[38].

3.19 ComReg agrees with the views of Plum and is of the preliminary view that that there are no alternative and suitable rights of use available for Smart Grid use. These views are consistent with ESBN's ("Electricity Supply Board Networks") and EUTC's (European Utilities Telecommunications Union) submission, and contained in Document 17/105s, that alternative and suitable rights of use are not available for wideband utility networks and the provision of Smart Grid[39].

3.20 The lack of alternative and suitable rights of use for Smart Grid compared to other potential uses identified raises two important policy considerations that require ComReg's consideration.

1. Is there a likely requirement for Smart Grids in Ireland?

2. Are there alternative solutions that could deliver a Smart Grid(s)?

3.21 These policy considerations are assessed in order below. However, prior to this assessment, it is helpful to provide information and a definition of Smart Grids in order to provide context to the remainder of this RIA.

[37] In particular, the 700 MHz EC Decision gives Member States flexibility in terms of the potential uses of the 700 MHz Duplex Gap, including for PPDR. To date, no national policy decision has been taken in relation to the specific use of the 700 MHz Duplex Gap in Ireland and, in particular, in respect of PPDR. See ComReg Document 18/60.

[38] For example, O2 are providing connectivity for smart meters to over 23 million locations in the UK - https://www.o2.co.uk/business/iot/solutions/smartmeters

[39] ComReg Document 17/105s - Non-Confidential Submissions to ComReg Document 17/67 on the Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published December 2017.

What are Smart Grids?

3.22 There are various definitions for Smart Grid used by industry stakeholders. This consultation document uses the definition provided by Plum. The Plum definition of Smart Grid is based, in part, on the International Telecommunications Union ("ITU") definition[40].

3.23 Plum defines Smart Grid as "a term used for advanced delivery systems for utility services (electricity, gas and water) from sources of generation and production to key elements in the grid networks and includes all supervisory and control necessary for their effective management." [41]

3.24 In effect, Smart Grids provide the information to enable two-way data flows between various parts of a utility network. At the core of the Smart Grid is the use of intelligent communication networks to bring together monitoring and control functions to enable grid analysis of various aspects of the utility systems, for example from power generation to transmission and distribution. Smart Grids have a significantly higher number of elements and sensors compared to the legacy grid[42] and are deployed at all levels of the grid such as power plants, substation equipment, generators and transformers. The sensors are used for data acquisition and information exchange between equipment and data centres. In order to handle increased data, a Smart Grid requires reliable and resilient communication infrastructure able to provide real-time secure communications[43].

3.25 Existing utility distribution systems are designed to deliver resources uniformly, regardless of the need for those resources at different times and places. These systems however lack the intelligence to optimise delivery in line with demand leading to more inefficient delivery and use. The primary aim of a Smart Grid is to take advantage of the potential for technology to improve the operation and control of information and communication systems by optimising management of demand, improving the cost-effectiveness of grid infrastructure investments and increasing the reliability of the utility distribution system for supply and delivery to end users.

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[40] The International Telecommunications Union ("ITU") defines Smart Grid as follows: "Smart Grid is a term used for advanced delivery system for utility services (electricity, gas and water) from sources of generation and production to consumption points, and includes all the related management and back office systems, together with integrated modern digital information technologies." Smart Grid Utility Management Systems, Report ITU-R SM.2351-2 06/17.

[41] As noted by Plum this definition does not include Smart Metering which is a use case considered separately in its report and has alternative frequencies and solutions available.

[42] The legacy grid communication systems are mainly used for data acquisition from limited number of sensors that are located in the main transmission and distribution points, limited number of control signals transmission and faults detection.

[43] Baimel, D, 2016, Smart Grid Communication Technologies, Journal of Power and Energy Engineering, 2016, 4, 1-8.

1. Is there a likely requirement for Smart Grids in Ireland?

3.26 ComReg considers it necessary to assess whether Smart Grid systems are a viable service proposition likely to require spectrum rights of use in the period up to 2040 (that is, a 15 - 20 year licence duration)[44]. Below, ComReg sets out its preliminary views on whether there is likely to be a demand or requirement for radio spectrum in the provision of Smart Grids, noting that any actual demand requirement can only be determined through applications from interested parties and the assignment of rights of use to a particular licensee.

3.27 Smart Grids are a key component of government efforts to meet demand for increased energy requirements in a cost effective and secure way while reducing the environmental impact of consumption and associated carbon emissions[45]. Different functions of the Smart Grid could provide substantial reductions in energy use and carbon emissions by using new technology and making renewable energy and efficiency programs more affordable and potentially more accessible.

3.28 In particular, greater integration of renewable energy into electricity and gas grids is key to lowering the environmental impacts of generation and meeting climate change targets. For example:

- The ITU has outlined how Smart Grids can help to mitigate climate change by building more controllable and efficient energy systems[46];
- The United Nations ("UN") has outlined that the demands of climate change requires the development of a Smart Grid which is founded upon communications networks that can deliver centralised real time monitoring and control, eventually across the entire power distribution domain[47].

3.29 A number of seminal international and national studies have estimated the potential carbon reductions arising from the use of Smart Grids:

- the Electrical Power Research Institute ("EPRI") has estimated that Smart Grid enabled electrical distribution could reduce electrical energy consumption by 5% to 10% and carbon dioxide emissions by 13% to 25%[48];

[44] See Section 5.4 (Licence Duration).
[45] Transition to a Low Carbon and Climate Resilient Society – National Strategic Outcome 8 of the National Development Plan 2018 – 2027. https://www.gov.ie/pdf/?file=https://s3-eu-west-1.amazonaws.com/govieassets/831/130718120306-5569359-NDP%20strategy%202018-2027_WEB.pdf#page=76
[46] https://news.itu.int/energy-efficiency-fight-climate-change-vital-role-icts/
[47] United Nations Economic Commission For Europe, Electricity Systems Development – A Focus on Smart Grids, August 2015.
[48] Smart Grid Utility Management Systems, Report ITU-R SM.2351-2, 06/17.

- a smart electrical power grid could decrease annual electric energy use and utility sector carbon emissions by at least 12% by 2030[49]; and
- the Sustainable Energy Authority of Ireland estimates that by 2050, Smart Grids will see an accumulated reduction in energy related CO_2 emissions of 250 million tonnes[50] [51].

3.30 At a European Level, the European Commission has been encouraging the use of Smart Grids in order to encourage more efficient energy generation and consumption. For example, under the Electricity Directive[52]:

- *"Member States should encourage the modernisation of distribution networks, such as through the introduction of* ***smart grids****, which should be built in such a way that encourages decentralised generation and energy efficiency*"[53] [Emphasis added].
- "*In order to promote energy efficiency, Member States or, where a Member State has so provided, the regulatory authority shall strongly recommend that electricity undertakings optimise the use of electricity, for example by providing energy management services, developing innovative pricing formulas, or introducing intelligent metering systems or* ***smart grids****, where appropriate*"[54] [55] [Emphasis added].

3.31 The European Commission has an existing policy framework for climate and energy from 2020 to 2030 which proposes new targets and measures to make the EU's economy and energy system more competitive, secure and sustainable. It includes targets for reducing greenhouse gas emissions and increasing use of renewable energies noting that "*the EU and Member States will need to develop further their policy frameworks to facilitate the transformation of energy infrastructure with more cross-border interconnections, storage potential and* ***smart grids*** *to manage*

[49] The Smart Grid: An Estimation of the Energy and CO_2 Benefits, Department of Energy's Pacific Northwest National Laboratory.
[50] https://www.seai.ie/resources/publications/Smartgrid-Roadmap.pdf
[51] The Effort Sharing Regulation (ESR), was published by the European Commission in July 2016. The ESR proposal suggests a 39% GHG (Greenhouse Gas) reduction target for Ireland, based on GDP per capita, for the period 2021 to 2030.
[52] Note that references to the Electricity Directive are made to indicate demand or a requirement for Smart Grid rather than ComReg being subject to any specific requirements under those Directives.
[53] Recital 24 – Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2008.
[54] Article 3(11) – Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2008.
[55] The development of technology to deliver more efficient management of networks is more commonly known as Smart Grids. The new systems will improve efficiency, reliability, flexibility and accessibility and are the key next steps in the evolution of the internal market in energy Interpretative Note on Directive 2009/72/EC Concerning Common Rules for the Internal Market in Electricity and Directive 2009/73/EC concerning Common Rules for the Internal Market in Natural Gas.

demand to ensure a secure energy supply in a system with higher shares of variable renewable energy"[56] [Emphasis added].

3.32 In that regard, at a national level the Department of Communications, Climate Action and Environment is currently developing a National Energy and Climate Plan ("NECP") as one of the key provisions of the proposed Governance of the Energy Union Regulation. The plan, which is due to be submitted to the European Commission by the end of 2018,[57] will include trajectories for renewable energy, energy efficiency, and national emissions, and measures required to achieve these trajectories[58]. The plan must set out how Ireland is going to achieve targets on reducing carbon emissions and increasing renewable energy up to 2030. The then Minister for Communications, Climate Action and Environment, Denis Naughten T.D noted that this will be facilitated by existing work streams such as the National Development Plan ("NDP")[59]. The NDP includes measures such as Smart Grid to transition to a low-carbon economy.

3.33 Such requirements are also broadly in line with State policy to encourage the provision of Smart Grid and other related technologies. For example:

- The Project Ireland 2040 National Planning Framework[60] promotes a transition to a low carbon energy future which requires decisions around development and deployment of new technologies relating to areas such as wind, **smart grids**, electric vehicles, buildings, ocean energy and bio energy. It also commits to a roll-out of the National Smart Grid Plan enabling new connections, grid balancing, energy development and micro grid development. [Emphasis added]

- The Department of Communications, Climate Action and Environment National Mitigation Plan observes that smart operation of the power system at both transmission and distribution level and energy efficiency will enable maximisation of the existing grid[61].

[56] European Commission, 'A policy framework for climate and energy in the period from 2020 to 2030, (COM(2014) 15 final), January 2014.
[57] https://merrionstreet.ie/en/News-Room/Speeches/MINISTER_DENIS_NAUGHTEN_TD_ENERGY_IRELAND.html
[58] https://www.oireachtas.ie/en/debates/question/2018-05-30/198/
[59] https://www.per.gov.ie/en/national-development-plan-2018-2027/
[60] Project Ireland 2040 - National Planning Framework – 2018.
[61] Department of Communications, Climate Action and Environment - National Mitigation Plan – July 2017.

- The National Development Plan 2018 – 2027 foresees the piloting of 'climate-smart countryside' projects to establish the feasibility of the home and farm becoming net exporters of electricity through the adaptation of smart metering, **smart grids** and small-scale renewable technologies, for example, solar, heat pumps and wind [Emphasis added].

- The Sustainable Energy Authority of Ireland "Smart Grid" Roadmap to 2050[62] notes that Smart Grid can maximise our use of indigenous low carbon renewable energy resources which is central to ensuring Ireland meets its long term target of a secure and low carbon future.

3.34 Finally, at least one Network Utility Operator (ESBN) has publicly expressed an interest in acquiring 400 MHz spectrum rights of use in order to support the provision of a Smart Grid[63].

3.35 In relation to other utilities, the requirement for Information and Communications Technology ("ICT") in the water distribution network is documented by the ITU[64]. Sensors placed throughout the water distribution network are required in order to save water. The system will manage end-to-end distribution from reservoirs to pumping stations to smart pipes, allowing water utilities to identify leaks in real time, and reducing the approximately 50% of water that is lost through leaks in developed countries[65].

3.36 Expert Group 4 of the EU Commission task force for Smart Grids examines Smart Grid aspects related to gas[66]. It has stated that Smart Gas Grids will support the ability of gas to play a major ongoing role in the energy mix while meeting the carbon targets and the renewable energy targets (targets outlined by the European Commission and discussed earlier). It also states that Smart Gas Grids empower end-users to optimise their energy use and to allow them to participate actively in the energy market. A Smart Gas Grid also allows the injection of non-conventional gases, such as Biomethane which is CO_2 neutral, into the network, reducing the carbon intensity of the Gas Grid.

3.37 Finally, ComReg notes that other EU member states are also addressing the need for spectrum for Smart Grids:

- Germany has initiated a process for the provision of critical infrastructures (for example, Smart Grid) for nationwide use in the 450 MHz frequency

[62] Sustainable Energy Ireland, Smart Grid 2050.
[63] ComReg Document 17/105s - Non-Confidential Submissions to ComReg Document 17/67 on the Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz sub-band – Published 8 December 2017.
[64] https://www.itu.int/dms_pub/itu-t/oth/23/01/T23010000100003PDFE.pdf
[65] https://www.itu.int/dms_pub/itu-t/oth/23/01/T23010000100003PDFE.pdf
[66] https://ec.europa.eu/energy/sites/ener/files/documents/2010-2011.zip

range on a technology neutral basis[67]. BNetzA, the German regulator, is of the view that the 450 MHz range is suitable for applications of critical infrastructures.

- The Polish Office of Electronic Communications ("UKE") has recently assigned 450 MHz spectrum rights of use to PGE Systemy S.A., which is part of Poland's largest energy sector company for the provision of voice communication and data transmission to manage the transmission or distribution networks of gas, liquid fuels or electricity[68].

3.38 Therefore, ComReg is of the preliminary view that Smart Grid systems are likely to be required in order to meet various national and international policy goals and as such is likely to be a viable service proposition in the period up to 2040 (that is, a 15 - 20 year licence duration).

2. Are there alternative solutions that can deliver a Smart Grid(s)?

3.39 In light of the above, it is necessary to consider whether the likely requirement for Smart Grid in Ireland can be provided through other alternatives. In particular, in order to provide that any preferred option is proportionate, it is necessary to assess whether the provision of a Smart Grid network in Ireland could be provided absent the assignment of 400 MHz rights of use for that purpose.

3.40 In that regard, it is first necessary to (i) assess the technical requirements for Smart Grid and (ii) assess how much spectrum is required to support those requirements. Such an assessment is necessary in order to determine whether other potential solutions are likely to be viable.

(i) What are the technical requirements of Smart Grids?

3.41 Plum outlines a number of requirements for Smart Grids that would need to be provided for in order to effectively provide for Smart Grid in the future. These include:

- low to medium data rates typically 9.6 Kbit/s to around 64 Kbit/s and up to multiple Mbit/s if video is required to monitor key installations;
- grid networks are expected to be deployed for a significant time (for example, 10 to 20 years);
- low jitter and synchronous requirements;

[67] https://www.bundesnetzagentur.de/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Frequenzen/Firmennetze/450MHz/450MHz-node.html
[68] https://bip.uke.gov.pl/konsultacje-i-wyniki-konsultacji/komunikat-ws-przetargu-na-rezerwacje-czestotliwosci-zzakresow-452-5-457-5-mhz-oraz-462-5-467-5-mhz,378.html

- provide enhanced resilience – for example this requires battery power back-up which far exceeds that provided over MNO networks;
- instant and guaranteed channel access;
- extensive geographic coverage (including less populated areas) to provide 100% coverage of the utility network;
- stringent latency requirements; and
- high levels of security[69].

3.42 Further, ComReg observes that in September 2017, the CEPT working group FM 54[70] agreed to draft some elements for a further revision of ITU-R Report SM.2351-2[71] to include PMR/PAMR technologies already in use. In May 2018, WGFM approved this proposed revision as a CEPT contribution to ITU-R Working Party 1A[72]. This contribution (referred to as the "CEPT contribution") was submitted by the United Kingdom on behalf of WGFM/CEPT. The Plum Report is largely in line with the updated CEPT contribution. In particular, the CEPT contribution notes that while recent developments in commercial telecoms networks facilitate the carriage of critical communications, mission critical utilities retain a number of uniquely demanding requirements. ComReg lists these requirements below and further information is available from the CEPT contribution[73]:

- Utility telecommunications growth comes from increasing the geographic coverage of the monitoring networks, numbers of connection points, and speed of response, rather than necessarily increased data rates;
- Geographic coverage availability requirements (for example, up to 99.999% for power line protection and 99.9% for scanning telemetry systems) within the defined service area including, in some cases, remote and unpopulated areas[74];

[69] Network security, confidentiality, data and user privacy, network integrity and availability.
[70] https://cept.org/ecc/groups/ecc/wg-fm/fm-54/client/introduction/
[71] ITU-R Report SM.2351-2 on Smart Grid utility management.
[72] ITU Working Party 1A developed a preliminary draft revision of ITU- R SM.2351-2 during its recent meeting (Geneva, 4-12 June 2018). The draft will be further discussed at the next meeting of Working Party 1A (planned on 28 May to 5 June 2019). An ITU TIES account is required to access the draft report, however, the contribution from FM 54 may be accessed on the FM 54 website without restriction.
[73] https://www.cept.org/Documents/fm-54/43494/fm54-18-25_reporting-from-wgfm91-may-2018-incl-relevant-annexes
[74] For example, power lines traverse remote regions where there is little population. Renewable energy and water resources are also often in remote locations. These remote and unpopulated areas may not attract commercial telecom operator services. The CEPT contribution note that "*The coverage of the commercial*

- Enhanced resilience to enable networks to operate in the absence of main electric power for an extended period, which may extend from a few minutes to 72 hours, and even beyond;
- Network hardened to ensure resilience against severe weather, including high winds, flooding, snow, icing, extreme temperatures, and electromagnetic disturbances such as lightning strikes;
- System reliability needs to be designed to meet exact technical requirements rather than for economic gain;
- Separate, independent and diverse redundant routing. Note: when the primary route is interrupted, it is essential that the diverse route works immediately and correctly. This is especially true when instant access to radio spectrum is required;
- Access to suitable allocated spectrum is preferred so that expansions and enhancements to the grid control network may be planned with confidence and incorporated speedily;
- Utilities need high levels of security for their telecoms networks, and infrastructure sites, not only in terms of integrity to prevent malicious disruption of utility operations; but also guaranteed access where denial of service occurs either from network congestion or malicious intent, denying the utility visibility of its network;
- Telecom signal latency and asymmetry requirements in the electricity industry are linked to voltage / power levels, requiring latencies as low as 6 ms with associated asymmetry of less than 300 µs if protection systems are to function correctly. These requirements emerge from the need to compare 'in cycle' values across an electricity network in real time where the duration of a half-cycle is needed to maintain stability and accurately identify fault; and
- Whereas commercial networks are inherently download-centric, utility networks are upload-centric with a small number of control rooms remotely monitoring large geographic areas.

3.43 In regard to the above, ComReg notes that any potential alternative solutions, networks or frequencies would need to provide for each of the requirements outlined by Plum and CEPT. In particular, these requirements largely arise from the need for a Smart Grid to react effectively to changes in the conditions of generation and

3GPP networks is targeted to population centres and cannot in general be relied on in isolated non-populated areas across which utility supplies must frequently be carried and controlled."

transmission, and that access to a Smart Grid should not be compromised[75]. If there is a need to shut these down due to conditions such as overload, full coverage across all connected elements is paramount and delays of milliseconds can be serious, hence network availability, reliability, resilience and security is essential. In the case of water supply there can be similar requirements to monitor key points in the water network such as the flow of water in major pipe lines or water levels in areas prone to flooding where it may be necessary to open or close various valves and dams to alleviate such risks[76].

(ii) How much spectrum is required to support the Smart Grid?

3.44 Plum is of the view that Smart Grid requires 2 × 3 MHz of contiguous spectrum. This is primarily based on the expectation that LTE technology will be required to deliver the technical requirements as set out above and that equipment for LTE in the 410 – 430 MHz band will be in FDD mode and use a minimum bandwidth of 3 MHz (that is, a total of 2 × 3 MHz).

3.45 Similarly, ETSI, also recommends that the shortfalls in bandwidth required for Smart Grid would be overcome if an allocation of spectrum, for example, 2 × 3 MHz in the 400 MHz band, for Utility Operations systems were to be made available[77]. Further, ETSI observed that the details of the future spectrum requirements will be expanded within ETSI TR 103 492[78]. In that regard, ComReg understands the requirement for 2 × 3 MHz of usable spectrum will remain and that this should be facilitated within the 400 MHz Band (380 to 470 MHz)[79].

3.46 In light of the views of Plum and ETSI, ComReg is of the preliminary view that 2 × 3 MHz of contiguous spectrum rights of use in the 400 MHz band would be required in order to provide a Smart Grid in Ireland.

Are viable alternatives available to support Smart Grid?

3.47 ComReg is of the preliminary view that there are two main alternatives for providing a Smart Grid, namely (a) existing telemetry systems and (b) the use of existing mobile networks. ComReg assesses each of these potential alternatives against the technical requirements outlined by Plum and CEPT above in order to determine whether a Smart Grid can be provided in Ireland absent 400 MHz rights of use.

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[75] Smart Grids typically contain multiple network devices, such as transformers, and switches each of which each could be vulnerable to network interference.
[76] Document 18/92b, Plum Report, 'Potential use of the 400 MHz band in Ireland' 2018, p8.
[77] ETSI, 'Smart Grid Systems and Other Radio Systems suitable for Utility Operations, and their long-term spectrum requirements', November 2016. ETSI TR 103 401 V1.1.1 (2016-11).
[78] ETSI, 'Critical Infrastructure Utility Operations requirements for Smart Grid systems, other radio systems, and future radio spectrum access arrangements below 1,5 GHz' - To be published.
[79] https://portal.etsi.org/portal_LatestDrafts/form1.asp?Register=&Param=&Alone=1&Alui=1&tbid=286&SubTB=286

(a) Existing telemetry systems

3.48 Plum notes that monitoring of utility systems has historically been met through scanning telemetry networks to provide the necessary command and control of a centralised grid network. These systems are mainly used for data acquisition from a limited number of sensors that are located in the main transmission and distribution points, and provide a limited number of control signals and fault detections[80] [81].

3.49 However, Plum notes that utility system networks are changing to distributed networks requiring a new level of control that cannot be met with legacy technology and available spectrum. In particular, existing telemetry systems will be unable to support the bandwidth requirements for Smart Grids as recommended by ETSI and Plum. For example, ESBN's existing telemetry assignments in the 450 – 470 band consist of 2 × 300 kHz[82] (two blocks, each comprising 12.5 kHz channels) which is 10 times less than the 2 × 3 MHz recommended by Plum and ETSI.

3.50 Further, the shift from fossil fuels to renewable energy requires more points in the network as renewable energy such as wind tends to be generated across a large number of small generation points in more rural areas compared to a small number of large generators using fossil fuels. In that regard, the number of rural and remote rural links are predicted to increase between 10 and 12 times so these systems are unlikely to have sufficient bandwidth or spectrum required to support the likely increased level of usage[83] [84]. For these reasons, Plum is of the view that existing Telemetry systems are likely to be unsuitable for the provision of Smart Grids as they cannot support requirements for changes to supply networks.

3.51 In light of the above, and the views of its expert advisors, ComReg is of the preliminary view that existing telemetry systems are unlikely to be sufficient to provide for the provision of Smart Grid in the period up to 2040.

(b) Mobile Networks

3.52 There are a number of technical requirements listed above from CEPT and Plum that could be provided by mobile networks, and support certain Smart Grid applications, including:

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[80] Smart Grid an optimal solution to economic and environmental benefits. International Journal of Electrical Electronics & Computer Science Engineering Volume 4, Issue 4 (August, 2017).
[81] Baimel, D, 2016, Smart Grid Communication Technologies, Journal of Power and Energy Engineering, 2016, 4, 1-8.
[82] https://www.comreg.ie/industry/radio-spectrum/licensing/search-licence-type/telemetry/
[83] ETSI, 'Smart Grid Systems and Other Radio Systems suitable for Utility Operations, and their long-term spectrum requirements', ETSI TR 103 401 V1.1.1 (2016-11).
[84] ECC Report 292, Current Use, Future Opportunities and Guidance to Administrations for the 400 MHz PMR/PAMR frequencies.

- low to medium data rates typically 9.6 Kbit/s to around 64 Kbit/s and up to multiple Mbit/s if video is required to monitor key installations; and

- grid network deployed for 10 – 20 years.

3.53 ComReg notes that mobile networks offer high rates of data transfer and implementation of security algorithms[85]. However, mobile networks appear not be suitable to satisfy the majority of the technical requirements listed by Plum and CEPT and in particular mission critical communications[86]. ETSI[87] has noted that public mobile phone systems would need to have appropriate resilience and power backup measures before they could be considered suitable for utility systems. CEPT is of the view[88] that commercial 3GPP systems[89] are unlikely to be appropriate for the delivery of Smart Grid because it is less suited to utilities facilities mission critical control systems where rapid dynamic interactivity is required.

3.54 For example, existing mobile networks are unlikely to provide sufficient geographic coverage, resilience, reliability or latency and is not a fully dedicated network[90]. As noted by Plum, if there is a need to shut down network elements (for example, transformers) due to conditions such as overload, delays of milliseconds can be serious, hence network availability, reliability and resilience is essential[91]. ETSI further notes that it is essential that utility systems are self-managed so as to maintain and ensure coverage, latency and power backup[92]. ComReg sets out its preliminary view on each below:

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[85] Baimel, D, 2016, Smart Grid Communication Technologies, Journal of Power and Energy Engineering, 2016, 4, 1-8.

[86] CEPT define mission critical utilities as transmission/distribution monitoring and control systems which need very rapid dynamic interactivity and extremely high reliability and security capable of operating for many days without power in harsh environments but with far fewer points of interactivity and again with relatively small data volumes.

[87] ETSI TR 103 401 Smart Grid Systems and Other Radio Systems suitable for Utility Operations, and their long-term spectrum requirements Note 3.

[88] CEPT contribution on Report ITU-R SM2351-2 - approved WGFM#91 - 14-18 May 2018 - https://cept.org/Documents/fm-54/41892/temp1_draft-revised-cept-contribution-for-report-sm-2351-2

[89] 3rd Generation Partnership Project (3GPP) is a collaborative project caters to a large majority of the telecommunications networks in the world. It is the standard body behind UMTS (Universal Mobile Telecommunications System), which is the 3G upgrade of GSM. The 3GPP technologies from these groups are constantly evolving through Generations of commercial cellular / mobile systems (see table below). Since the completion of the first LTE and the Evolved Packet Core specifications, 3GPP has become the focal point for mobile systems beyond 3G.

[90] Baimel, D, 2016, Smart Grid Communication Technologies, Journal of Power and Energy Engineering, 2016, 4, 1-8.

[91] For example, ESB noted that "*Smart Grid requires almost instantaneous communications with certain applications, extremely high availability of telecommunications channel, and coverage from designated base station as well as robust cybersecurity*". ComReg Document 17/105s.

[92] ETSI TR 103 401 Smart Grid Systems and Other Radio Systems suitable for Utility Operations, and their long-term spectrum requirements.

- Geographic Coverage (99.999%) – mobile networks provide population coverage in the high 90%, however, geographic coverage is typically lower and low density areas where renewable energy sources (such as wind farms) are typically located are not covered. The coverage of the commercial 3GPP networks is targeted to population centres and cannot in general be expected to serve isolated non-populated areas across which utility supplies must frequently be carried and controlled[93];

- Resilience – While mobile networks resilience levels are typically high, quality of service interruptions do occur as a result of extreme weather conditions. All mobile operators reported network failures to ComReg during Storm Emma and Ophelia, and mobile operators have made consumers aware of such issues. For example, Eir[94] and Vodafone[95] have all experienced service interruptions during extreme weather events. Smart Grid networks must be resilient to short term link breaks and power outages which is not normal on a commercial basis where base stations are not usually provided with multi-day battery backed up power facilities[96];

- Reliability – Reliability can generally be measured by the frequency and duration of outages, the number of disturbances due to poor power quality, and virtual elimination of widespread blackouts. While mobile networks have proven to be very reliable they do on occasion intermittently fail for a variety of network related reasons. For example, Eir[97], Three[98] and Vodafone[99] have all experienced network failures unrelated to extreme weather events. Further, the potential for interruptions to the network is recognised in the operator's licence conditions whereby licensees are subject to the minimum "Availability of the Network" Standard[100]; and

[93] CEPT updates to ITU - 'Smart grid utility management systems' Report, p21.
[94] https://www.rte.ie/news/business/2018/0302/944570-eir-reporting-service-interruptions-due-to-weather/
[95] http://www.thejournal.ie/vodafone-storm-1316479-Feb2014/
[96] CEPT updates to ITU - 'Smart grid utility management systems' Report, p21.
[97] https://www.rte.ie/news/2015/0902/725168-eircom-fault/
[98] http://www.thejournal.ie/mobile-phone-networks-are-having-problems-2032568-Apr2015/
[99] http://www.thejournal.ie/vodafone-network-down-4124400-Jul2018/
[100] The Licensee shall ensure that network unavailability is less than 35 minutes (based on the weighting factors set out License) per six month period.

- Latency – Latency requirements for Smart Grids vary but are at a maximum of 10 ms to maintain stability but can be as low as 1 ms in the control of electricity sub-stations[101]. As noted by Plum, existing mobile networks currently are unable to meet these requirements, with 4G networks having minimum latencies of around 30 ms.

3.55 Plum is therefore of the view that while certain aspects of the Smart Grid operation could be supported on mobile networks, there is strong rationale for a dedicated network because:

- Mobile networks may not be able to meet the availability and reliability requirements, in particular they may fail when the mains power fails, which is precisely the time when Smart Grid networks are most critically needed;
- Mobile networks may not have coverage in areas where Smart Grid elements such as remote sub-stations and wind farms are located, and the operators may have little incentive to provide this coverage;
- Despite new concepts such as network slicing, mobile networks may have insufficient capacity, or there may not be a clear business model to give the appropriate prioritisation to Smart Grid control messages; and
- The benefits of using commercial networks are smaller for Smart Grids than public safety[102] as there is little need for handsets which benefit substantially from commercial economies of scale.

3.56 These views are consistent with those of at least one Network Utility Operator (ESBN) who concluded that mobile networks may or may not deliver on the requirements and the costs in delivering same are likely to be an issue[103].

3.57 In light of the above, ComReg is of the preliminary view that:

a) there are no alternative unassigned frequencies that would allow the provision of Smart Grid in Ireland;

b) there are no alternative technology solutions that would allow the provision of Smart Grid in Ireland; and

[101] The JRC in the UK has indicated that for some of the critical applications, particularly with transformers, 0.25 the cycle time (that is, 5ms) might be typical.
[102] In the UK, emergency services have opted to move to mobile using EE's LTE network and US public safety organisations are following a similar approach – Document 18/92b Plum Report - Potential use of the 400 MHz band in Ireland.
[103] https://www.comreg.ie/publication-download/non-confidential-submissions-comreg-document-1767-proposed-release-410-415-5420-425-5-mhz-sub-band

c) the use of existing mobile networks would not be suitable in order to provide for the likely requirements of Smart Grid as described by Plum and CEPT.

3.58 ComReg is of the preliminary view that the primary policy issue to be considered in relation to the assignment of rights of use in the 400 MHz band is whether such rights of use should be assigned on a service neutral basis or on a service specific basis to Smart Grid use.

Objectives

3.59 This RIA assesses the impact of the proposed measure(s) (see regulatory options below) on stakeholders, including consumers, and on competition. This should enable ComReg to identify and implement the most appropriate and effective means to assign the new rights of use, while also achieving the following objectives:

- To assign new rights of use in the 400 MHz band on the basis of justified, objective, transparent, and non-discriminatory selection criteria; and
- To promote the interests of end-users and the economic development of the State and the electronic communications sector.

3.60 Further, ComReg aims to design and conduct the process for assigning new rights of use in the 400 MHz band in accordance with its statutory remit in managing spectrum which, in summary, is to encourage the efficient use and ensure the effective management of spectrum, to promote competition in the electronic communications sector, to contribute to the development of the internal market, and to promote the interests of users within the Community. Please see Annex 1 for a more detailed overview.

3.61 ComReg's goal, ultimately, is to choose the regulatory measure(s) which are most likely to maximise the benefits for consumers, in terms of the price, choice, and quality of products and services.

3.62 The remainder of this chapter contains the "**Assignment Process RIA**" – this addresses the primary policy issue and the statutory objectives outlined above.

Identify and describe the regulatory options (Step 2)

3.63 In light of the preceding discussion, and taking into consideration information provided in submissions in response to Document 17/67, ComReg considers that the following three regulatory options are available to it.

Option 1 – Assign all rights of use to the 400 MHz band on a service and technology neutral basis.

3.64 Under Option 1 the rights of use would be assigned on a service and technology neutral basis, allowing all bidders to compete for the same spectrum regardless of the intended use of those rights of use.

Option 2 – Limit all rights of use to the 400 MHz band for the provision of Smart Grid.

3.65 Under Option 2 all rights of use (2 × 5.5 MHz) to the 400 MHz band would be limited to the provision of Smart Grid as defined by Plum[104]. The only valid bidders would be those designated or licensed to operate a utility network (electricity, gas and water) in Ireland.

3.66 Bidders would require a licence issued by the Commission for Regulation of Utilities ("CRU") to distribute electricity, gas and/or water through a utility network. The current network licence holders are: ESB Networks (electricity distribution network operator and owner), EirGrid (electricity transmission network operator), and Gas Networks Ireland[105] (gas network owner and operator)[106].

3.67 In that regard, the definition of a "Network Utility Operator" that ComReg proposes to use for the purpose of this award is:

- **in the electricity sector-**
  A person that has been granted a licence by the Commission for Regulation of Utilities under section 14 of the Electricity Regulation Act 1999, as amended:
  - *to discharge the functions of the transmission system owner;*
  - *to discharge the functions of the transmission system operator;*
  - *to discharge the functions of Distribution System Owner;*
  - *to discharge the functions of the distribution system operator.*
- **In the gas sector-**
  The company or a subsidiary of the company, the functions of which are laid out in section 8 of the Gas Act 1976 and in section 11 of the Gas (Interim) (Regulation) Act 2002; and
- **In the water sector-**
  The private company limited by shares formed by virtue of section 4 of the Water Services Act 2013 as amended.

[104] See para 3.23 of this document.
[105] Gas Networks Ireland is a subsidiary of Ervia. Ervia is a commercial semi-state company with responsibility for the delivery of gas and water infrastructure and services in Ireland
[106] https://www.cru.ie/professional/energy/energy-networks/

3.68 Alternatively, Option 2 could proceed in the same manner as Option 1. If no applications are received then a full service and technology neutral award would be held for the entire 2 × 5.5 MHz, as would be the case under Option 1.

Option 3 – Limit some rights of use for the provision of Smart Grid and the remainder on a service and technology neutral basis.

3.69 Under Option 3, the available rights of use would be divided into two parts (Part A and Part B). Part A would be comprised of 2 × 3 MHz whose rights of use would be limited to Network Utility Operators as described in Option 2.

3.70 Part B would comprise the remaining 2 × 2.5 MHz whose rights of use would be available on a service and technology neutral basis as described under Option 1.

3.71 Alternatively, Option 3 could proceed in the same manner as Option 1. If no applications are received for Part A (2 × 3 MHz) then a full service and technology neutral award would be held for the full 2 × 5.5 MHz as would be the case under Option 1.

Identification of stakeholders

3.72 Step 3 assesses the likely impact of the proposed regulatory measures on stakeholders. Hence a necessary precursor is to identify such stakeholders who, in this RIA, fall into two main groups:

i. Consumers (Impact on consumers is considered separately below); and

ii. Industry stakeholders.

3.73 There are a number of key industry stakeholders in relation to the matters considered in this chapter. These are:

- Network Utility Operators (that is, in the Electricity, Gas and Water sectors);
- Mobile Network Operators (“MNOs”); and
- Other Service Operators (for example, providers of PMR, PPDR and TETRA/TEDS[107], Narrowband Internet of Things (“NB-IoT”) etc.).

Impact on stakeholders (Step 3)

3.74 It is recognised that, to the extent that a stakeholder has submitted a proposal in response to Document 17/67 they are likely to prefer the option that most closely reflects that proposal. Otherwise, stakeholders are likely to prefer an option which

[107] See Section 2 of the Plum Report - ComReg Document 18/92b.

would offer the greatest amount of contestable spectrum (so as to provide the greatest chance of obtaining spectrum rights).

Network Utility Operators

3.75 ComReg notes the views of ESBN that a minimum of 2 × 3 MHz is necessary to provide for the provision of Smart Grid. Utility Network Operators are likely to prefer Option 2 as this would provide the best opportunity for such operators to obtain 400 MHz rights of use for the provision of a Smart Grid. Smart Grids will require a minimum of 2 × 3 MHz, however, while there is currently no requirement for 2 × 5.5 MHz, applications such as video surveillance of key installations may be introduced in the future requiring access to the full spectrum available[108]. Option 2 would allow a Network Utility Operator to obtain access to additional rights of use to support such uses that may arise in the future.

3.76 While a Network Utility Operator would clearly prefer Option 2, it would likely prefer Option 3 to Option 1 to the extent that this option would still reserve a sufficient portion of spectrum (2 × 3 MHz) for Smart Grid. Under Option 2, a Network Utility Operator would not be precluded from bidding on rights of use in the remaining 2 × 2.5 MHz in order to support additional uses such as video surveillance as described above. This may be preferred by certain Network Utility Operators who wish to be assigned rights of use for the provision of Smart Grid (2 × 3 MHz) and other alternative uses such as Smart Metering.

3.77 Under Option 1 there is no certainty that such a provider would be assigned its preferred quantum of spectrum necessary for the provision of Smart Grid. Under Option 1, and in light of the findings of the Plum Report, there is a risk that Network Utility Operators could be denied an essential input to the provision of Smart Grid for which no alternative frequencies are available. Such operators would have to operate their networks using existing telemetry systems or over mobile networks, which, as previously noted, is not conducive to the effective operation of a Smart Grid and in particular Mission Critical activities.

MNOs

3.78 MNOs are likely to prefer Option 1 over Options 2 and 3 as all available spectrum is contestable and would not restrict potential bidders from competing for all available spectrum. While mobile services are unlikely to be provided as a result of the assignment of 400 MHz rights of use, MNO's nonetheless may be interested in those rights of use to complement existing rights of use currently providing NB-IoT

[108] ETSI note that ultimately, the need of real-time video, and other high speed data services, will only become clear as Smart Grids are rolled out (ETSI TR 103 401 V1.1.1 (2016-11) indicating that video is not a central requirement for Smart Grids at this time.

type services, noting that the Plum Report outlined that alternative uses of spectrum may be suitable for NB-IoT.

3.79 There are already multiple general-purpose IoT networks in Ireland including NB-IoT and Sigfox[109] as well as some LoRa deployments[110]. In that regard, MNOs have adopted new networks for specific uses such as Low Power Wide Area Networks ("LPWAN") specifically to support NB-IoT devices. Vodafone activated an NB-IoT network in August 2017[111]. Such technologies are also available for deployment in licence-exempt spectrum, meaning that end-users can deploy their own IoT network.

3.80 MNOs would likely prefer Option 3 over Option 2 as this provides an opportunity for the assignment of some 400 MHz rights of use. However, MNOs may also be indifferent between Options 2 and 3 given that LTE equipment for the 410 – 430 MHz will likely be FDD and use a minimum bandwidth of 3 MHz (that is, a total of 2 × 3 MHz)[112].

Other Operators

3.81 Other operators (PMR uses, PPDR and Smart Metering) would likely prefer Option 1 over Option 2 as all available spectrum is contestable and would not restrict certain potential bidders from competing for all available spectrum. However, such operators may also prefer Option 3 over Option 1 because 2 × 2.5 MHz is available on a service and technology neutral basis and other potential competing operators such as MNOs may be less likely to compete for that portion of the band given the lack of a 2 × 3 MHz block (while the minimum bandwidth for LTE is 1.4 MHz, there is little or no equipment available for that bandwidth in any of the LTE bands. As a result, the expectation is the minimum bandwidth will be 3 MHz)[113].

Impact on competition (Step 4)

3.82 Plum is of the view that it is very unlikely that MNOs would be interested in deploying a general-purpose network in the 400 MHz band. While the 400 MHz band is low in frequency and has good propagation characteristics suitable for coverage, there are no mobile handsets compatible with the 400 MHz band and coverage gains can only

[109] For example, VT have deployed a Sigfox network and claim this can be used for Smart Metering. VT is the exclusive operator of the SIGFOX network in Ireland.
[110] https://www.semtech.com/company/press/Semtech-LoRa-Technology-to-Enable-Irelands-Nationwide-IoT-Network
[111] http://www.vodafone.com/business/news-and-insights/press-release/vodafone-is-first-to-announce-nb-iot-launch-markets
[112] See Section 3.2.2 of the Plum Report – ComReg Document 18/92b.
[113] Plum Report – ComReg Document 18/92b, p19.

be realised if efficient antennas can be deployed on terminal devices[114]. Therefore, the assignment of 400 MHz rights does not impact the provision of existing and future mobile services. As a result, under all options, competition in downstream mobile markets would not likely be affected.

3.83 Under Option 1, there is a risk that rights of use could be assigned to bidders other than a Network Utility Operator. Under these circumstances, one of two scenarios is likely to arise:

a) The winning bidder would use the spectrum rights of use for uses other than Smart Grid thereby foreclosing spectrum rights of use for the provision of Smart Grid; or

b) The winning bidder would use the spectrum rights of use to provide Network Utility Operators with access to a communications network to enable them manage their Smart Grids.

3.84 In relation to (a), Network Utility Operator(s) would have no alternative frequencies or solutions suitable to satisfy the technical requirements as described above. Network Utility Operators would have to rely on other sub-optimal alternatives such as existing telemetry systems or mobile networks. Indeed, by foreclosing rights of use to Network Utility Operators for the provision of Smart Grid, MNOs may strategically or inadvertently compel Network Utility Operators to use mobile networks as a sub-optimal alternative in order to, at a minimum, improve on existing telemetry systems. As previously discussed, these alternatives would seem unlikely to provide for an effective Smart Grid solution and the benefits of same (increased efficiencies, reduced cost, reduced CO_2 emissions)[115] would not be realised to the same extent. In effect, under this scenario, Smart Grid as set out above could be significantly impaired with the existing grid unable to realise many of these benefits[116].

3.85 In relation to (b), a winning bidder may be able to offer access to a communications network to enable a Smart Grid using the 400 MHz band and potentially other rights of use (for example the 800 and 900 MHz bands). Alternatively, rights of use could be leased or traded to the Network Utility Operator to operate a communications network for the Smart Grid in its own right. However, this would likely lead to a negative impact on competition as rights of use to an essential input would be

[114] At 400MHz the optimal passive half-wave dipole antenna is around 35cm this is larger than most mobile handsets so if the band were used for mobile the reduced antenna size would likely nullify the propagation gains over frequencies such as 800MHz.
[115] See Impact on Consumers below.
[116] Xi Fang et al. 2012 Smart Grid – The new and Improved Power Grid: A Survey – IEEE Communications Surveys & Tutorials

invested in a single provider (only one block of 2 × 3 MHz is available) who would not be utilising the Smart Grid but rather providing network access or rights of use to a Network Utility Operator.

3.86 In effect, such an entity could become the sole provider of spectrum rights of use for the provision of access to a Smart Grid communications network. As noted by DotEcon, this would distort any auction, as there would effectively be competition to secure the position of sole provider and spectrum prices could be artificially inflated by competition for monopoly rents. DotEcon also notes that such an outcome would be contrary to the objective of ensuring an efficient assignment and use of the radio spectrum. Further, the provision of access to this communications network using the 400 MHz band rights of use would likely be at a rate above the cost incurred by that entity during the Award Process. By extension this would also be above the value expressed by the Network Utility Operators during the award process. In effect, a Network Utility Operator would likely have to pay a premium above the market clearing rate determined by the Award Process, potentially eroding any efficiency gains that may be accrued from the provision of a Smart Grid in the first instance.

3.87 For similar reasons, such an approach is also not recommended by ETSI in the provision of Smart Grid who notes that "*Ideally, the 400 MHz UHF/VHF spectrum for the Utility Operation Networks (UON) will be self-owned/self-managed so as to ensure that the required resilience, quality of service (QoS), etc., are maintained and, especially, the cost of operation is kept similar to existing costs. Some utility operations may consider allowing a third-party to supply the necessary communications so long as the spectrum remains under the control of the utility*."[117] [Emphasis added].

3.88 Alternatively, under Option 2, 2 × 5.5 MHz rights of use would be limited to Smart Grid use. Each Network Utility Operator would have the opportunity to be assigned rights of use for the provision of Smart Grid whose use could not be foreclosed and spectrum rights of use would not be a barrier to the provision of Smart Grid, compared to Option 1. However, under Option 2, 2 × 5.5 MHz would likely be assigned to a Network Utility Operator for Smart Grid when 2 × 3 may have been sufficient and the remaining 2 × 2.5 MHz would be assigned to Smart Grid as a result of the restriction rather than a requirement of same. While alternative spectrum is available for other uses (for example, PMR), an unreasonable restriction of an additional 2 × 2.5 MHz for Smart Grid could deny other uses additional spectrum that would likely improve competition in those markets.

[117] ETSI, 'Smart Grid Systems and Other Radio Systems suitable for Utility Operations, and their long-term spectrum requirements', ETSI TR 103 401 V1.1.1 (2016-11).

3.89 Under Option 3, 2 × 3 MHz rights of use would be limited to Smart Grid in line with the amount of spectrum necessary for the efficient operation of a Smart Grid. Each Network Utility Operator would have the opportunity to be assigned rights of use for the provision of Smart Grid whose use could not be foreclosed and spectrum rights of use would not be a barrier to the provision of Smart Grid compared to Option 1. Finally, under Option 3, as noted by DotEcon, any winning bidder of the 2 × 3 MHz portion could find it difficult to justify denying any remaining Network Utility Operators a reasonable and necessary request to access the Smart Grid and/or associated spectrum rights because the winning bidder would be subject to ex-post competition law obligations, noting that there are currently no alternative frequencies available for the provision of Smart Grid.

3.90 Therefore, ComReg is of the preliminary view that Option 3 provides for the best opportunity to promote competition for the following reasons:

- It would prevent foreclosure of an essential input for Smart Grids by providing Network Utility Operators with an opportunity to be assigned the amount of spectrum rights of use necessary to efficiently operate a Smart Grid;
- It would release all remaining spectrum rights of use (2 × 2.5 MHz) on a service and technology neutral basis allowing other uses access to additional spectrum notwithstanding the availability of suitable alternatives in other bands;
- The possibility of a subsequent ex-post competition complaint by an alternative Network Utility Operator against the winning bidder should provide a sufficient restraint on the winning bidder denying reasonable access.
- It would likely prevent any Network Utility Operator from leveraging its position as sole licensee of an essential input as the winning bidder would be subject to ex-post competition law obligations;
- It would avoid outcomes where spectrum goes unsold despite efficient demand existing for that spectrum (that is, the auction would be sequenced such that demand for Smart Grid would be assessed first); and
- The award would promote incentives for bidders not to engage in strategic or collusive behaviour.

3.91 Therefore, and for the reasons stated above, Option 3 would, in ComReg's view, better promote competition.

Impact on consumers (Step 5)

3.92 ComReg considers that consumers would prefer the regulatory option which does not impact its existing use of mobile services and has the greatest potential to promote efficient energy technologies while increasing consumer welfare, thereby maximising the long term benefits to consumers in terms of price and quality in the provision of mobile and non-mobile services. Consumers are also likely to prefer options which can avoid or reduce disruptions to the services they currently use.

3.93 As noted in the 'Impact on competition' section above, 400 MHz rights of use are not suitable for the provision of mobile services. Therefore, for all options there is no consumer impact in the provision of mobile services. As a result, consumers are likely to be concerned about the provision of services resulting from the use cases considered suitable in the Plum Report (that is, PMR, PPDR, Smart Metering and Smart Grid) and the related end-uses provided by those networks (for example, energy and other utilities). Further, the provision of 2 × 2.5 MHz on a service and technology neutral basis provides rights of use for other uses identified by Plum noting that such uses also have other alternative spectrum rights of use.

3.94 In relation to Option 1, consumers may be indifferent about the assignment of rights of use to a particular user given that the provision of mobile services are unlikely to be affected. However, under Option 1, and given the multiple likely uses of the band there is a possibility that the assignment of rights of use for the provision of one type of use could exclude the provision of other use types. In particular, the possibility for deployment of a Smart Grid network in Ireland would be entirely removed if more than 2 × 2.5 MHz were assigned to users for the provision of other services (such as PMR or NB-IoT). This situation would not arise for any other use type since, as noted by Plum, all other potential uses (that is, PMR, PPDR and Smart Metering) have alternative frequencies on which to operate or alternative solutions to provide for those services. Smart Grid is the only use case that does not have suitable alternative frequencies or solutions.

3.95 In that regard, it is worth considering what consumer benefits would arise from the provision of Smart Grid which could be denied under Option 1. ComReg assesses the benefits of a Smart Grid for the electricity network below noting that similar benefits are available for other utility providers. In that regard, consumer benefits from Smart Grid use can be broadly divided into three areas:

a) Reduced losses and inconvenience to consumers from power outages and power quality issues. For example, there was a total of 35,859[118] power outages occurred across the country in 2015[119];

[118] This excludes outages due to storms, outages that lasted less than 3 minutes and those caused by problems in the transmission system.
[119] Latest ESB Performance Report - 2015.

b) Downward pressure on energy prices (gas and electricity) through improved operating efficiencies arising from use of Smart Grid; and
c) Increased use of renewable energies and reduced carbon emissions.

3.96 In relation to (a), Smart Grid systems are designed to detect power quality issues and loss of power, enabling system operators to rapidly diagnose system problems, preventing outages from occurring and more rapidly restore service when they occur. For example:

- Demand response systems can reduce the stress on system assets during peak conditions, reducing their probability of failure[120] [121].
- Sensors and intelligent controls provide operators with increased awareness of the network allowing early detection of failing equipment[122] allowing predictive condition-based maintenance[123].
- Smart Grid can quickly isolate system problems and location of outages, reducing outage duration and restore itself after a blackout[124], thereby limiting the number of customers affected[125].

3.97 In relation to (b) 'operating efficiencies' from Smart Grids can occur in a number of ways including:

- Reduced use of inefficient generation to meet system peaks. Usually the most costly and inefficient generation occurs during peak periods[126]. Demand for electricity is not constant and the cost to meet these different demands varies. This requires a buffer of excess power in the existing grid. This causes higher emissions, higher costs and lower efficiency[127], ultimately impacting on consumers.
- Improved efficiency removes or reduces the need for capacity expansion or upgrades and the associated costs of same[128].
- Reduced transmission congestion costs[129] through the use of Smart Grid technologies can translate into significant savings.

[120] Momoh, J, 2012, Smart Grid Fundamentals of Design and analysis, p23.
[121] US Department of Energy, Understanding the Benefits of the Smart Grid, 2010.
[122] US Department of Energy, Understanding the Benefits of the Smart Grid, 2010.
[123] Bangalore, P & Tjernberg, L (2016) Condition Monitoring and Asset Management in the Smart Grid.
[124] Xiao, Y, Communications and Networking in a Smart Grid, p5.
[125] Borlase, S, 2017, Smart Grids: Infrastructure, Technology, and Solutions, p406.
[126] Smart Grid Handbook, 3 Volume Set, Volume 1, p16.
[127] Ramana, V & Manoj, S, 2017, Smart Grid an optimal solution to economic and environmental benefits. International Journal of Electrical Electronics & Computer Science Engineering Volume 4, Issue 4 (August, 2017).
[128] Smart Grid Handbook, 3 Volume Set, Volume 1, p16.
[129] Transmission congestion costs arise from the fact that, when transmission lines represent a bottleneck, it is not possible to generate electricity from the cheapest sources.

3.98 In relation to (c), Consumers are also likely to prefer options that promote increased use of renewable energy, particularly where such options do not require actions by consumers themselves[130]. For example, 7 in 10 residential electricity customers believe it important that energy is produced from renewable resources[131] [132]. Further, 88% of Irish consumers agree that fighting climate change and using energy more efficiently can boost the economy and jobs[133].

3.99 In that regard, Smart Grid systems are needed in order to intelligently manage renewable energy such as solar and wind. Intelligence in sub-stations will enable control and data acquisition systems to more effectively manage power supply and demand in grid segments that contain renewable energy sources. Smart Grid technologies enable high levels of renewables mainly by increasing grid flexibility and facilitating the increased use of variable renewable generation technologies. Further, in the medium to long term, the provision of Smart Grid systems provides the opportunity for certain consumers to sell consumer-produced renewables back to the grid.

3.100 Operating efficiencies and a more intelligent grid network leads to a more reliable grid reducing power outages and keeping a downward pressure on electricity prices. Further, these benefits are obtained while also increasing access to renewable energies and reducing carbon emissions. Consumers are therefore likely to prefer the assignment of radio spectrum that promotes such efficiencies.

3.101 In light of the above, ComReg is of the preliminary view that consumers are unlikely to prefer Option 1 as the benefits of Smart Grid outlined above may not arise. Option 2 would likely be preferred to Option 1 as this provides Network Utility Operators with the opportunity to obtain spectrum rights of use in the provision of a Smart Grid. However, the assignment of 2 × 5.5 MHz would likely be in excess of the spectrum requirements of Smart Grid and the remaining 2 × 2.5 MHz may be better served for other alternative uses as outlined in the Plum Report. In that regard, Option 3 best provides for the provision of the Smart Grid while also ensuring other uses are also provided with 400 MHz rights of use where required.

3.102 Therefore, ComReg is of the preliminary view that consumers are likely to prefer Option 3.

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[130] In that regard, it is ComReg's understanding that much of the benefits of a Smart Grid relate to the transmission network and can be obtained absent consumer action on Smart Meters.
[131] CRU Annual Survey of Residential and SME Customers in the Gas and Electricity Markets in Ireland, December 2017.
[132] In particular, this would appear to arise that Smart Grid can deliver certain benefits absent full engagement of smart meters. Much of the gains from Smart Grid in terms increased access to renewable energies are independent from Smart Meters which certain consumers remain unconvinced.
[133] Special Eurobarometer 459, Climate Change, September 2017.

Preferred Option (Step 5)

3.103 The above assessment considers the likely impact of all valid regulatory options from the perspective of industry stakeholders and considering the likely impacts of all options on competition and consumers. In summary, ComReg considers that MNOs and to a lesser extent other potential users would likely prefer Option 1 in which all rights of use are assigned on a service and technology neutral basis. Alternatively, Network Utility Operators could prefer Option 2. However, ComReg considers that while these Options might be in the best interests of particular stakeholders, neither is likely to be in the best interests of competition and consumers.

3.104 Option 3, in this case, appears to be the best means to promote competition for spectrum usage rights and, in turn, promote competition in the related markets. Further, consumers are likely to prefer Option 3 as it provides a range of benefits across different potential uses of the radio spectrum. This approach allows an essential input in the provision of Smart Grid to be provided for where there are no alternative frequencies available to Network Utility Operators. DotEcon also recommend that it is likely to be efficient for at least part of the band (2 × 3 MHz) to be used for Smart Grid given that there is no alternative spectrum available to support such a use. Therefore, for the reasons set out in this draft RIA, ComReg is of the preliminary view that Option 3, to limit some rights of use for the provision of Smart Grid and award the remainder on a service and technology neutral basis, is its preferred option. [134]

3.105 In forming this view, ComReg is aware that a key principle to the management of radio frequencies under the Regulatory Framework is service and technology-neutrality.[135] This principle is reflected in ComReg's obligations under the Framework Regulations[136], the RSPP Decision[137] and the 2002 Act, as amended[138]. Despite this overarching principle, restrictions may be imposed on the types of services and/or technologies that may be provided or deployed in a specific band though any such restrictions must be justified, proportionate, transparent, and non-discriminatory in order to fulfil certain relevant objectives including to safeguard the efficient use of spectrum[139] and when general interest objectives are at stake.[140]

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[134] ComReg is also of the preliminary view that the new rights of use should be assigned by auction. Chapter 4 considers different auction formats and identifies a "simple clock auction" (SCA) as preferable in the assignment of all rights of use.
[135] Recitals 32 and 34 of the 2009 Amending Directive.
[136] Regulations 16(1)(a), 17(2) and 17(4) of the Framework Regulations.
[137] Articles 2(1)(e), 2(2)(a), 3(f) and 6(3) of the RSPP Decision.
[138] Section 12(6) of 2002 Act, as amended.
[139] Regulation 17(5) of Framework Regulations; Articles 2(1)(e) of the RSPP Decision; Recital 38 of the 2009 Amending Directive; and Recitals 34 and 35 of the 2009 Amending Directive.
[140] Recital 34 of the 2009 Amending Directive.

3.106 ComReg considers its 'Preferred Option' is justified and proportionate for the reasons set out in the RIA above, and in summary include:

- There is likely a key requirement for Smart Grid as evidenced by the various national and international policy targets to reduce carbon emissions and make the energy system more secure and sustainable, all of which include the provision of Smart Grids (see paras 3.26 – 3.38);

- Suitable and sufficient alternative spectrum rights of use are not readily available in other bands. In that regard, ComReg notes that:

    - There are no alternative radio frequencies available for the use of Smart Grid. The 450 – 470 MHz band is the only other sub 1 GHz spectrum that is suitable for the provision of Smart Grid and is currently assigned for PMR (Business Radio) and is therefore unavailable (see paras 3.11 - 3.20);

    - Alternative technical solutions such as existing telemetry systems and mobile networks are not effective or sufficient for the provision of Smart Grid and do not cater for the technical requirements of a Smart Grid as determined by Plum and CEPT (see paras 3.39 – 3.58);

    - ComReg's expert advisors Plum are of the view that there is no other suitable spectrum available in the medium term to meet the critical communications needs of Smart Grids compared with the situation for the other identified uses; and

    - The likely technologies that have been considered by Plum are likely to be varied for the different use cases (PMR, NB-IoT, LTE and TETRA) warranting a technology neutral approach.

- A service and technology neutral award could result in the assignment of rights of use to other uses foreclosing spectrum rights of use for the provision of Smart Grid;

- It would better ensure the efficient use of the radio spectrum by preventing speculative acquisition of 400 MHz rights of use in order to deny a Network Utility Operators those rights of use;

- The proposed restriction would only relate to the spectrum rights of use necessary to efficiently operate a Smart Grid (that is, 2 × 3 MHz). The remaining 2 × 2.5 MHz would be made available on a service and technology neutral basis (see paras 3.44 – 3.46 and 3.63 – 3.71);

- The proposed restriction is being applied such that if there are no applications for the 2 × 3 MHz portion from applicable Network Utility Operators, the full 2 × 5.5 MHz would be released on a service and technology neutral basis (see paras 3.63 – 3.71);
- ComReg has taken account of issues raised by responses by commissioning Plum to assess potential uses of the 400 MHz and the availability of alternative frequencies for same;
- The views of DotEcon that this band is the only opportunity in the foreseeable future to establish a wireless Smart Grid network in Ireland; and
- There does not appear to be any less onerous means to address the likely requirement for spectrum rights of use in the provision of Smart Grid and to address the risk that those rights of use may not be assigned to a Network Utility Operator in a service and technology neutral award.

3.3 Assessment of preferred option against ComReg's statutory functions, objectives and duties

3.107 This draft RIA identifies and considers a number of options potentially available to ComReg, within the context of the RIA analytical framework as set out in ComReg's RIA Guidelines (that is, impact on industry stakeholders, the impact on competition and the impact on consumers). This draft RIA also analyses the extent to which those various options would facilitate ComReg to meet its statutory remit in managing the 400 MHz band. This includes, in particular, analysing the extent to which the various options would promote competition and ensure that there is no distortion or restriction of competition in the electronic communications sector, whilst also encouraging efficient investment in infrastructure, promoting innovation, and ensuring the efficient use and effective management of the 400 MHz band.

3.108 In this section, ComReg assesses the Preferred Option against the statutory provisions relating to spectrum management (see Annex 1). Those provisions are not exhaustively set out herein. In summary, ComReg's statutory function is to manage the national radio spectrum resource and its objectives, in doing so, are to promote competition, to contribute to the development of the internal market, to promote the interests of users within the Community, and to ensure the efficient use and effective management of spectrum. ComReg is also required to take measures towards the achievement of its objectives but must also have regard to certain regulatory principles. Specifically, its measures must be justified, transparent, non-discriminatory, and proportionate.

Promotion of Competition

3.109 One of ComReg's statutory objectives, set out in section 12 of the 2002 Act, as amended, is to promote 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; and
- ensuring that elderly users and users with special social needs derive maximum benefit in terms of choice, price and quality.

3.110 Other statutory provisions also require ComReg to promote and safeguard competition in the electronic communications sector:

- Regulation 16(2) of the Framework Regulations 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;
- Regulation 9(11) of the Authorisation Regulations requires ComReg to ensure that competition is not distorted by any transfer or accumulation of rights of use for radio frequencies; and
- Article 4 of Directive 2002/77/EC (Competition Directive) requires ComReg to refrain from granting exclusive or special rights of use of radio frequencies for the provision of electronic communications services;

3.111 ComReg remains of the preliminary view that the Preferred Option would best safeguard and promote competition. In particular, it should maximise competition by preventing the foreclosure of an essential input to the provision of Smart Grid (that is, 400 MHz rights of use). In identifying the Preferred Option, ComReg applied objective, transparent, non-discriminatory and proportionate criteria and principles.

3.112 ComReg also considers that the alternative options would not achieve its objectives concerning competition to the same extent as the Preferred Option. In particular, Option 1 could lead to the foreclosure of an essential input to the provision of Smart Grid and Option 2 goes beyond what is necessary to prevent the said foreclosure.

Contributing to the development of the Internal Market

3.113 ComReg considers the following factors to be particularly relevant to its statutory objective to contribute to the development of the Internal Market, in the context of this award process:

- The Preferred Option should best support the establishment and development of trans-European networks and the interoperability of pan-European services, in particular by facilitating, or at the very least by not distorting or restricting, entry into the Irish mobile market by undertakings from other EU Member States; and
- In selecting the Preferred Option, and in order to ensure the development of consistent regulatory practice and the consistent application of EU law, ComReg has had due regard to the views of the European Commission, BEREC and other EU Member States.

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

3.114 ComReg notes the overlap between this objective and the objective to promote competition. Encouraging the establishment and development of trans-European networks requires that operators from other Member States, who seek to develop such networks, are given a fair and reasonable opportunity to obtain and/or use all requisite spectrum. ComReg considers that any regulatory measure which failed to encourage (or which actively discourages) the establishment and development of trans-European networks, would not meet the objective at issue.

3.115 ComReg, in this regard, considers that limiting rights of use to part of the 400 MHz band for Smart Grid best encourages the establishment and development of trans-European networks. The European Commission's Trans-European Networks for Energy TEN-E Regulation has identified Smart Grid deployment as one of 12 trans-European energy infrastructure priority corridors and areas. Smart Grids feature on the Commission's list of projects of common interest (PCIs). PCIs are key energy infrastructure projects seen as essential to completing the EU's internal energy market.

3.116 The Integrated Single Electricity Market (I-SEM) is a new wholesale electricity market arrangement for Ireland and Northern Ireland. The new market arrangements are designed to integrate the all-island electricity market with European electricity markets, enabling the free flow of energy across borders. The market is run by the Single Electricity Market Operator (SEMO), a joint venture

between EirGrid (electricity transmission operator)[141] and the System Operator for Northern Ireland (SONI). The new market arrangements are designed to integrate the all-island electricity market with European electricity markets, making optimal use of cross-border transmission assets.[142]

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

3.117 ComReg continues to cooperate with other National Regulatory Authorities ("NRAs") and to closely monitor developments in other Member States, to ensure that its regulatory practice and implementation of the Common Regulatory Framework is generally consistent with comparable jurisdictions.

3.118 For example, ComReg has had regard to international developments in the use of the radio spectrum for the provision of Smart Grid, including the policy goals of the European Commission and technical standards as described by CEPT, ETSI and the ITU.

3.119 ComReg will continue to note relevant international developments during this consultation including future updates to ITU-R SM.2351-2 and ETSI TR 103 492 as identified in the ITU and ETSI respective work plans.

Promote the interest of the users within the Community

3.120 The likely impact of the Preferred Option and of the other identified option on users, generally and in the context of ComReg's objective to promote competition, has been considered earlier in this draft RIA and is not considered in any further detail in this section.

3.121 ComReg also observes that most of the measures set out in section 12(2) (c) of the 2002 Act, as amended, aimed at promoting the interests of users, relate to consumer protection more than to spectrum management. In that regard, ComReg has identified the likely consumer benefits arising from the Preferred Option.

Efficient use and effective management of spectrum

3.122 Section 10 of the 2002 Act, as amended, requires ComReg to manage spectrum in accordance with any Ministerial Policy Direction No. 11 of 21 February 2003, issued under section 13 of the 2002 Act, as amended. Policy Direction No.11 requires ComReg to ensure that, in managing spectrum, it takes account of the interests of all users of spectrum, including commercial and non-commercial users.

[141] EirGrid Group is the independent Transmission System Operator (TSO) in Ireland and Northern Ireland, through EirGrid and SONI, respectively.
[142] EirGrid - Quick Guide to the Integrated Single Electricity Market.

Also, in pursuing its objective to promote competition ComReg must take all reasonable measures to encourage efficient use and ensure effective management of spectrum.

3.123 Further, section 12(3) of the 2002 Act, as amended, also requires that all measures by ComReg, including any measure related to managing spectrum, be proportionate, and regulation 9(11) of the Authorisation Regulations requires ComReg to ensure that spectrum is used efficiently and effectively having regard to section 12(2)(a) of the 2002 Act, as amended, and regulations 16(1) and 17(1) of the Framework Regulations.

3.124 In relation to Policy Direction No.11, this draft RIA seeks to take into account the interests of all current and potential users of the 400 MHz band, commercial and non-commercial. ComReg commissioned Plum to review all potential uses of the band in order to best inform ComReg's decision making on same. ComReg is of the view that the Preferred Option would best safeguard and promote those interests. Further, ComReg's expert economic advisors DotEcon also note that it is likely to be efficient for at least part of the band to be used for Smart Grid and that an outcome which prevented this could be contrary to ComReg's objectives to ensure the efficient assignment and use of the radio spectrum.

3.125 Based on this draft RIA, ComReg is of the preliminary view that the Preferred Option would best encourage the efficient use of the 400 MHz band and, in particular, the portion of the 400 MHz band in which new rights of use would be assigned. There is likely to be a continued reliance on a portion of the 400 MHz band for Smart Grid into the future. If demand does not arise, a full service and technology neutral award would be conducted. Assignment of new 400 MHz rights of use for Smart Grid should provide certainty that a portion of the 400 MHz band would be available for Smart Grid use for at least 15 years, at which point demand for the band and its potential uses can be considered afresh.

3.126 The Preferred Option also promotes effective management of the radio spectrum because there are no alternative frequencies available to provide for a Smart Grid.

3.127 ComReg therefore remains of the preliminary view that the Preferred Option best accords with its statutory objectives in managing the 400 MHz band and that by pursuing any of the alternative options, ComReg would likely fail to meet some or all of its relevant statutory objectives.

Regulatory principles

3.128 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, as amended,

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;
- 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 ensuring that competition in the market and the principles 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

3.129 ComReg generally has regard to the requirement for predictability in managing spectrum though this requirement must always be weighed against all relevant factors, some of which may necessitate measures which are less predictable or which are not predictable. ComReg has had regard to the requirement for predictability in its consideration of how best to reassign the 400 MHz band, as illustrated below.

3.130 ComReg considers that regulatory predictability in relation to spectrum is best promoted by having an open, transparent, and non-discriminatory process for assigning new spectrum rights of use. In that regard, where ComReg is of the view that rights of use should be limited to a certain service or technology such restrictions must be justified, proportionate, transparent, and non-discriminatory in order to fulfil certain relevant objectives. ComReg sets out in detail the reasons for limiting rights of use to a particular service for 400 MHz rights of use in the draft RIA. This approach is similar to that taken in the recent 26 GHz Spectrum Award in the 2018 where a service restriction also applied and detailed justification for that restriction was provided[143].

3.131 ComReg notes that the Preferred Option would ensure that the future assignment of rights of use in the 400 MHz band at issue would be known as soon as is possible. This should result in utmost transparency and predictability, in terms of interested parties being aware of the availability of 400 MHz rights of use in the future.

[143] ComReg Document 18/53 – Results of the 26 GHz Spectrum Award 2018 – Published 19 June 2018.

ComReg, in Section 4.9 of this document, has also set out its views that any unsold lots would not be assigned for a reasonable period after the award process has ended.

3.132 ComReg remains of the preliminary view that the alternative options, would be unlikely to promote regulatory predictability as important use cases in the future that are clearly established (for example, Smart Grid in 400 MHz and National Fixed Links in 26 GHz) and have no viable alternative frequencies may be foreclosed.

3.133 In addition, ComReg remains of the preliminary view that the Preferred Option:

- should no demand from Network Utility Operators for spectrum rights of use for the provision of Smart Grid arise, all remaining rights of use should be made available on a service and technology neutral basis;
- has been justified based on the available evidence and views of Plum, CEPT, ETSI and the ITU; and
- remain technology neutral in line with the Plum report which identified a number of technologies that could be used to deliver a variety of use cases.

3.134 In light of the above, ComReg remains of the preliminary view that the Preferred Option, an auction, should best accord with the regulatory principle of promoting regulatory predictability.

Promoting efficient investment and innovation in New and Enhanced Infrastructures

3.135 ComReg remains of the preliminary view that the Preferred Option is consistent with this regulatory principle in that it should:

- facilitate a competitive release of a portion of the 400 MHz band for Smart Grid at the earliest possible opportunity, thus ensuring that the winners of the new 400 MHz rights of use are appropriately incentivised to invest in new technologies and infrastructures;
- provide clarity as to whether demand for spectrum rights of use in the provision of Smart Grid exists in practice, and allows other services access to other spectrum rights of use (2 × 2.5 MHz) or additional rights of use (2 × 5.5 MHz) if demand for spectrum does not exist; and
- allows Network Utility Operators access to spectrum rights of use that are necessary in order to efficiently role out a Smart Grid, noting that investment in alternative solutions would lead to less efficient and less innovative outcomes.

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

3.136 ComReg is required to be objective, transparent, non-discriminatory, and proportionate in the exercise of its statutory functions under the Common Regulatory Framework.

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

- Regulation 11(2) of the Authorisation Regulations requires ComReg to grants rights of use for radio frequencies on the basis of selection criteria which are objective, transparent, non-discriminatory and proportionate; and
- Regulation 16(2) of the Framework Regulations requires ComReg 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.

3.138 ComReg at all times seeks to take account of and act in accordance with the above guiding principles of Irish and EU law.

3.139 ComReg, having had regard to the applicable statutory provisions, its draft RIA and other analyses, the advice of its external consultants, and all other relevant material, remains of the preliminary view that the Preferred Option would be an objectively justified, transparent, proportionate and non-discriminatory regulatory measure by which to assign new rights of use in the 400 MHz band for 15 – 20 years duration and for the purposes of deploying Smart Grid and/or other uses as determined by winning bidders.

Chapter 4

4 Award Mechanism and Fee Structure

4.1 Introduction

4.1 ComReg's 'Preferred Option' set out in the draft RIA is to limit some rights of use for the provision of Smart Grid and to assign the remaining rights of use on a service and technology neutral basis. The available rights of use would be divided into two parts (**Part A** and **Part B**).

- Part A would comprise 2 × 3 MHz whose rights of use would be limited to Network Utility Operators as described in Option 2 of the draft RIA.
- Part B would comprise the remaining 2 × 2.5 MHz whose rights of use would be available on a service and technology neutral basis as described under Option 1 of the draft RIA.

4.2 Alternatively, if no applications are received for Part A (2 × 3 MHz) then a full service and technology neutral award will be held for the full 2 × 5.5 MHz.

4.3 This chapter describes the award type and design necessary to facilitate the Preferred Option. In that regard, this chapter is structured into the following sections:

- Auction or Administrative award;
- Sequencing of Part A and Part B of the award process;
- The Preferred Auction format;
- Packaging of available spectrum;
- Frequency Specific vs Frequency Generic Lots;
- Competition caps;
- Unsold lots; and
- Fees.

4.4 ComReg assesses each section in order below.

4.2 Auction or Administrative Award

4.5 ComReg considers that the decision to decide on an appropriate award process (that is, auction or administrative assignment) warrants an assessment on a case-by-case basis, having regard to the particular features of the spectrum band(s) at issue and the market circumstances. ComReg has previously expressed its views in detail on the assignment of spectrum by auction or administrative award, including most recently in Document 18/12 and Document 15/140[144].

4.6 In summary, ComReg notes that it must determine at least four award outcomes through an award process, noting that these apply irrespective of the assignment format adopted, be that an auction or some form of administrative process. Depending on the spectrum awarded these award outcomes broadly concern the following:

1. Which electronic communications network/services and, of those, using which technologies are going to be the ones most likely to provide the greatest end benefits?
2. Which of the interested providers (and using potentially different technologies) identified in (1) are the ones most likely to provide the greatest end benefits?
3. What quantum of spectrum rights of use should be assigned to each particular user?
4. Which part of the band should those spectrum rights of use be located?

4.7 In relation, to 1, 3 and 4, ComReg has set out in detail its reasons for limiting rights of use for Smart Grid, and the quantity of spectrum that would be appropriate in providing for same. Further, as set out in the DotEcon report, it is not clear if there are any material value differences between different locations in the band (although ComReg will provide a competitive Assignment Stage if material differences between locations becomes evident).

4.8 However, it remains unclear which of the Network Utility Providers and which technologies are best placed to provide for the provision of Smart Grid, if any. Therefore, in relation to Part A, an auction format is necessary to determine the most appropriate users and the associated technologies that should be used to provide for the Smart Grid. As noted by DotEcon, while Smart Grid represents the best use of the spectrum, the value of this spectrum is uncertain, and there could be multiple parties interested in operating such a network. In the event of excess

[144] ComReg (2015) 'Response to Consultation and Draft Decision on Proposed 3.6 GHz Band Spectrum Award' (page 32).

demand, leaving it to the regulator to determine the most efficient use could result in an inefficient outcome. In that regard, it is preferable to allow market mechanisms to establish the optimal outcome for Part A.

4.9 In relation to Part B, Plum outlined a number of different potential users and technologies that each require a variety of different amounts of spectrum. ComReg has relatively little information about which of these uses and technologies would generate the greatest social/economic value or how much spectrum would be required for particular users. As noted by DotEcon, there is a high level of uncertainty about the value of the spectrum and also the potential uses. This makes it difficult for ComReg to run an administrative process with any likelihood that it would yield the most efficient outcome that ensures the most efficient use. In that regard, it is preferable to allow market mechanisms to establish the optimal outcome for Part B.

4.10 In light of the above, and the views of DotEcon ComReg is of the preliminary view that an auction is necessary to determine the assignment of Part A and Part B.

4.3 Sequencing of award process

4.11 In relation to the sequencing of Part A and Part B there are two broad options available to ComReg.

(i). Assign all rights of use in a single auction where only qualified bidders (that is, Network Utility Operators) bid for Part A (2 × 3 MHz) and all bidders can bid for Part B (2 × 2.5 MHz).

(ii). Assign rights of use using two sequential auctions. The first auction would allow only qualified bidders (that is, Network Utility Operator) bid for Part A (2 × 3 MHz). The second auction would allow all bidders to bid for either the remaining 2 × 2.5 MHz, or 2 × 5.5 should Part A go unsold.

4.12 In relation to (i), DotEcon note that if all of the spectrum were to be included in a single auction process that allowed for package bidding, there is a risk that a Network Utility Operator could use the reservation to leverage an unfair advantage over winning additional spectrum. For example, a Network Utility Operator could bid only for packages containing both the Part A lot and additional spectrum in Part B, without placing a bid for the Part A lot on its own. In order for an alternative bidder to be assigned rights of use for Part B, it would have to pay a price for a Part B lot that is higher than the Network Utility Operator would pay for that spectrum and the Part A lot.

4.13 For example, suppose only two Bidders (Bidder A and Bidder B) partake in the award. Bidder A is eligible for Part A and Part B, and Bidder B is eligible to bid for only Part B. Bidder B values the Part B spectrum at €200,000. However, if Bidder A placed only one package bid of €440,000 for 2 × 5.5 MHz (even though it has a value for winning just the Part A lot without any additional spectrum) then Bidder B would be required to Bid above €440,000 in order to be assigned the 2 × 2.5 MHz in Part B. In effect this requires Bidder B to bid significantly higher than its value for the Part B spectrum to stand any chance of winning it. If Bidder A had submitted a second bid for Part A alone, then Bidder B would only need to Bid marginally above the difference between Bidder A's bid for all of the spectrum and its bid for Part A.

4.14 In relation to (ii), a Network Utility Operator for Part A has to first bid for that spectrum before competing for Part B. However, that same bidder would be unable to leverage an unfair advantage over winning additional spectrum because it is competing for the additional spectrum on the same basis as other bidders and cannot have Part A and Part B in one package.

4.15 Note this should not raise any concerns that a bidder for Part A would be exposed to not winning a sufficient amount of spectrum if it was not successful in winning additional lots in Part B (that is, more than 2 × 3 MHz). Part A is available for Smart Grid only and as described previously 2 × 3 MHz should be sufficient to provide for same. There is currently no requirement from Smart Grid for more than 2 × 3 MHz and although there may be some use cases in the future such as video surveillance, it is not clear that the 400 MHz band would be needed to provide for that use. In that regard, DotEcon are of the view that there may be some benefits in running two sequential auctions to award the spectrum.

4.16 For the reasons set out above, ComReg is of the preliminary view that the award process should consist of two sequential auctions.

4.4 Preferred Auction format

4.17 The DotEcon Report identified and examined a number of suitable auction formats for awarding rights of use in the 400 MHz band. These auction formats include:

- Simultaneous Multiple-Round Ascending (SMRA) auction;
- Simple Clock Auction (SCA);
- Combinatorial Clock Auction (CCA);
- Sealed Bid Combinatorial Auction (SBCA); and

- Combinatorial Multi-Round Auction (CMRA).

4.18 It is not proposed to fully repeat DotEcon's discussion and analysis of these formats. Stakeholders are encouraged to review the mechanics of each auction format as set out in the DotEcon report which accompanies this consultation[145].

4.19 In order to assess which design and format is best suited to this award process, it is necessary to assess whether any risks are likely to arise, and determine which format and/or design considerations best mitigates those risks while ensuring spectrum is awarded to those users who value it the most. The DotEcon Report outlines a number of issues or risks that are relevant for this proposed award process. These are:

- Aggregation risks;
- Common value uncertainty
- Inefficiently unsold lots;
- Fragmentation risks (See section 4.7 below); and
- Complexity.

4.20 These risks are assessed in turn below with fragmentation risks discussed as part of Section 4.7 (Frequency Generic vs Frequency Specific).

4.4.1 Aggregation Risks

4.21 Aggregation risk refers to the risk that bidders with a minimum spectrum requirement may be exposed to winning an unwanted subset of its demand, such as winning some lots, but fewer than the minimum number of lots it requires in a band. This is particularly serious where rights of use above a certain minimum are necessary in order to be of value to that user.

4.22 In relation to Part A, there is a clear requirement for 2 × 3 MHz in the provision of Smart Grid. Any Network Utility Operator interested in the provision of Smart Grid should not require greater amounts in order to provide for that use. Therefore, DotEcon advises that there are no aggregation risks associated with Part A of the Award.

4.23 In order to provide maximum flexibility for potential users to acquire blocks of spectrum tailored to their needs, it is proposed that spectrum rights of use should

[145] ComReg Document 18/92a DotEcon Limited - Award of licences for the use of radio frequencies in the 400 MHz band – Published alongside this Document.

be offered as 2 × 100 kHz lots (see Section 4.6 below). In that regard, DotEcon are of the view that aggregation risks would be likely to arise for Part B as the proposed lot size is small in relation to the potential minimum requirements that may be required by certain bidders.

4.24 Therefore, some bidders are likely to want to aggregate multiple contiguous blocks in order to have sufficient spectrum rights of use to provide a given service. For example, if a bidder has a minimum requirement for 1 MHz then rights of use for any amount of spectrum up to 1 MHz are of little use. If such a bidder was a winning bidder for 2 × 500 kHz but was outbid for additional spectrum the bidder would be stranded with unwanted lots below its minimum requirement and unable to provide its preferred service. Further, because all bids are binding, this bidder would be required to pay associated spectrum fees (upfront fees) for rights of use it has no value for. Unless protective measures are put in place, aggregation risk is therefore likely to be important and DotEcon is of the view that addressing aggregation risks is an important consideration for the proposed award process.

Award formats and aggregation risk

4.25 In a SMRA bidders bidding on a combination of lots may be exposed to the risk of being the standing high bidder for some, but not all, of the lots on which they wished to win and paying a total price in excess of their valuation for the lots won. This does not create an issue for Part A as this part only has one 2 × 3 MHz lot. However, DotEcon advises that this is likely to be problematic for Part B where there is a potential range of uses with varying minimum requirements. The use of a SMRA would expose bidders to the risk of winning only a subset of lots risking an inefficient outcome as that bidder may have no use for that subset, and an alternative losing bidder may have been willing to use that spectrum albeit at a lower price.

4.26 DotEcon concludes that while these problems could be somewhat ameliorated by providing rules for limited withdrawals of standing high bids, they cannot be eliminated and create significant additional complexity in the award process. Further, increasing the lot size to reduce the risk from arising is not a good solution given that 2 × 100 kHz is the likely minimum block size and some users may have a requirement of up to 2 × 5 MHz. Therefore, the SMRA is not likely to be a viable auction format for this award as no guarantees can be provided that the minimum amount of spectrum required by a bidder would be achieved, as a bidder might eventually win fewer lots than is required to meet its own minimum objective.

4.27 In that regard, DotEcon recommends the use of an auction format that involves package bidding, so that bidders do not face aggregation risks arising from the possibility of winning some, but not all, of their target lots. In that regard, the issue of aggregation risk does not arise in combinatorial auctions such as the SBCA, SCA,

CCA or CMRA as bidders can only ever win packages they bid on in their entirety, or nothing at all. A combinatorial format allows bidders to make mutually exclusive package bids for spectrum and bidders can express valuations for various combinations of lots.

4.28 Therefore in light of the above, ComReg is of the preliminary view that a SMRA is unlikely to be suitable for this award process.

4.4.2 Common value uncertainty

4.29 Common value uncertainty occurs when there is a value to the rights of use being made available that is common across bidders, but there is a degree of uncertainty over what the amount of that value is. Common value uncertainty is particularly relevant where bidders face common risks. The factors determining a bidders value for the lots on offer is similar for different bidders because it is driven by common factors such as likely demand for new services, equipment availability and/or network costs from deploying new technologies. However, these common factors are subject to uncertainty as bidders need to form expectations about the way in which these factors will develop. This uncertainty leaves bidders exposed to the risk of either bidding significantly above or below their true value of the spectrum, which could risk an inefficient outcome and/or the winning bidder overpaying for the spectrum.

4.30 Where there is common value uncertainty, bidders may want to update their own valuation in light of information received about the valuations of other bidders. For example, if a bidder has an incorrect or overly optimistic expectation about what a lot is worth, proceeding on its own expectations alone, such a bidder runs the risk of being assigned rights of use that it may not be able to earn a return on. This bidders estimates of the value of spectrum did not incorporate all available information (some unknown) as other bidders could have held some information that could have been relevant to its bid. The valuations of other bidders could contain useful information that might be relevant to a bidder's own valuation. For example, a bidder might reduce its own valuation if it sees other bidders dropping out sooner than expected, or revise it upwards if it sees other bidders staying in at higher prices than expected.

4.31 DotEcon are of the view that there will be a reasonable amount of uncertainty over the value of the available spectrum for this award. There may be significant common value uncertainty regarding the spectrum rights of use for the provision of Smart Grid (Part A), given that Smart Grid is the only use for that spectrum and the common factors are likely to be the same (or similar) across competing utilities. In relation to Part B, while there are other potential uses, bidders are likely to focus on providing NB-IoT solutions (regardless of the technology used) in which case there

may also be common value uncertainty for those frequencies. In any event, DotEcon suggests that there are benefits for bidders in using the same auction format for Part A and Part B (for example, it avoids the need for bidders having to prepare for two different auctions), so if an auction format that helps to reduce common value uncertainty is required for Part A, the same format should be used for Part B unless there are good reasons not to.

4.32 The use of an open auction format allows bidders to bid again if their current bids are unsuccessful. This means that bidders can learn from the information revealed about the demand of other bidders and continue to bid in light of that information, potentially with updated valuations. An open process would also reduce the consequences of unsophisticated bidders making a bidding error in a sealed bid auction, where there would be no opportunity to recover from a bidding error. The issue of common value uncertainty is reduced under any open award such as SCA, CCA or CMRA. However, such concerns cannot be addressed in a SBCA.

4.33 Therefore, ComReg is of the preliminary view that the SBCA is unlikely to be suitable for this award process due to the risk of common value uncertainty.

4.4.3 Inefficiently unsold lots

4.34 Unsold lots do not necessarily represent an inefficient outcome from an auction. However, if bidders have increasing returns for additional lots and such lots remain unsold, this would represent an inefficient outcome.

4.35 DotEcon advise that this problem is avoided through the use of combinatorial auctions that do not impose linear pricing, such as the CMRA, CCA and SBCA. These formats allow bidders to submit multiple bids that reveal the structure of their demand for spectrum at different prices. Winners (and prices) are established taking into account the whole range of bids submitted, with the consequence that (if bidders reflect their full demand profiles in their bids) lots will only remain unsold if there is no additional value that can be achieved by assigning them. Therefore, these formats do not suffer from the risk of inefficiently unsold lots.

4.36 A SCA has an inherent risk of leaving lots inefficiently unsold. However, a SCA can be tailored to significantly reduce the risk of inefficiently unsold lots from occurring without introducing other risks such as complexity depending on the circumstances of an award. The risk of inefficiently unsold lots arises because there is a risk that aggregate demand might drop too abruptly between rounds (for example, if several bidders reduce demand in the same round, or if bidders reduce demand by several units in one step).

4.37 DotEcon notes that large drops in demand may be the result of:

a) price increments being too large (referred to as ‘price overshoot’); or

b) due to the structure of bidders' valuations regardless of how small the price increments are.

4.38 In relation to (a), if the price increment between two rounds is large, a particular bidder may be willing to pay a price between the current round and the next round which was subject to the large increment. If the award process ends in the next round with unsold lots as a result of a particular bidder reducing demand, then a more efficient outcome would have been to assign rights of use to that bidder at a price between the two rounds increasing the total value of the assigned lots.

4.39 To overcome this issue, DotEcon propose that 'exit bids' could be used to reduce the impact that large drops in demand may cause. Exit bids allow a bidder to specify a price (required to be between the round price in the preceding round and the current round price) at which the bidder would be prepared to buy the lots it no longer demands at the current round price. For example, suppose that a bidder is bidding for one lot at round prices of €10 per lot. In the following round, the price rises to €12 but this is above the bidder's valuation of €11. Rather than the bidder withdrawing altogether, a more efficient outcome could be provided by allowing the bidder to make an exit bid for that lot of €11 which could then be considered when assessing the total value of the assigned lots.

4.40 Exit bids allow bidders that reduce their demand in a lot category to specify prices between the price of the previous round and the prevailing clock price, up to which level they want to maintain their specified demand. Such exit bids help to reduce the risk of a sudden excess of supply because the auctioneer set the clock price too high and gives the auctioneer additional options for assigning more spectrum than would have been the case without the exit bids.

4.41 In relation to (b), inefficiently unsold lots may also occur regardless of exit bids as there could be demand expressed in previous rounds for unsold lots that occur at the end of the auction but at a lower price per lot. A bidder might be willing to be assigned additional lots to those won at the final round price, if those lots were available at a lower previous round price.

4.42 To reduce the impact of (b), DotEcon propose that a combinatorial closing rule could be introduced in addition to exit bids. At the end of each round, the value maximising combination of bids would be based on all clock bids and exit bids submitted in all rounds rather than just that round alone. Additional rounds would only be necessary if a bidder who submitted a non-zero bid in the last round is not assigned rights of use. Ending the auction in that scenario would be unfair on that bidder as it would not have had an opportunity to respond by increasing its bids.

4.43 Therefore, while the risks of inefficiently unsold lots are not fully removed, ComReg is of the view that the SCA may be appropriate for this award depending on the balance of risks associated with other formats.

4.4.4 Complexity

4.44 Auction 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 between its own bids and those of other bidders.

4.45 The design of the proposed award should, to the extent possible, seek to minimise complexity for bidders. However, ComReg notes that this should not act to the detriment of the proposed award process and should be appropriately balanced against the risks identified in this Chapter. Readers are referred to Annex 8 of Document 15/140 for a detailed discussion of the different forms of complexity arising from an auction.

4.46 Certain awards are more computationally complex than others. However, it should be noted that for any of the award mechanisms assessed, the burden of computational complexity falls entirely on the auctioneer who typically uses algorithms or other methods to determine which of the bids will be winning bids and to determine what the winning bidders pay. Therefore, computational complexity is primarily a concern for the auctioneer regardless of the award type.

4.47 Like all combinatorial auction formats, the CMRA has a higher degree of associated complexity. Even though a large part of the complexity rests with the auctioneer, bidders have to assess when they would like to bid for additional packages, and possibly manage a portfolio of package bids in a given round. The CMRA is also a new award format and unlike other combinatorial awards, such as the CCA, its mechanics are relatively unknown.

4.48 Similarly, the CCA is often considered to have a relatively complicated structure, and the process of pricing and winner determination is relatively complex for bidders to understand. However, once the format is understood and bidders have generated their valuations for different packages of lots, the process of bidding to reflect these valuations (and importantly, relative preferences between different packages) can be relatively straightforward. In particular, there is no need to adopt a complex bid strategy to bid successfully in a CCA. To date, the CCA has been used twice for spectrum awards in Ireland and the mechanical complexity can be overcome through the use of bidder training, which has proved successful in both the MBSA in 2012 and the recent 3.6 GHz award.

4.49 The clock auction is a relatively simple format, both in terms of implementation and with regard to transparency for bidders. DotEcon notes that the clock auction has the benefit of being very simple for bidders to understand and participate in. In particular, in the case of Part A there would be a single lot and bidders would simply need to say whether or not they wished to purchase the lot at a given round price. The increase in complexity when dealing with Part B is also likely to be very small, with bidders only needing to state how many lots they wish to acquire at a given price.

4.50 Therefore, ComReg is of the preliminary view that the SCA is the least complex open award format in terms of implementation and participation for bidders.

4.5 Auction Format

4.5.1 Auction format requirements

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

- Minimise common value uncertainty, which may exist where bidders use the available spectrum to deploy new technologies;
- Minimise the risk of inefficient outcomes for bidders and allow all bidders to express their demand without creating excessive complexity;
- Be flexible enough that bidders are able to construct their preferred packages of lots without running the risk of winning unwanted subsets of their demand;
- Encourage participation in the process and avoid outcomes where spectrum goes unsold despite demand existing for that spectrum; and
- Be as simple and transparent to bidders as possible, in light of the above factors.

4.52 The SMRA is easy for bidders to understand and allows for price discovery (helping to mitigate the risks of common value uncertainty). However, the SMRA exposes bidders to significant aggregation risk. This is likely to be a particular concern in this award given the strong synergies across lots that are likely to exist for some bidders. In such cases bidders may be stranded on a subset of the lots they want and facing prices that are above its valuation of the lots won. While measures can be

introduced to mitigate the impacts of this this substantially increases complexity for bidders.

4.53 Each of the remaining combinatorial awards (CCA, CMRA, SCA, and SBCA) supports package bidding thereby eliminating aggregation risks. The CCA, SCA and CMRA are open round combinatorial awards while the SBCA is a single round combinatorial award (or two rounds if an assignment stage is used). However, a SBCA is unlikely to be suitable for this award given the risks of common value uncertainty or bidding error. It does not provide for price discovery and bidders only have one opportunity to submit their bids for the lots auctioned, and the winning bids and bidders are determined on the basis of just one round of bidding.

4.54 Therefore, in light of the discussion above, and the views of DotEcon, ComReg is of the view that the SMRA auction and the SBCA are not suitable for this award process because there are no tools available to reduce common value uncertainty in the SBCA, and any measure to improve aggregation risk in the SMRA would likely make the award significantly more complex.

4.5.2 Preferred auction format

4.55 In relation to the remaining viable award formats, ComReg notes that there is a balance between providing adequate protection against the risk of inefficiently unsold lots and reducing complexity by creating a format that is relatively easy for bidders to understand.

4.56 While a CCA or CMRA would likely result in the efficient assignment of the radio spectrum and would be a suitable award format in that regard, both these formats are more complex and in some cases have detailed rules that bidders are required to understand in order for such formats to provide for that efficient use. In that regard, ComReg typically provides detailed bidder training where its preferred award format is a CCA in order to ensure bidders are familiar with the rules in order to limit any errors as may occur. This is important because any errors made by bidders due to a lack of understanding of the rules can lead to inefficient outcomes which can create significant problems downstream.

4.57 The main risk of the SCA is that some lots could remain inefficiently assigned. However, the proposal by DotEcon to allow for exit bids and use a combinatorial closing rule, taking into account of all clock bids and exit bids at the end of each round significantly reduces the extent to which this might arise. This does not fully remove the risk of inefficiently unsold lots occurring as the proposed clock auction may not necessarily allow bidders to submit bids for every package of interest in the same way as a CCA or SMRA.

4.58 Inefficiently unsold lots are of particular concern where they create significant harm downstream by denying services to consumers that would have been provided through the efficient use of unsold lots. In that regard, DotEcon noted that bidders (other than the potential Smart Grid operators) would have alternative frequency options available in other bands, which would help to mitigate the risk of inefficiencies (and the impact on the downstream market) arising as a result of some bidders being unable to submit bids for all packages of interest. Further, the issue of inefficiently unsold lots does not arise for Part A since there is only one lot available and the proposed auction format would allow all qualified bidders to submit a bid at their value for the lot (potentially using an exit bid).

4.59 Therefore, ComReg is of the preliminary view that the SCA with exit bids and combinatorial closing rule provides sufficient protection against inefficiently unsold lots arising in the award while also being less complex than alternative combinatorial awards providing a simple process for less sophisticated bidders that may participate in this award. The proposed clock auction format offers sufficient flexibility to deal with the concerns outlined by DotEcon without compromising the efficiency of the award process.

4.60 Finally, DotEcon advise that a CCA or CMRA are more complex and the efficiency gains are unlikely to be sufficient to justify their use in this particular context. Certain participants may have no previous experience of spectrum auctions and the benefits of simple rules and bidders always being able to bid again if not in the winning outcome are likely to be important.

4.61 In light of the foregoing and its statutory functions, objectives and duties, ComReg is of the view that a clock auction proposed by DotEcon is the auction format best suited to deal with the considerations outlined in the DotEcon Report.

4.6 Packaging of lots

4.62 ComReg's approach in previous awards has been to include lot sizes that best accommodate all types of users and technologies. Offering spectrum in blocks that can be aggregated to satisfy larger demand profiles provides bidders with greater flexibility to make bids on its preferred amount of spectrum. Bidders can choose the exact amount of spectrum that they wish to acquire and reduce this amount in relatively small increments if necessary as market prices become more apparent. Using larger lot sizes could have significant potential downsides because it could limit the flexibility that bidders have in expressing demand for precise quantities above any minimum requirement and therefore could lead to an inefficient outcome.

4.63 In Document 17/67, ComReg proposed to make available 2 × 5.5 MHz divided into 11 lots of 2 × 500 kHz. Subsequently, in Document 17/105, ComReg noted its intention to further develop its proposals with regard to such matters during the next consultation phase of the award. In that regard, ComReg commissioned Plum to, among other things, assess the minimum spectrum building block size of the various technologies that are suitable for 400 MHz rights of use.

Technology	Minimum Bandwidth
PMR	2 × 100 kHz
TETRA	2 × 1.25 MHz
CDMA	2 × 1.25 MHz
NB - IoT	2 × 200 kHz
LTE	2 × 3 MHz and 2 × 5 MHz

Table 1: Minimum lot size

4.64 As outlined in Table 1, the minimum bandwidth requirements range from 2 × 100 kHz to 2 × 5 MHz. Increasing the lot size above 2 × 100 kHz could create asymmetries amongst bidders to the extent that this might only be a suitable building block for some but not all bidders, and some bidders who may only want 2 × 100 kHz could be excluded or be required to pay for more spectrum. In that regard, increasing the lot size would not be aligned with the objective of service and technology neutrality in Part B of the award because some services that may only require 2 × 100 kHz would not be appropriately provided for. Such lot sizes (2 × 100 kHz) best accommodate all types of users and technologies since the auction design can provide for smaller lots to be aggregated to satisfy larger demand profiles.

4.65 Further, DotEcon advises that reducing the block size to 2 × 100 kHz makes little difference to the complexity of the proposed auction and recommend that 2 × 100 kHz blocks would be suitable, as this would provide the maximum required flexibility to potential users for acquiring bandwidths based on their individual requirements.

4.66 Therefore, ComReg is of the preliminary view, taking account of the information provided by Plum and DotEcon's assessment of same, that spectrum should be offered using lot sizes of 2 × 100 kHz.

4.7 Frequency Specific vs Frequency Generic Lots

4.67 It is generally desirable to determine the frequency assignments for winning bidders on the basis that those winning multiple lots will be assigned contiguous spectrum. The lots made available in the proposed award process can be offered on either a frequency specific or frequency generic basis.

- In a frequency specific auction, bidders bid on lots where each lot is assigned a specific radio frequency. The winning bidder is assigned rights of use to those winning frequency lots and has no opportunity to be assigned rights of use to a different part of the band at a later stage. This approach does not require a frequency assignment stage and there would be just one stage of bidding.

- In a frequency generic auction, bidders bid on lots independent of the position of those lots within the band. Where lots are assigned in this fashion, the auction requires an assignment stage in which the specific frequencies to be assigned to winners of the frequency generic lots are determined. Where there are material value differences for different parts of the band, a competitive process that allows bidders to express their preferences over different assignment options may be required.

4.68 A frequency specific award might be appropriate if some bidders are likely to have strong preferences across frequencies which would likely impact the value of one or more blocks materially depending on which frequencies are assigned. In more severe cases, a winner of generic spectrum would prefer not to have been assigned any spectrum if it ended up outside its preferred frequency range. This usually arises with incumbents where the cost of migration is high.

4.69 A frequency generic approach is typically preferred where frequency blocks are likely to be very close substitutes and are of similar value to bidders. If the lots within a generic lot category have different values for a bidder (that is, not all lots have the same value to a bidder), it may be difficult for the bidder to decide how much to bid for a given number of generic lots when it does not know the value of the spectrum it will ultimately receive. When bidding for frequency generic lots, such bidders would need to balance the risk of bidding closer to the high value lots but then winning lower value frequencies in the assignment stage, against the risk of bidding

at the lower end of its valuations and winning fewer lots than it might have done in the efficient outcome.

4.70 In relation to Part A, DotEcon recommend that Part A be assigned on a frequency specific basis at the lower end of the band as there are minor benefits arising from a reduction of the potential for interference to Trunked Systems from LTE (greater than normal due to the duplex direction applied varying across Trunked Systems users). This view is in line with the recommendations set out in the Plum report, which suggests that the lower part of the band would be more suitable for Smart Grid in order to avoid the risk of interference with existing services at the upper end of the band.

4.71 In relation to Part B, DotEcon is not aware of any material differences in the value of different lots, and suggests that all of the available 25 unreserved lots (55 lots if there is no demand for Part A) could be offered as a single category of frequency generic lots. ComReg agrees with DotEcon that a frequency generic approach is preferable given that the amount of spectrum available (max 2 × 5.5 MHz) is small and equipment[146] is likely to be re-tuneable across the entire range.

4.72 Therefore, ComReg is of the preliminary view that lots in Part A should be made available on a frequency specific basis (that is, 410 – 413 MHz / 420 – 423 MHz) and Part B should be made available on a frequency generic basis.

4.7.1 Assignment Stage

4.73 A frequency generic auction typically has two stages:

1. **Primary Stage** - where bidders bid on a specific number of lots, without reference to the frequency location of the lots. This stage determines the number of lots that a successful bidder has won.

2. **Assignment Stage** - determines the specific frequencies to be assigned to each winning bidder. For example, if a bidder won five 2 × 100 kHz lots in the primary stage, the assignment stage would decide what frequencies these five lots would correspond to on a contiguous basis.

4.74 ComReg's preferred auction format (the clock auction with exit bids and combinatorial closing rule) represents the primary stage above.

4.75 In relation to an assignment stage, bidders are typically able to submit assignment bids for positions in the band that reflect their preferences and compete with other winners of generic spectrum who have the same or different preferences. This is

[146] For example, Plum note that equipment for LTE use should be able to cover the entire band in a single variant so there should be no requirement to specify access to a specific portion of the band.

often necessary where bidders have material value differences over different frequencies (for example, to coordinate with the tuning range of existing equipment, or because certain frequencies have interference issues with adjacent users).

4.76 DotEcon are of the view that there does not appear to be any material differences in the value of various locations within the band and that specific frequencies could be assigned by ComReg through a random selection process (most likely determined algorithmically), subject to:

- All winning bidders being guaranteed a contiguous block of spectrum; and
- Any Part B spectrum won by the winner of Part A would be automatically assigned next to the Part A frequencies.

4.77 ComReg's approach in recent awards has been to assign rights of use as frequency generic lots and run a separate assignment stage in which bidders are able to submit assignment bids. For example, the recent 26 GHz and 3.6 GHz awards used a competitive assignment stage that allowed for the submission of assignment bids and winning assignment bids were received[147] [148].

4.78 However, given that bidders are likely to be indifferent about where in the 400 MHz band they are located an additional round of bidding would seem unnecessary given that such bids would likely be set at zero to reflect that indifference. This approach also simplifies the award process for bidders as the random assignment will be determined by the EAS (Electronic Auction Software).

4.79 However as noted by DotEcon, if there are valid reasons presented in the responses to this consultation to suggest that potential users might have material value differences across different frequencies within the 400 MHz band, this recommended approach may be revised to incorporate an assignment bidding process.

4.8 Competition Caps

4.80 The main purpose of a competition cap is to guard against the risks of an extreme asymmetric outcome that has the potential to harm downstream competition. However, the competition cap should be set at a level that still allows for the distribution of spectrum to be determined by competition amongst the bidders, rather

[147] See Document 18/53, 'Results of the 26 GHz Band Spectrum Award 2018 – Information Notice, published 19 June 2018.
[148] See Document 17/46, 'Results of the 3.6 GHz Band Spectrum Award 2018 – Information Notice, published 1 June 2017.

than unduly restricting the potential outcomes to a symmetrical split of the frequencies.

4.81 DotEcon advise that competition caps are not necessary in this award process because there appears to be little reason for concern over how spectrum might be awarded causing problems for competition in any of the potential downstream markets that might be served. In Part A are there is only one block available that is set at the level necessary to provide for the provision of a Smart Grid and multiple winners cannot be accommodated. A competition cap is not necessary for Part A because it would reduce the amount of spectrum available for any one Network Utility Operator below the level required to efficiently operate a Smart Grid.

4.82 For the remaining uses, Plum consider that there are other frequencies available in other bands for each of the other potential uses, and that this spectrum is not suitable for mobile services. Furthermore, the use cases highlighted by Plum requires spectrum in different multiples up to 2 × 5 MHz. For example, there is no need to prevent any winner of Part A from acquiring more spectrum rights of use as there may be a valid use case for additional spectrum as outlined in the Plum Report. Any cap could reduce the ability of any bidder to acquire rights of use necessary for the efficient provision of the preferred use or service. This could also lead to unsold lots where a bidder restricted by a cap would have preferred to be assigned additional lots.

4.83 ComReg agrees with the views of DotEcon and is of the preliminary view that a competition cap is not necessary for this award, because, among other things:

- It could prevent a Network Utility Operator from being assigned a sufficient amount of spectrum necessary to efficiently operate a Smart Grid;
- It would better allow bidders to obtain sufficiently large contiguous blocks of spectrum to meet likely requirements and would not unduly restrict the range of demand that could be expressed in the proposed auction;
- It would better ensure the efficient use of spectrum by minimising the potential for lots to be stranded and therefore unused; and
- There are alternative frequencies for other potential use cases if certain bidders were unsuccessful in this award as a result of a small number of users obtaining large amounts of the band.

4.84 Therefore for the reasons stated above, ComReg’s preliminary view is that a competition cap is not appropriate for this award process.

4.9 Unsold Lots

4.85 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.

4.86 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.

4.10 Fees

4.87 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 considers the following:

- The relevance of minimum prices and the proposed approach in setting a minimum price for this award process;
- ComReg's approach to minimum prices in this award;
- The minimum price structure and whether a split of the minimum price into an upfront and ongoing portion is necessary; and
- The level of the minimum price including the proposed upfront SAF and ongoing SUFs that will be applicable to rights of use assigned under the proposed award process.

4.88 For ease of reference, ComReg sets out below definitions for the main technical terms used in this section:

- **Reserve Price/Minimum SAF**– This is the minimum bid for such a lot to be assigned. The reserve price in an auction is an established price floor below which a lot will not be sold.

- **Spectrum Access Fee ("SAF")** – This is the upfront fee which is payable by a winning bidder for a licence at the end of the auction.

- **Spectrum Usage Fee ("SUF")** – This is the annual fee which a successful bidder must pay throughout the duration of the licence and is additional to the amount that would be payable upfront at the conclusion of the auction.

- **Minimum Price** – This price is the combination of the Reserve Price and SUF and is therefore the total price per lot set at the beginning of the auction. For ComReg, the minimum price represents the lowest overall price subject to which it will grant rights of use for the licence period in relation to the spectrum concerned. For bidders, the effective minimum price is the sum of the upfront reserve price and the discounted stream of annual SUFs.

4.11 Relevance of minimum prices for this award

4.89 The purpose of this section is to explain the rationale for applying a minimum price and consider whether a minimum price is necessary for the proposed award process. In more recent awards, a minimum price has been necessary to guard against low participation scenarios and reduced competition creating incentives for bidders to bid conservatively to keep prices low. In this award, the spectrum is divided into two parts and there are separate considerations for each part.

4.90 In relation to Part B, DotEcon strongly recommends the use of minimum prices on the basis that they:

- reduce incentives for strategic behaviour within an auction aimed at decreasing the price paid for spectrum rights of use below the true market value; and

- discourage frivolous bidding by ensuring that only bids over a certain non-trivial level will be considered eligible by ComReg.

4.91 Minimum prices for Part B would reduce the potential gains associated with gaming behaviour aimed at restricting competition in the award (such as tacit collusion) and encourage bidders to compete thus promoting an efficient outcome. It would also discourage frivolous bidding by ensuring that only bids over a certain level would be considered eligible by ComReg.

4.92 In relation to Part A, DotEcon notes that concerns over strategic behaviour or speculative bidding are less relevant since only one lot is available and the risks of speculative bidding are removed by restricting the potential licensees to Network

Utility Operators. However, there is a fairness argument to suggest that a Network Utility Operator should face the same minimum price as those competing for the open spectrum.

4.93 In that regard, ComReg notes that the most efficient use (Smart Grid) has already been determined by ComReg. In effect, the purpose of assigning rights of use for Part A is to determine the most efficient user of those rights of use for Smart Grid. ComReg has put in place particular criteria (see Section 3.2) to determine the Network Utility Operators that would be eligible to bid for spectrum rights of use in Part A. This already prevents non-credible or frivolous bidders participating for that part of the spectrum. Further, there is only one 2 × 3 MHz lot available so incentives for bidders to collude to keep the price low are unlikely to apply since only one winner is possible.

4.94 However, a minimum price is still necessary as any winning bidder in Part A is eligible to participate in Part B. The absence of a minimum price for Part A would provide the winning bidder with an unfair advantage in competing for additional rights of use for Part B as any such rights of use could also be used to provide for Smart Grid (that is, a winning bidder could be able to obtain additional rights of use arising from a lower price in Part A). Furthermore, the minimum price is composed of an upfront and ongoing element over the duration of the licence (SUF). A SUF is an important tool to incentivise any winning bidder to return the spectrum.

4.95 For the reasons stated above, ComReg agrees with the views of DotEcon and is of the preliminary view that a minimum price is necessary in Part A and Part B of this award.

4.12 ComReg's approach to minimum prices in this award

4.96 ComReg observes that previous approaches to setting minimum prices relied upon the availability of suitable data which only used competitive award process using auctions in order to provide a conservative estimate of the likely market value. However, DotEcon advises that a lack of data or other information about the market value of a Smart Grid network or any of the other potential uses means that it is very difficult to set the reserve price and annual licence fees in a way that reflects the likely value of the spectrum.

4.97 In that regard, the primary goals in determining the level at which the minimum price should be set for this award, include that:

a) The minimum price should not be set so high as to choke off demand of the potential uses outlined in the Plum Report;

b) The minimum SAF should be set high enough to discourage participation by frivolous bidders in Part B;

c) The minimum price should allow for SUFs to be set at a level that provides at least some incentives for winning bidders to return spectrum rights of use to ComReg if left unused; and

d) The minimum price should not be different for Part A and Part B.

4.98 In relation to (a), the primary concern should be to avoid the risk of setting the minimum fees for the reserved 2 × 3 MHz too high and making it too expensive for a Network Utility Operator to acquire since there are no alternative frequency options for Smart Grid.

4.99 In relation to (b), the risks of this are low in Part A given the requirements to become a qualified bidder as described in the draft RIA. For Part B, and for larger amounts of spectrum, frivolous bidders may be willing to acquire rights of use speculatively, displacing future uses that may arise.

4.100 In relation to (c), SUFs are an important tool used by ComReg to provide any winning bidder with some incentives to return spectrum rights of use to ComReg where those rights of use are not being utilised.

4.101 In relation to (d), this is provided for by keeping the minimum price for Part A and Part B the same.

4.13 Minimum price structure

4.102 The minimum price is typically made up of a minimum upfront SAF which is payable as part of the award process and the sum of annual spectrum usage fees (SUFs) which are paid periodically over the licence duration. A minimum price typically requires a balance of considerations, including that:

- A reasonable part of the overall price of spectrum determined by the auction is recovered upfront soon after the auction and is not refundable at a later date if that bidder decided to return the spectrum rights of use to ComReg. This encourages the bidder to make credible bids that reflect its use case(s) at the time of the award. In the absence of a minimum upfront SAF, a bidder could make speculative bids (for example, bids where it was unsure about a use case) in the award and return rights of use at a later date and not be subject to future SUF payments; and

- On-going usage fees face licensees with an actual cost of using the spectrum. The rationale for having some portion of the minimum price in the form of a usage fee in this award is to create sufficient incentives for winning bidders to hand back part or all of any spectrum holdings for which they no longer have any use.

4.103 ComReg is of the preliminary view that a fee structure composed of both a minimum upfront SAF and ongoing stream of indexed SUFs should be applied for the following reasons:

- Paying SUFs on an ongoing basis during the licence period would encourage licence holders to consider alternative uses throughout the period of the licence; and

- A minimum upfront SAF reduces the risk that spectrum is assigned to speculative bidders who may use the spectrum inefficiently or deny other more efficient users.

4.104 Given the likely uncertainty over the future development and value of the potential services, DotEcon considers that there may be some merit in putting a slightly greater weight on the ongoing annual fees such that around 60% of the minimum price would be composed of SUFs. DotEcon observes that this should help to reduce the risks for bidders with uncertainty over their revenue streams and encourage the return of unused spectrum but also maintain a sufficiently high upfront fee so as to discourage speculative bidding.

4.105 ComReg agrees with DotEcon that a heavier weighting for SUFs is appropriate for this award. 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 use of the spectrum or the return of unused spectrum. A higher SAF proportion may be necessary where bidders have incentives to acquire more spectrum than appropriate for an efficient use and if the benefits from retaining such spectrum fell below the cost of annual SUFs. However, the risk that bidders may acquire excess spectrum is lower in this award compared to the assignment of harmonised ECS spectrum where the potential impacts on downstream competition are likely to be larger.

4.106 Therefore, ComReg is of the preliminary view that the minimum price for all spectrum rights of use (that is, Part A and Part B) should be split on a 40/60 SAF/SUF basis.

4.14 Level of minimum price

4.107 The Plum report outlined four different potential uses (PMR, NB-IoT, Smart Grid and Smart Metering) all of which are likely to have different valuations. In that regard, and in light of the lack of available benchmarks for the use cases, ComReg is of the preliminary view that the minimum price should be low enough not to choke off any of the likely use cases as described in the Plum Report. Discouraging participation by frivolous bidders is a secondary concern because the opportunities for frivolous bidding would appear low in this award. For Part A, frivolous bidders are less likely to participate in the first instance because this portion of the spectrum already has restrictions on what bidders are allowed to participate (that is, Network Utility Operators). For Part B, the presence of alternative frequencies limits the extent to which frivolous bidders would benefit from being assigned spectrum rights of use. Further, given a lot size of 2 × 100 kHz any minimum price would be set at a low level to reflect the small lot size.

4.108 In that regard, DotEcon consider that a (discounted at a rate of 8.63%)[149] minimum price of €590,000 for the 2 × 3 MHz block and €19,600 for a 2 × 100 kHz lot is set at a level that would not choke off any of the likely uses in the Plum Report. At these levels, there is little risk of leaving spectrum inefficiently unassigned. As set out in Table 2 below the fees for the proposed award process are set out below:

- **Part A:** The Minimum Price should consist of an upfront minimum SAF of €240,000 per 2 × 3 MHz block and an annual SUF of €39,000 per block subject to annual indexation by CPI.

- **Part B:** The Minimum Price should consist of an upfront minimum SAF of €19,600 per 2 × 100 kHz block and an annual SUF of €1,300 per block subject to annual indexation by CPI.

4.109 The proposed minimum fee structure is on the basis that SUFs are paid prior to the first grant of a Licence and then over its duration. This is in line with ComReg's current approach to SUFs. In that regard, there will be 15 SUF payments that begin at the start of year one.

4.110 SUFs are indexed-linked to the overall Consumer Price Index ("CPI") as published by the Central Statistics Office of Ireland or its successor. As the CPI may vary over time, the SUF per Lot may increase or decrease over the duration of the 400 MHz

[149] This is the discount rate used by ComReg for recent spectrum awards, for example, the 3.6 GHz award.

Licence based upon the increases or decreases in the CPI for the relevant time period.

Spectrum Block	Minimum Price (discounted)	Minimum SAF	Annual SUF
Part A (Smart Grid 2 × 3 MHz)	€590,000	€240,000	€39,000
Part B (2 × 100 kHz Lots)	€19,600	€8,000	€1,300

Table 2: Minimum Price, SAF and SUF for each Lot

Chapter 5

5 Indicative Licence Conditions and Key Aspects of the Proposed Spectrum Award

5.1 Introduction

5.1 In this chapter, ComReg sets out its preliminary views and further proposals for the licensing framework for the 400 MHz band.

5.2 In coming to the views expressed below, ComReg has taken note of:

- the views expressed by respondents to date;
- the expert advice received from Plum and DotEcon; and
- international developments in the 400 MHz band that could change both the attractiveness and demand of this band to certain services.

5.3 Except for where it is explicitly stated, all licence conditions apply to both Parts of the spectrum as defined in para 4.1 of this document.

5.4 As stated in the draft RIA, ComReg is adopting the Plum definition of Smart Grid for this consultation paper: “Smart Grid is a term used for advanced delivery systems for utility services (electricity, gas and water) from sources of generation and production to key elements in the grid networks and includes all supervisory and control necessary for their effective management.”

5.5 For the avoidance of doubt, this definition does not include Smart Metering. As in the Plum report, Smart Metering is considered a separate use case in this document.

ComReg welcomes views from interested parties on all aspects of the proposed licensing framework set out in this Chapter.

5.2 National Licences

5.6 In Document 17/67, ComReg proposed to award this spectrum on a national basis. ComReg observes that national licences for the potential use cases would provide

greater flexibility to users to meet their respective needs (in similar fashion to national block licences for radio links). In considering the possible uses identified, it is a reasonable conclusion that national licences would also ensure the most efficient use of the 400 MHz band:

- **Smart Grids** – the Electricity, Water and Gas grids are deployed across the entirety of Ireland and so regional licences would not be appropriate;
- **Smart Metering** – the Electricity, Water and Gas meters are to be deployed across the entirety of Ireland and so regional licences would not be appropriate;
- **PMR –** Private Mobile Radio type networks can and do currently operate on a local or regional scale (for example Business Radio). The potential advantages of this spectrum to PMR type networks are that the licences would be for national use and for a longer period than the current Third Party Business Radio ("TPBR") licensing scheme.

5.7 Based on the above and the views of the respondents to Document 17/67, ComReg maintains its proposal that licences for the 400 MHz band should be awarded on a national basis.

5.3 Channel Bandwidth

5.8 In Document 17/67, ComReg proposed not to restrict potential licensees to a specific channel bandwidth, but instead to allow potential licensees greater flexibility to use spectrum rights of use with whatever bandwidth they wish.

5.9 In Document 17/105, ComReg noted that all respondents largely agreed with the above proposal.

5.10 In its report to ComReg, Plum identifies the different technologies that are likely to be deployed in the band, based on the potential uses identified.

5.11 ComReg is of the view that specifying a channel bandwidth could constrain the technologies that could be deployed in this band. For example, specifying a narrow channel bandwidth of 100 kHz may be prohibitive to entity's wishing to use the spectrum rights of use to deploy wideband technologies such as LTE.

5.12 ComReg therefore remains of the view that licensees should have the flexibility to use whatever bandwidth their technology requires, noting that potential bidders may be required to aggregate enough spectrum to satisfy their spectrum needs. For the avoidance of doubt, potential licensees must operate within their spectrum holdings

and comply with the Block Edge Masks discussed in Section 5.6 and specified in Annex 2.

5.4 Licence Duration

5.13 In both Documents 17/67 and 17/105, ComReg outlined a number of important factors which it takes into consideration when determining an appropriate licence duration.

5.14 ComReg favours granting rights of use for spectrum for a fixed duration. Fixed term licences should:

- promote competition between undertakings and the efficient use of spectrum and it should contribute to the development of the internal market;
- be wholly compatible with the Common Regulatory Framework;
- allow licensees sufficient time to make a return on their investments, in line with the expected life-cycles of any technologies deployed;
- provide enough flexibility to deal with any international harmonisation of a spectrum band, for example at EU-level, as may occur after fixed-term licences in that band have been granted;
- ensure that there are no long-term barriers to a co-ordinated approach to the bands (particularly important where a co-ordinated approach is necessary to introduce new services); and
- ensure that there can be a co-ordinated approach to bringing about the desired change but without creating perverse incentives for incumbents to hold out in order to gain more rents.

5.15 Plum observes that the potential uses identified are for services and networks that would require a long lifetime. For example, in a Smart Grid network it is necessary to refit sensors and controllers which is a noticeable overhead in addition to the cost of the communications network.

5.16 Plum therefore recommends that a licence duration of no less than 15 years would be appropriate.

5.17 ComReg notes and agrees with Plum's recommendation. Considering the potential uses, a long lifetime is required to ensure that a licensee can have time to design and deploy a network, as well as see a return on their investment. Further, a licence

duration of 15 years is not an unduly long period and is generally in line with respondents' views[150].

5.18 ComReg proposes a licence duration of 15 years.

5.5 Mode of Operation

5.19 ComReg, in Document 17/105, proposed that the spectrum would be made available for FDD operation only, but noted that ComReg would explore the matter further in its next consultation phase.

5.20 ComReg notes that draft ECC Decision (19)02 referred to in para 2.6 above provides the Least Restrictive Technical Conditions for LTE FDD systems.

5.21 In its report to ComReg, Plum notes that in the case of Ireland, FDD would appear to be the most appropriate solution as it would align with likely equipment availability, and with the use of this and neighbouring bands both in Ireland[151] and other countries. In section 6 of its report, Plum advises that the spectrum should be made available for FDD operation. Further, Plum notes that the likely technology to provide Smart Grids will be LTE, and that the likely configuration of LTE deployed in this band will be FDD.

5.22 As noted in ComReg Document 17/105, the introduction of both FDD and TDD has the potential to cause unacceptable levels of interference, resulting in the need for guard bands and the restriction of spectrum blocks. Given the limited amount of spectrum available any such restriction should be avoided, if at all possible.

5.23 As set out in the draft RIA (Chapter 3), Part A of this spectrum would be made available to Smart Grid. Allowing TDD operation in the remaining 2 × 2.5 MHz could well cause interference issues, and considering that equipment availability would likely align with FDD operation, ComReg continues to be of the view to award this spectrum for FDD operation only.

5.6 Interference Mitigation

5.24 In Document 17/67, ComReg proposed not to assign guard bands between adjacent operators. Instead, ComReg proposed that licensees would need to internalise any

[150] ComReg Document 17/105s - Non-Confidential Submissions to ComReg Document 17/67 on the Proposed Release of the 410 – 415.5 / 420 – 425.5 MHz Sub-band – Published 8 December 2017.
[151] For example, the 450 – 470 MHz band in Ireland is offered on an FDD basis only.

guard bands that their choice of technology may require, and that any inter-operator interference could be mitigated by co-ordination between the parties involved.

5.25 In Document 17/105, ComReg stated that it would analyse the suitability of introducing a Block Edge Mask ("BEM") or some other coordination technique(s).

5.26 As defined in ECC/REC/(11)06[152], BEMs are used in order to provide a certain level of protection for wireless systems in adjacent frequency blocks and to reduce the necessity for coordination between operators.

5.27 BEMs have been used by ComReg in the past as part of implementing ECC Decisions, for example, ECC Decision 11(06) - Harmonised frequency arrangements for mobile/fixed communications networks (MFCN) operating in the bands 3400 – 3600 MHz and 3600 – 3800 MHz. However there is no EC harmonising Decision for the 400 MHz band and so there is no defined BEM that Member States may refer to.

5.28 Based on the likely technologies to be deployed in the band, Plum recommend two BEMs, one for systems with channel bandwidths of 6.25 kHz – 200 kHz, and another for systems with channel bandwidths of 1.25 MHz – 5 MHz (together "the Proposed BEMs"). These BEMs are based on draft ECC Decision (19)02. In coming to this recommendation, Plum:

- has taken into account the existing users of the 400 MHz band[153]:
  - Plum refers to ECC Report 240 and ECC Report 283 which suggest that there will be little interference between LTE and Private Business Radio (in this case Trunked Systems) if:
    - (i) the normal out-of-band emissions masks are used for LTE; and
    - (ii) the uplink/downlink arrangements are in the same direction.
  - In relation to (i) Plum advises that the Proposed BEMs, though more restrictive than a standard LTE mask[154], appear appropriate and likely to offer a good mix of protection to existing users while not being unduly problematic for new users to meet.
  - In relation to (ii), there is currently a mix of duplex directions in Trunked Systems which, according to Plum, and taking account of the afore mentioned ECC Reports, increases the risk of interference.

[152] http://www.erodocdb.dk/doks/filedownload.aspx?fileid=3826&fileurl=http://www.erodocdb.dk/Docs/doc98/official/pdf/REC1106.PDF
[153] See Annex 3 for the 400 MHz band plan.
[154] LTE Evolved Universal Terrestrial Radio Access (E-UTRA) Base Station (BS) radio transmission and reception 3GPP TS 36.104 version 14.7.0 Release 14.

- Plum opines that interference seems unlikely to occur to Trunked Systems users, and that the Proposed BEMs would be adequate to provide protection to such systems.

- considers that the Proposed BEMs are suitable to be used as the basis of coordination between licensees, and should provide sufficient protection for adjacent users within the 2 × 5.5 MHz band.

5.29 ComReg considers that the Proposed BEMs would provide sufficient protection to any adjacent licensees within the 2 × 5.5 MHz band, and also sufficiently protect current adjacent users of Trunked Systems, notwithstanding its light usage. ComReg notes that the Proposed BEMs are based on draft ECC Decision (19)02, a strong indication that compliant equipment is available, or will be available in the near term.

5.30 ComReg therefore proposes to adopt Plums recommendations regarding emission limits and interference mitigation and propose that it will be a condition of any future licence that licensees should base any coordination that may be necessary on the Proposed BEMs specified in Annex 2.

Protection of Radio Astronomy

5.31 ComReg notes that the 406.1 – 410 MHz frequency band is allocated to the Radio Astronomy service in both the ITU and European Common Allocation Tables.

5.32 ComReg further notes that footnote 5.149 of the Radio Regulations and ITU Recommendation RA. 769-2 recommend that administrations take all practicable steps to protect the Radio Astronomy service from harmful interference.

5.33 ECC Report 283 further develops the findings of ECC Report 240[155] and considers the potential interference LTE systems may introduce to the Radio Astronomy service operating in the adjacent band and recommends geographic separation areas.

5.34 In its report to ComReg, Plum is of the opinion that it is likely that future use of the Radio Astronomy band 406.1 – 410 MHz can be accommodated through careful selection of the location of the Radio Astronomy site and through coordination with the licensee.

5.35 Although there is currently no Radio Astronomy activity in the band in Ireland, ComReg proposes to attach a licence condition that any potential future licensee(s) must coordinate with any potential Radio Astronomy users so as to minimise interference.

[155] https://www.ecodocdb.dk/download/1886c872-fec6/ECCREP240.PDF

EIRP Limit

5.36 ComReg, in Document 17/67 proposed an EIRP limit of 50 W for this award as it balances interference concerns with the UK while allowing a potential user to deploy a national network using fewer sites[156] and has proven successful in other licence types such as Data Telemetry.

5.37 Respondents to Document 17/67 were in favour of a 50 W EIRP limit, provided that all systems complied with the relevant standards for out-of-band emissions.

5.38 As noted above, Plum advises ComReg to implement a BEM based on draft ECC Decision (19)02, which in turn is derived from ECC Report 283 (the emissions mask in this report is based upon a maximum EIRP of 54 dBm). Plum considers that the ECC has taken all possible precautions to prevent undue interference.

5.39 Given that respondents were in favour of an EIRP of 50 W, and taking into account Plums advice that the Proposed BEMs would, according to ECC Report 283, provide sufficient protection between adjacent users, an EIRP limit of 50 W (or 47 dBm) will likely facilitate better coordination between adjacent licensees.

5.40 ComReg reminds potential licensees that a limit of 50 W is an upper limit and that the minimum EIRP required to maintain the network should be used at all times. Licensees must also take into consideration potential future obligations to protect the Radio Astronomy service, adjacent licensees, and any potential cross border MOU's.

5.7 Roll out obligations / usage conditions

5.41 In Document 17/105, ComReg stated that it would revisit the matter of roll-out and usage conditions more generally during the next consultation phase.

5.42 'Use it or lose it conditions' can be implemented in different ways such as coverage obligations, roll-out obligations, population coverage obligations and so on.

5.43 Roll-out and usage conditions are useful as they can ensure efficient and timely use of the radio spectrum, as there is no guarantee that market forces alone would ensure the efficient use of radio spectrum.

- ComReg has previously utilised some of these approaches, for example, in the 2012 Multi-Band Spectrum Award where existing mobile operators were obliged to have 70% population coverage within 3 years and where a new entrant was obliged to have 35% population coverage within 7 years.

[156] As compared to limiting EIRP to 25 W or even 10 W.

5.44 As noted earlier, the spectrum would be made available in one tranche of 2 × 3 MHz and another tranche of 2 × 2.5 MHz that would be packaged in smaller lots of 2 × 100 kHz.

5.45 With the various possible potential uses, ComReg is unable to specify a 'one size fits all' approach for roll out obligations. For example, a roll-out condition that is suitable for a Smart Grid may not be suitable for an entity that wishes to provide or use Business Radio services. For example, as per the CEPT contribution to ITU WP 1A, Smart Grid will likely require 99.9% geographic coverage, whereas a Business Radio licensee generally requires short distance communications covering major centres. Therefore ComReg is of the opinion that separate roll-out conditions are likely required for the differing tranches of spectrum and these are defined below.

5.46 With regard to Part B, due to the number of potential uses, it is difficult to specify a roll-out or usage condition that fits all parties.

5.47 ComReg considers a reasonable roll-out obligation of no less than 10 base stations in each of the three areas[157] shown in the figure below within the first 3 years.

[157] Area 1, coloured Orange (Carlow, Dublin, Kildare, Kilkenny, Laois, Longford, Louth, Meath, Offaly, Westmeath, Wexford, and Wicklow), Area 2 coloured blue (Clare, Cork, Kerry, Limerick, Tipperary, and Waterford), Area 3 coloured green (Cavan, Donegal, Galway, Leitrim, Mayo, Monaghan, Roscommon, and Sligo)

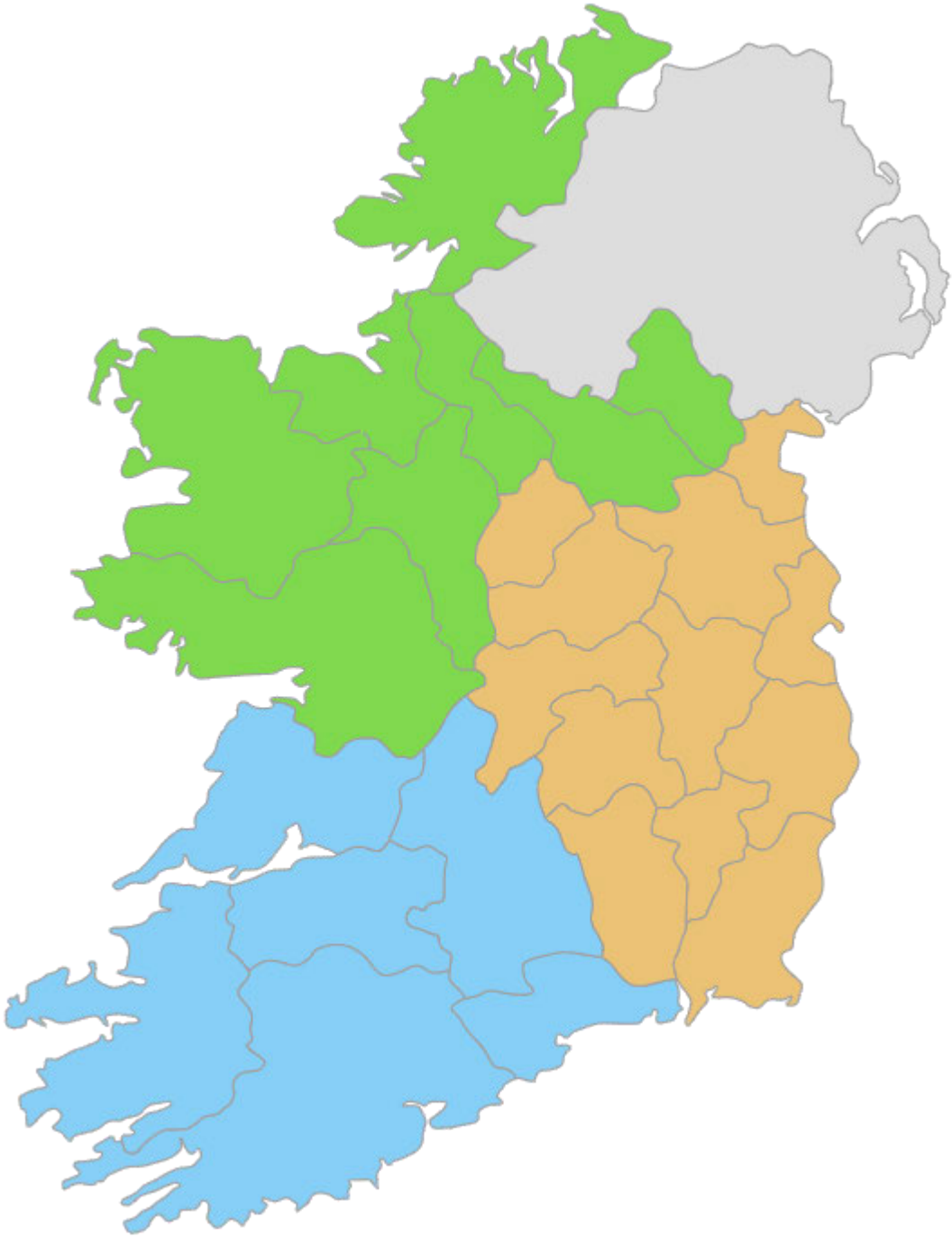

Figure 2. Coverage Areas for the 2 × 2.5 MHz tranche of spectrum

5.48 With regard to Part A, ComReg notes that within Annex 4 of draft ECC Report 292, Figure 10 shows that in the UK by 2031, at least 89% of high voltage sub-stations will require communications as part of the UKs Smart Grid deployment. The report

states that these percentages are expected to be representative of the requirements in most member states. A proposed roll-out condition may be based upon the number of utility network elements to be deployed.

5.49 Considering the above, for Part A, ComReg proposes that a reasonable roll-out obligation is for a Network Utility Operator to provide communications to 50% of its utility network within 3 years of the commencement date of the licence. With a proposed licence duration of no less than 15 years, these licences would expire in 2034 at the earliest, allowing a Network Utility Operator to fully provide for communications capabilities in its utility network by the indicated date of 2031 in para 5.48.

5.50 For the avoidance of doubt, and as stated in the introduction of this document, Smart Metering is not considered part of a Smart Grid and so any roll-out obligation may not be based on, or include, any references to Smart Meter deployment.

Measurement of roll-out obligation

5.51 The obligation for Part B would be assessed after a 3 year period to ensure compliance. The licensee would be required to register the locations of apparatus (both base stations and numbers of connected devices) each on the anniversary of licence issue for ComReg's records and assessment of the usage of spectrum.

5.52 With respect to Part A, in order for the above roll-out obligation to be measurable, ComReg proposes that interested parties must submit details of their utility network (for example, the number and locations of Wireless Telegraphy equipment deployed to cover the Smart Grid network) with their application to participate in any award that may take place. ComReg also proposes to make it a condition of the licence that licensees must submit an annual report on the anniversary of licence issue demonstrating compliance with its roll-out obligation.

5.53 ComReg proposes that the compliance report would include:

- details and location of sites currently in operation, including an indication of the percentage of the network rolled out and a percentage of national geographic coverage;
- next steps and how roll-out obligations would be met; and
- progress since previous report (applicable from the second report).

5.54 The above proposal also requires potential licensees to register, on an annual basis, the locations where wireless telegraphy apparatus is operating in Part A has been deployed. This would allow ComReg to continually measure and assess a licensee's progress against its roll-out obligation.

5.55 ComReg reminds all potential licensees that it would be a condition of the licence that the licensee complies with any rules to prevent spectrum hoarding and the effective exploitation of the rights of use as laid down by ComReg under Regulation 17(10) of the Framework Regulations. While no such rules have yet been laid down by ComReg, ComReg reserves the right to specify such rules in the future and such rules may apply to rights of use for radio frequencies associated with the 400 MHz band.

5.8 Memorandum of Understanding

5.56 ComReg, in Document 17/67, noted that there is a Memorandum of Understanding ("MOU") on frequency coordination between the Republic of Ireland and the United Kingdom in the 400 MHz band, specifically the 410 – 414 / 420 – 424 MHz sub-band, and that all potential operators would be subject to the coordination thresholds and corresponding procedures set out in the MOU.

5.57 Plum, in its report to ComReg, examined the MOU that is currently in place. Plum considers that the MOU should be revisited, as technologies or potential uses that require bandwidths of greater than 25 kHz may experience a greater risk of interference from the narrowband networks present in the UK.

5.58 Plum recommends that systems using a channel spacing of greater than 25 kHz should be accounted for using CEPT Recommendation 25/08[158] and the Harmonised Calculation Method Agreement.

5.59 ComReg concurs that the current MOU should be re-examined as the current potential uses are likely to utilise wideband technologies. ComReg also notes that there has been an increase in the amount of spectrum available to 410 – 415.5 / 420 – 425.5 MHz which could have an effect on systems deployed in the UK.

5.60 ComReg would engage with Ofcom, the UK National Regulatory Authority, to re-examine the current MOU.

5.9 Third Party Use

5.61 In Document 17/67, ComReg outlined that this spectrum may also be acquired for third party use, whereby licensees can allow third parties to use the spectrum without the need for individual licensing by each third party user.

[158] https://www.ecodocdb.dk/download/063e7311-fba7/TR2508.pdf

5.62 ComReg, in Document 17/105, stated that its preliminary view was that the proposed scheme would likely mirror the Third Party Business Radio conditions[159] [160].

5.63 Regarding Part B, ComReg maintains its view that third party use in the band would mirror the Third Party Business Radio by allowing licensees to provide services to third parties throughout the country without the need for individual licensing for specific geographic sites or by each third party user.

5.10 Compliance with the RED Directive

5.64 All radio and telecommunications equipment must comply with the essential requirements and other relevant provisions of the Radio Equipment Directive ("RED")[161] before putting them into service.

5.11 Summary of Proposals

5.65 A summary of ComReg's preliminary views and proposals in this document are as follows:

- Part A of the spectrum would be technology neutral but service specific and restricted for use of Smart Grids as defined in para 3.22 of this document. Part B, the remaining 2 × 2.5 MHz would be awarded in a manner which respects the principles of service and technology neutrality;
- to make 400 MHz spectrum available on a national basis;
- no restriction on bandwidth, but to allow licensees to use spectrum rights of use with whatever bandwidth they wish, provided that potential licensees operate within their spectrum holdings and comply with the Proposed BEMs discussed in section 5.6 and specified in Annex 2;
- a licence duration of 15 years;
- to make the spectrum available for FDD operation only;
- a Block Edge Mask ("BEM") which licensees must conform to;

[159] https://www.comreg.ie/media/2016/04/Third-Party-BR-Guidelines-Document-05_82R4.pdf
[160] http://www.irishstatutebook.ie/eli/2005/si/646/made/en/print
[161] http://www.irishstatutebook.ie/eli/2017/si/248/made/en/print

- ComReg's further proposal on allowing potential Third Party Use in the band is that the proposed scheme is likely to mirror the Third Party Business Radio licensing scheme;

- Part B would be made available in lots of 2 × 100 kHz. To clarify, this represents the smallest building block that potential users may use to aggregate spectrum into larger amounts;

- ComReg's proposals on roll-out and usage obligations:

    - for Part B of the spectrum, ComReg considers a reasonable roll-out obligation of no less than 10 base stations in each of the three areas as defined in section 5.7 by year 3. This obligation will be assessed after 3 years; and

    - for Part A, a roll-out obligation for a Network Utility Operator to provide communications to 50% of its utility network within 3 years of the commencement date of the licence.

- ComReg is of the view that a SCA is the auction format best suited to deal with the considerations outlined in the DotEcon Report;

- ComReg is of the preliminary view that lots in Part A should be made available on a frequency specific basis (that is, 410 – 413 MHz / 420 – 423 MHz) and Part B should be made available on a frequency generic basis;

- ComReg is of the preliminary view that a competition cap is not appropriate for this award process;

- any spectrum not taken up in the Part A auction will be included as part of the award for the remaining Part B; and

- the fee proposals are as follows:

Spectrum Block	Minimum Price (discounted)	Minimum SAF	Annual SUF
Part A (Smart Grid 2 × 3 MHz)	€590,000	€240,000	€39,000
Part B (2 × 100 kHz Lots)	€19,600	€8,000	€1,300

Chapter 6

6 Submitting Comments

6.1 All input and comments are welcome. However, it would make the task of analysing responses easier if comments were referenced to the relevant section / paragraph number in each chapter and annex in this document.

6.2 Please also set out your reasoning and all supporting information for any views expressed so that ComReg can make a full assessment of your input.

6.3 The consultation period will run until 17:00 on Wednesday 21 November 2018 during which time ComReg welcomes written comments on any of the issues raised in this paper.

6.4 Responses must be submitted in written form and sent to the below email address for the attention of Mr. Patrick Bolton, and clearly marked – Submissions to ComReg 18/92:

Email: marketframeworkconsult@comreg.ie

6.5 ComReg requests that electronic submissions be submitted in an unprotected format so that they can be redacted (if required) and included in the ComReg submissions document for electronic publication.

6.6 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. In that regard, **respondents are requested to provide both a confidential and non-confidential versions 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.

6.1 Next Steps

6.7 When it has concluded its review of all submissions received and other relevant material, ComReg's intention would be to publish a response to consultation and a draft decision as appropriate.

Annex: 1 Legal Basis

A 1.1 The Communications Regulation Acts 2002-2017[162] (the "2002 Act"), the Common Regulatory Framework (including the Framework and Authorisation Directives[163] as transposed into Irish law by the corresponding Framework and Authorisation Regulations[164]), and the Wireless Telegraphy Acts 1926 to 2009[165] 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 1.2 Apart from licencing 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 1.3 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 (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.

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[162] The Communications Regulation Act 2002, the Communications Regulation (Amendment) Act 2007, the Communications Regulation (Premium Rate Services and Electronic Communications Infrastructure) Act 2010, the Communications Regulation (Postal Services) Act 2011, the Communications Regulation (Postal Services) (Amendment) Act 2015, and the Communications Regulation (Postal Services) (Amendment) Act 2017.

[163] 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")

[164] 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.

[165] The Wireless Telegraphy Acts 1926 to 1988 and Sections 181 (1) to (7) and (9) and Section 182 of the Broadcasting Act 2009.

A 1.4 All references in this annex to enactments are to the enactment as amended at the date hereof, unless the context otherwise requires.

Primary Objectives and Regulatory Principles under the 2002 Act and Common Regulatory Framework

A 1.5 ComReg's primary objective in carrying out its statutory functions in the context of electronic communications are to:

- Promote competition[166]
- contribute to the development of the internal market[167]
- promote the interests of users within the Community[168];
- 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;[169] 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 regulations[170] in particular those designed to ensure effective competition[171]

Promotion of Competition

A 1.6 Section 12(2)(a) of the 2002 Act requires ComReg to take all reasonable measures which are aimed at the promotion of competition, including:

[166] Section 12 (1)(a)(i) of the 2002 Act.
[167] Section 12 (1)(a)(ii) of the 2002 Act.
[168] Section 12(1)(a)(iii) of the 2002 Act.
[169] 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.
[170] 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).
[171] Regulation 16(1)(a) of the Framework Regulations.

- 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 1.7 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 1.8 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.

Contributing to the Development of the Internal Market

A 1.9 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 1.10 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.

Promotion of Interests of Users

A 1.11 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 1.12 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 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.

Regulatory Principles

A 1.13 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.

BEREC

A 1.14 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.

Other obligations under the 2002 Act

A 1.15 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[172];
- 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[173]; 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.[174]

Policy Directions

A 1.16 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.

[172] Section 12(3) of the 2002 Act.
[173] Section 12(5) of the 2002 Act.
[174] Section 12(6) of the 2002 Act.

Policy Direction No.4 on Industry Sustainability

A 1.17 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.

Policy Direction No.5 on Regulation where necessary

A 1.18 Where ComReg has 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 1.19 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 1.20 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 Management of the Radio Frequency Spectrum

A 1.21 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

A 1.22 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.

Other relevant obligations under the Framework and Authorisation Regulations

Framework Regulations

A 1.23 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 1.24 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 1.25 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 1.26 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 1.27 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 1.28 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 1.29 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 1.30 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 1.31 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 1.32 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 1.33 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.

Authorisation Regulations

Decision to limit rights of use for radio frequencies

A 1.34 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 1.35 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 1.36 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 1.37 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 1.38 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 1.39 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 1.40 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 1.41 Regulation 10(02) 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 1.42 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 1.43 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 1.44 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 1.45 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 1.46 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.

Amendments of rights and obligations

A 1.47 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).

Other Relevant Provisions

Wireless Telegraphy Act, 1926 (the "1926 Act")

A 1.48 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 1.49 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 1.50 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 1.51 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 1.52 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.

Article 4 of Directive 2002/77/EC (Competition Directive)

A 1.53 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."

EECC and other relevant standards

A 1.54 The project team has taken account, where relevant, of:

- provisions of the draft European Electronic Communications Code (Proposal for a Directive of the European Parliament and of the Council establishing the European Electronic Communications Code (Recast) - COM(2016)590) (it is currently envisaged that the Directive will be published in the Official Journal in late 2018, and that there will be a two year transposition period), including, for instance, provisions relating to spectrum rights of use;
- reports by the International Telecommunication Union ("ITU"), including Report ITU-R SM.2351 (Smart grid utility management systems), Working Document towards a preliminary draft revision of Report ITU-R SM.2351-2, 28 June 2018;
- standards of the European Telecommunications Standards Institute ("ETSI"), including ETSI TR 103 528: "SmartM2M; Landscape for open source and standards for cloud native software applicable for a Virtualized IoT service layer" and ETSI TR 103 527: "SmartM2M; Virtualized IoT Architectures with Cloud Back-ends".

See Annex 4 to this consultation paper for Electronic Communications Committee decisions relevant to the 400 MHz Band.

Annex: 2 Interference Mitigation

A 2.1The below is taken from draft ECC Decision (19)02.

Base station transmitter mask

Table 3: BS frequency range of out-of-block emissions (1.4 MHz, 3 MHz and 5 MHz channel bandwidth)

Frequency range	Maximum mean out-of-block e.i.r.p. (dBm/cell)	Measurement bandwidth
UL band 410 – 420 MHz	-43	100 kHz
0 MHz ≤Δf < 0.2 MHz offset from BS transmit band edge	-11 dBm (see note)	100 kHz
0.2 MHz ≤Δf < 1 MHz offset from BS transmit band edge	-26 dBm (see note)	100 kHz
1 MHz ≤Δf < 10 MHz offset from BS transmit band edge	-43 dBm (see note)	100 kHz
Note: additional 40 dB out-of-block emission reduction may be needed on national level for the protection of radiolocation services.		

Table 4: BS frequency range of out-of-block emissions (1.25 MHz channel width)

Frequency offset from centre frequency (MHz)	Channel width 1.25 MHz	Measurement bandwidth
±0.885-1.98	-17 dBm	30 kHz
±1.98-4	-22 dBm	30 kHz

User Equipment

Table 5: UE transmitter characteristics

Parameter	Value
Channel bandwidth	1.25, 1.4, 3 or 5 MHz
Maximum mean in-block power	23 dBm

Table 6: UE maximum unwanted emission levels (1.4 MHz, 3 MHz and 5 MHz channel width)

Frequency offset from channel edge (MHz)	Channel width			Measurement bandwidth
	1.4 MHz	3 MHz	5 MHz	
±0-1	-10 dBm	-13 dBm	-15 dBm	30 kHz
±1-2.5	-10 dBm	-10 dBm	-10 dBm	1 MHz
±2.5-2.8	-25 dBm	-10 dBm	-10 dBm	1 MHz
±2.8-5		-10 dBm	-10 dBm	1 MHz
±5-6		-25 dBm	-13 dBm	1 MHz
±6-10			-25 dBm	1 MHz

Table 7: UE maximum unwanted emission levels (1.25 MHz channel bandwidth)

Frequency offset from channel edge (MHz)	Channel width 1.25 MHz	Measurement bandwidth
±0.885-1.98	-24 dBm	30 kHz
±1.98-4	-44 dBm	30 kHz

A 2.2For channel bandwidths of 6.25 – 200 kHz, the following should be applied:

Wanted channel effective radiated power: 40 dBm for user equipment and 53 dBm for base station equipment

Adjacent and alternate adjacent channel power: Power in upper and lower channels shall not exceed a value of 60 dBc below the transmitter power level without the need to be below the -36 dBm e.r.p.

Unwanted emissions in the spurious domain: During operation shall not exceed -36 dBm for frequencies up to 1 GHz and -30 dBm for frequencies above 1 GHz. During standby shall not exceed -57 dBm for frequencies up to 1 GHz and -47 dBm.

Annex: 3 The 400 MHz Band Plan

Figure A1. 400 MHz Band Plan

Annex: 4 ECC Decisions Relevant to the 400 MHz band

A 4.1 **ECC Decision (04)06** – this Decision specifies that the frequency requirements for Wide Band Digital Land Mobile PMR/PAMR systems using different channel bandwidths shall be met in a number of bands, including the 410 – 430 MHz band, in response to market demand. In 2005, ComReg assigned spectrum rights of use in this band to Wideband Digital Data Services. These licences expired in 2015.

A 4.2 **ECC Decision (06)06** – this Decision covers Narrow Band Digital Land Mobile PMR/PAMR using channel spacing up to 25 kHz. It specifies that a sufficient amount of spectrum shall be made available in response to market demand for Narrow Band Land Mobile PMR/PAMR within a number of bands, including the 410 – 430 MHz band. Currently, there is ample spectrum available in the Business Radio, Third Party Business Radio and PMSE licence schemes.

A 4.3 **ECC Decision (08)05** – this Decision identifies the frequency bands for digital Public Protection and Disaster Relief (PPDR) narrow band and wide band radio applications in the 380 – 470 MHz band. The Decision specifies that spectrum shall be made available for wideband digital PPDR radio applications using channel spacing of 25 kHz or more in the 380 – 470 MHz band. Currently, TETRA Ireland are licensed to operate in the 380 – 385 / 390 – 395 MHz band.