Commission for
Communications Regulation

Proposed Strategy for Managing the Radio Spectrum - 2019 to 2021

Consultation on ComReg's new Radio Spectrum Management Strategy Statement

Reference: ComReg 18/74

Date: 03/08/2018

An Coimisiún um Rialáil Cumarsáide
Commission for Communications Regulation
Abbey Court Irish Life Centre Lower Abbey Street Dublin 1 Ireland
Telephone +353 1 804 9600 Fax +353 1 804 9680 Email info@comreg.ie Web www.comreg.ie

Contents

Section Page

Annex

Section **Page**

Chapter 1

1 Introduction

1.1 Background and Purpose

1.1 The Commission for Communications Regulation ("ComReg") is the statutory body responsible for the regulation of the electronic communications (telecommunications, radiocommunication and broadcasting networks), postal and premium rate sectors in Ireland in accordance with European Union ("EU") and Irish law. ComReg also manages Ireland's radio spectrum (or "spectrum") and national numbering resource.

1.2 Radio spectrum is a medium by which information may be transmitted wirelessly over distances ranging from a few metres to thousands of kilometres. It is a valuable national resource underpinning important economic, social and communications activities. These include widely used services, such as mobile/fixed wireless communications and broadband, radio and TV broadcasting, and the safe operation of air and maritime transport. Radio spectrum is also fundamental in the day-to-day operation of the emergency services and defence forces and is a vital input to many other services including important scientific applications, such as weather forecasting and monitoring the Earth's environment. However, it is a finite natural resource with competing uses and users and so it must be managed effectively and efficiently used.

1.3 To assist ComReg's management of the radio spectrum, ComReg regularly sets out and updates its strategy for same.[1] ComReg's current Spectrum Management Strategy Statement 2016 to 2018 (Document 16/50[2]) ("2016-2018 Strategy Statement)" was finalised in 2016 and set out, among other things, its work plan priorities at that time.

1.4 This documents sets out, and invites comments from interested parties on, ComReg's draft radio spectrum management strategy statement and work plan proposals for the period 2019 to 2021.

1.5 Published alongside this document is a report from Frontier Economics ("Frontier") entitled *"Report on Measuring the Economic Value of Spectrum"* (Document 18/74a) ("Frontier Report").

[1] In accordance with ComReg's obligations under section 31 of the Communications Regulation Act 2002 (as amended) ("2002 Act").

[2] ComReg Document 16/50 - Radio Spectrum Management Strategy 2016 to 2018 – 21 June 2016.

1.2 Structure of this document

1.6 The remainder of this document is structured as follows:

- **Chapter 2:** provides and introduction to Ireland's radio spectrum and the importance of managing the radio spectrum in Ireland;
- **Chapter 3:** provides an a review of the strategy period 2016 – 2018
- **Chapter 4:** considers the factors informing ComReg's strategy for the period 2019 - 2110
- **Chapter 5:** sets out ComReg's draft work plan for the period 2019 - 2021
- **Chapter 6:** sets out the economic contribution of radio spectrum to Ireland
- **Chapter 7:** sets out details of the next steps including the requirements for making submissions.
- **Annexes:**
- **Annex 1:** Summary of ComReg's statutory framework relevant to the management of the radio frequency spectrum in Ireland;
- **Annex 2:** Spectrum designators

Chapter 2

2 The Framework for Spectrum Management in Ireland

2.1 Spectrum Policy and Management in Ireland

2.1.1 Spectrum Policy

2.1 A key role of the Department of Communications, Climate Action and Environment ("DCCAE") is the development of policies for the regulation and optimal use of Ireland's radio spectrum. Spectrum policy is part of the national policy governing the telecommunications sector in Ireland, which also covers next generation broadband, electronic communications services ("ECS") and international connectivity. The DCCAE also has the responsibility for developing national broadcasting policy and associated spectrum use.

2.1.2 Spectrum Management: ComReg's mandate and role

2.2 The Communications Regulation Act 2002 (as amended) (the "2002 Act"), the European Common Regulatory Framework for electronic communications networks ("ECN") and ECS (including the Framework and Authorisation Directives[3] as transposed into Irish law by the corresponding Framework and Authorisation Regulations[4]), and the Wireless Telegraphy Acts 1926 (as amended)[5] (the "1926 Act") set out, among other things, functions, objectives, powers and duties that are relevant to ComReg's management of the radio spectrum.

2.3 In exercising its function of the management of Ireland's radio spectrum (and in accordance with relevant ministerial Policy Directions given under section 13 of the 2002 Act), ComReg's primary spectrum management objective is to ensure the efficient management and use of the radio spectrum. ComReg is obliged to

[3] Directive No. 2002/21/EC (as amended by Regulation (EC) No. 717/2007, Regulation (EC) No. 544/2009 and Directive 2009/140/EC) (the "Framework Directive") and Directive No. 2002/20/EC (as amended by Directive 2009/140/EC) (the "Authorisation Directive")

[4] European Communities (Electronic Communications Networks and Services) (Framework) Regulations 2011 (S.I. No. 333 of 2011) ("Framework Regulations") and the European Communities (Electronic Communications Networks and Services) (Authorisation) Regulations 2011 (S.I. No. 335 of 2011) ("Authorisation Regulations").

[5] The Wireless Telegraphy Acts, 1926 and 1956, the Broadcasting Authority Acts, 1960 to 1971, in so far as they amend those Acts, the Wireless Telegraphy Act 1972, Sections 2 , 9, 10,11,12,14,15,16,17 and 19 of the Broadcasting and Wireless Telegraphy Act 1988 and Sections 181 (1) to (7) and (9) and Section 182 of the Broadcasting Act 2009.

effectively carry out this function, including having regard to relevant government policy statements and international developments.

2.4 In the context of radio spectrum used for ECN/ECS, one of ComReg's primary objectives is to promote and create the conditions for effective competition in the provision of ECN and ECS. In that regard, section 12(2)(a) of the 2002 Act requires ComReg to take all reasonable measures which are aimed at the promotion of competition, including:

- ensuring that there is no distortion or restriction of competition in the electronic communications sector;
- encouraging efficient use and ensuring the effective management of radio frequencies and numbering resources; and
- ensuring that users, including disabled users, derive maximum benefit in terms of choice, price and quality.

2.5 Readers are referred to Annex 1 for an overview of the legal framework and statutory objectives relevant to ComReg's management of the radio spectrum.

2.6 ComReg recognises that the current European Common Regulatory Framework for ECN and ECS is expected to be superseded by the European Electronic Communications Code ("EECC") during the course of this forthcoming strategy period. Among other things, the ECCC will consolidate and update the various directives under the existing framework (i.e. the Framework, Authorisation, Access and Universal Service directives).

2.7 The EECC received political agreement on 6 June 2018. ComReg understands that the EECC is expected to be adopted (i.e. published in the Official Journal of the EU) by the end of 2018 and that Member States will be given up to two years to transpose the EECC into national law. In that regard, ComReg expects that the DCCAE will be responsible for its transposition, and ComReg will assist as appropriate.

2.8 In fulfilling its spectrum management function, ComReg carries out a range of programmatic activities, including the:

- licensing of spectrum rights of use in Ireland for a wide variety of uses;
- monitoring of radio spectrum usage in Ireland, including the enforcement of licence conditions and equipment standards; and
- promotion of Ireland as an ideal location for spectrum development using Test and Trial Ireland.

2.9 Further details of these activities are set out in Chapter 3.

2.2 Spectrum Management

2.10 The radio spectrum is a limited and valuable national resource that permeates all areas of communications, including radio, television, mobile voice and data, aeronautical/marine navigation, and satellite communications. Increased demand for the radio spectrum requires that it be used efficiently and that effective spectrum management processes be employed to maximise the benefits to society.

2.11 The ability to take full advantage of the spectrum resource depends on the spectrum management activities that facilitates the implementation of radio systems with minimum radio interference.[6] However, as spectrum is a finite resource with many different services and users, spectrum management involves the careful consideration of a broad range of factors (e.g. administrative, regulatory, social, economic and technical) with a view to ensuring that radio spectrum is efficiently used. This may also involve balancing a range of competing factors, including:

- appropriately meeting the reasonable requirements of all radio services, including commercial and public uses, such as public safety, national security and health care; and
- for spectrum used for ECS and ECN, promoting competition including ensuring that users derive maximum benefit in terms of price, choice and quality, contributing to the development of the internal market, and promoting the interests of users within the Community.

2.12 A system of spectrum management is required to ensure the efficient assignment and subsequent use of scarce frequencies among competing uses and users. This should promote competition within the relevant downstream markets, particularly given that spectrum is an essential input in the provision of many ECS and an inefficient assignment of spectrum has the potential to distort competition and create inefficient outcomes for society.

2.2.1 Spectrum management processes

International aspects to spectrum management

2.13 As radio frequencies naturally extend beyond national borders, spectrum management requires knowledge of, and involvement in, European and global spectrum management developments. Much of the radio spectrum requires international planning and in some cases this may constrain how specific

[6] The radio spectrum needs be managed because two or more radio signals occurring simultaneously and in the same location can interfere with each other reducing the ability of the radio spectrum to operate effectively. It is not possible for users to share spectrum indiscriminately because one user may cause interference for another user.

frequencies or frequency bands may be used. This is particularly so in the aeronautical and maritime sectors where, because of the global nature of these services, ships and aircraft must use specific frequencies for navigation and communication purposes. The frequency bands used by TV and radio broadcasting services have also been harmonised for many decades to facilitate coordination between neighbouring countries and to assist the development of consumer markets. More recently, an increasing number of radio frequency bands have been internationally harmonised for commercial radio systems, such as wireless mobile communications.

2.14 While the "allocation" and/or "assignment" of spectrum is a national function, the global regulation of spectrum is primarily within the remit of the International Telecommunication Union ("ITU"), while European regulatory functions lie with the EU and the European Conference of Postal and Telecommunications Administrations ("CEPT"). These bodies define the broad framework within which all spectrum users must operate and, in some cases, these bodies develop harmonised decisions, recommendations, and approaches for the use of spectrum. Harmonised radio frequency bands provide considerable benefits in facilitating the development of international services, promoting economies of scale with respect to the manufacture of radio equipment (thereby lowering both the cost of deploying wireless networks and the cost of wireless devices for consumers), and minimising the risk of interference between users.

2.15 As the radio spectrum manager for Ireland, ComReg is charged with the implementation of international treaties and obligations[7] relating to the use of radio spectrum in the State. The implementation of these measures often requires actions in relation to the allocation and/or assignment of radio spectrum as discussed below.

[7] The interference-free operation of radiocommunication systems across international borders is achieved through the implementation of the Radio Regulations (RRs) and Regional Agreements, and the efficient and timely update of these instruments through the processes of the World and Regional Radiocommunication Conferences. The Radio Regulations (RRs), which have the status of an international intergovernmental treaty, provide a framework for the use of the radio frequency spectrum and satellite orbits. To keep pace with the fast development of technologies and the consequent convergence of services and technologies, the Radio Regulations are revised every three to four years at a World Radiocommunication Conference. The last WRC was held in November 2015 in Geneva

The radio spectrum decisions and recommendations of the CEPT (ECC Decisions and ECC Recommendations) are non-binding on national administrations. The list of ECC Decisions/Recommendations and their implementation status for all CEPT countries, including Ireland, is maintained at http://www.erodocdb.dk .

The radio spectrum decisions of the EU (the EU/EC Decisions) are binding decisions on EU Member States. These decisions are normally based on the relevant technical harmonisation measures as outlined in the CEPT reports to the EC and are generally adopted subsequent to the prior adoption of a CEPT ECC Decision. A list of EU Decisions/Recommendations is maintained at https://ec.europa.eu/digital-agenda/en/radio-spectrum-policy-document-archive

2.16 Along with the DCCAE, ComReg plays an active role in international fora to ensure that, as far as possible, decisions relating to the international radio spectrum regulatory framework accommodate Ireland's specific requirements. ComReg additionally participates in technical compatibility studies and in the development of technical standards to support more efficient and flexible use of the spectrum.

The allocation of radio spectrum in Ireland

2.17 The **allocation** of radio spectrum means "the designation of a given frequency band for use by one or more types of radiocommunications services, where appropriate, under specified conditions".[8] An allocation identifies the services that could potentially use a radio frequency band and is an important activity in facilitating the international coordination of radio spectrum between regional areas and neighbouring countries (thereby reducing the potential for interference) and enabling economies of scale.

2.18 Under the 2002 Act, ComReg is obliged to publish a Radio Frequency Plan ("Plan"). The Plan is comprised of a set of tables which sets out Ireland's radio spectrum allocations for 8.3 kilohertz to 3000 Gigahertz, indicating the services to which each frequency band is allocated ("frequency allocations") in the radio spectrum and is an essential tool for current and future users of radio frequencies.

2.19 The Plan is updated regularly in line with the outcomes of the ITU World Radiocommunication Conferences ("WRCs") and other relevant developments, such as the adoption of European harmonisation decisions and recommendations for a particular radio frequency band or service. The current version was published in May 2017[9] and a comprehensive update is anticipated following the ITU World Radiocommunications Conference in 2019 (see Chapter 4 for further details on WRC-19).

The assignment of radio spectrum in Ireland

2.20 The assignment of radio spectrum refers to the spectrum management activities that issues, and authorises the use of, rights of use of radio frequencies[10]. In Ireland, the possession and use of radio equipment requires authorisation from

[8] European Communities (Electronic Communications Networks and Services) (Framework) Regulations 2011 (S.I. 333 of 2011).

[9] ComReg Document 17/34 - *Radio Frequency Plan for Ireland* — published 3 May 2017.

[10] A spectrum assignment refers to the rights of use for specific radio frequencies within a frequency band issued to an individual or for a station and usually under specified conditions (e.g. in the context of radio frequencies for ECS, one or more of the conditions identified in Part B of the Schedule to the Authorisation Regulations).

ComReg and this authorisation may take the form of either a licence or a licence-exemption under the 1926 Act.

2.21 Ideally, spectrum should be distributed efficiently, which means giving access to the combination of uses and users that maximises economic activity, subject to taking account of social welfare, public and other legitimate policy concerns. Granting spectrum rights of use to one user rather than another can greatly impact the extent to which the radio spectrum is efficiently used to deliver overall benefits for society.

2.2.2 Promotion of effective competition in management of spectrum for ECS and spectrum management tools

2.22 As noted above, spectrum is an essential input in the provision of ECS and an inefficient assignment has the potential to distort competition and create inefficient outcomes for society.

2.23 These issues are reflected in ComReg's ECS Strategy Statement[11] where the following three principle methods are identified by which to promote competition and consumer choice:

1. market access;
2. access to essential inputs; and
3. demand-side factors.

2.24 In relation to the second principle (i.e. access to essential inputs), ComReg outlined its strategy to ensure that the management of the national spectrum (and numbering) resources take account of the promotion of competition, and the potential impact that the assignment and allocation of these inputs may have on downstream markets.[12] This principle also informs Goal 5 of the ECS Strategy Statement, which requires ComReg to take all reasonable measures which are aimed at the promotion of competition.

GOAL 5
Spectrum management for electronic communications markets takes account, inter alia, of the promotion of competition.

Source: ECS Strategy Statement 2017-2019

[11] ComReg Electronic Communications Strategy Statement 2017-2019:
https://www.comreg.ie/publication/electronic-communications-strategy-statement-2017-2019-design-version/

[12] ComReg's Electronic Communications Strategy Statement 2017-2019 – p10.

2.25 Goal 5 in turn reflects one of ComReg's primary objectives in respect of ECN and ECS being the promotion of competition. The promotion of competition is a primary goal of ComReg's spectrum management functions because effective competition between wireless service providers brings long term benefits to consumers in terms of price, choice, quality of services and innovation. The efficient assignment and use of the radio spectrum is an important consideration in promoting effective competition[13].

2.26 In that regard, ComReg takes a proactive approach to ensuring the efficient assignment and use of the radio spectrum while promoting effective competition and producing an optimal outcome for society. ComReg has a number of spectrum management tools that are designed to serve the interests of all users of the radio frequency spectrum and strike the right balance between those users while ensuring that spectrum is used efficiently and competition is not distorted. ComReg uses these tools as required, depending on the circumstances of each particular assignment, in order to derive the maximum benefit for society and contribute to the development of the internal market, while promoting the interests of users within the Community. These tools are illustrated in Figure 1 below.

Figure 1: Spectrum Management Tools

[13] 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.

2.27 The use of these tools involves the careful consideration of a broad range of factors (e.g. administrative, regulatory, social, economic and technical) with a view to ensuring that radio spectrum is efficiently assigned and used. Any measures must also be objectively justified, transparent, non-discriminatory and proportionate in relation to their intended purpose. The proposed use of such spectrum management tools often requires detailed consideration with relevant stakeholders[14].

2.28 The ECS Spectrum Strategy Statement, among other things, also notes that:

- Creating the conditions for investment is as much about regulatory certainty as it is about shaping operator incentives;
- ComReg will continue to publish its forward-looking strategy for managing the radio spectrum; and
- ComReg publishes information on existing licensees' spectrum assignments and usage because, among other things, this can increase the efficient use of spectrum by better informing consumers and other interested parties (such as actual and potential spectrum users);

2.29 In relation to the first bullet, spectrum management can facilitate investment by fostering regulatory certainty and ensuring the availability of the necessary inputs by effectively managing the radio spectrum. In that regard, effective competition is the principal driver of efficient investment and as such ComReg seeks to create the conditions for investment primarily by promoting competition. This is in line with Goal 15 and ComReg's 'Third Strategic Intention'.[15]

GOAL 15
The management of spectrum and numbers facilitates efficient investment.

Source: ECS Strategy Statement 2017-2019

2.30 In relation to bullets 2 and 3, the Radio Spectrum Management Strategy Statement is an important spectrum management tool of itself as it provides interested parties with visibility of future planned releases of spectrum, which allows them in turn to plan for their spectrum needs. It also allows ComReg to take due account of the timing of each spectrum award. The assignment of

[14] See Goal 24 ECS Strategy Statement below. "We are proactive on engagement with a range of stakeholders."

[15] See Strategic Intention 3 ECS Strategy Statement "Efficient investment has enabled affordable, high quality and widespread access to communications services and applications"

harmonised bands, such as those suitable for widespread coverage[16], provides opportunities for promoting new entry and competition. Given that rights of use for important bands are typically assigned for long periods (e.g. 15 years, or potentially 20 years as proposed under the EECC), the timing of spectrum awards should be such that opportunities for promoting new entry and effective competition are maximised (e.g. ensuring that a mix of complementary and/or substitutable spectrum across different bands are available at different intervals).

2.31 Notwithstanding, ComReg is conscious of the need to respond to changing circumstances which could undermine efficiency and innovation. In that regard, ComReg continues to monitor the market in order to learn from users' ongoing experience and adapt to changes in, among other things, technologies, and demand for services from spectrum users and end-users, market developments and relevant public policy.

Consumer information and market monitoring

2.32 As part of its spectrum management function, ComReg monitors the market in order to be informed of changes to the market since previous radio spectrum management strategy statements and spectrum awards. ComReg is conscious that the circumstances previously present may have changed or the market has developed such that the spectrum management tools referred to above may need to be deployed differently to promote competition and protect consumers. This approach is in line with Goal 8 of the ECS Strategy Statement.

GOAL 8
ComReg understands evolving consumer needs, preferences, behaviours and perceptions.

Source: ECS Strategy Statement 2017- 2019

2.33 In that regard, ComReg continually tracks end-user usage trends (see ComReg Quarterly Reports) and has completed various market research and forecasting in order to inform future spectrum management activities. For example:

- B&A Mobile Consumer Experience Survey (See Documents 17/100 and 17/100a);
- 2017 Ireland Communicates Survey of ICT usage by consumers (Document 18/23a);
- 2017 Ireland Communicates Survey of ICT usage by SMEs (Document 18/23b); and

[16] For example: the 700 MHz, 800 MHz or 900 MHz bands.

- Mobile data usage forecasts (Document 18/35 and 18/35a).

2.34 For example, the following pertinent points have important spectrum management implications:

- Total annual mobile data traffic is forecast to increase by over 3.5 times between 2017- 2022[17];
- The Mobile Consumer Experience Survey highlighted a number of key issues and concerns with regard to mobile connectivity including:
    - inside the home is where consumers mostly use their mobile phone for voice and data services[18];
    - incidence of experiencing service issues in the house for calls/text and data (c. 30%) is higher than the same service issues that occur outside the home[19]; and
    - rural consumers have higher rates of experiencing service issues regardless of location with higher levels of service issues arising in the home (i.e. indoor).[20]
- The ICT survey highlighted that making and receiving calls domestically remains the most important use of mobile telephony.[21]

2.35 In response to the information received, ComReg initiated the following work streams with a view to (a) informing future spectrum award proposals, (b) providing additional consumer information and (c) improving the connectivity experience for consumers:

- its recently published preliminary consultation on a proposed multi-band award of spectrum rights in the 700 MHz Duplex, Paired 2.1 GHz, 2.3 GHz and 2.6 GHz bands[22];
- a Future Mobile Connectivity ("FMC") study to obtain advice on mobile connectivity services and the potential costs of providing same;
- *"Meeting Ireland's Connectivity Needs"* – a report for ComReg that will provide an overview of the challenges in providing connectivity in Ireland

[17] ComReg Document 18/35 – Mobile Data Traffic Forecast in Ireland

[18] ComReg Document 17/100a - *Ireland Communicates Survey 2017 – Consumer* - slides 43 & 46.

[19] ComReg Document 18/32a - Ireland Communicates Survey 2017 – Consumer - slide 51.

[20] ComReg Document 18/32a - Ireland Communicates Survey 2017 – *Consumer* - slides 54 & 56.

[21] ComReg Document 18/32a - *Ireland Communicates Survey 2017 – Consumer* - slide 32.

[22] ComReg Document 18/60 – Proposed multi band spectrum award - preliminary consultation on which bands to award.

and the actions that all stakeholders can take to optimise their levels of connectivity which are available on different networks across Ireland;

- Coverage obligations and Spectrum Awards – a report for ComReg that will assess the extent to which appropriate coverage and rollout obligations can be included in future spectrum awards;
- Effect of Building Materials on Indoor Mobile Performance: determining and reporting upon the extent to which some representative modern building materials impact on in-building coverage by measuring overall attenuation through each building material tested[23];
- Bi-Annual Drive Testing - Assessment of Mobile Network Operators' Compliance with Licence Obligations (Coverage)[24];
- Mobile Handset Performance: measuring and reporting on the antenna performance of mobile handsets available on the Irish market in order to quantify the performance of each handset when making or receiving a mobile call and to stream data. See:
    - Voice (Document 18/05)[25]
    - Data (publication expected Q3 2018); and
- Mobile Coverage Prediction Map - a solution to provide consumers with a visual (geographic-based) means of presenting predicted mobile coverage throughout Ireland, through the use of an interactive website.

2.36 This approach is also in line with Goal 17 of the ECS Strategy Statement. In particular, the 'FMC Report' and the 'Coverage Obligations and Spectrum Awards Report' will be used by ComReg to inform its considerations in relation to any coverage obligations associated with the assignment of 700 MHz rights of use.

GOAL 17
Mobile coverage obligations are used to promote investment where proportionate.

Source: ECS Strategy Statement 2017- 2019

2.37 In providing for same, ComReg recognises the need to communicate with different stakeholder groups and interested parties. This engagement takes a number of forms, including formal consultation[26] and publication of proposals

[23] ComReg Document 18/73 – The effect of building material on indoor mobile performance.

[24] ComReg Document 18/26 – Assessment of mobile network operators' compliance with licence obligations (coverage) winter 2017.

[25] ComReg Document 18/05 - Mobile Handset Performance (Voice).

[26] ComReg Document 11/34 - *Consultation Procedures*.

on the ComReg website, and is in line with Goal 24 of the ECS Strategy Statement.

GOAL 24
We are proactive on engagement with a range of stakeholders.

Source: ECS Strategy Statement 2017 - 2019

2.38 ComReg will publish the output from each work stream and the information contained therein will be used to inform ComReg's spectrum management activities across a range of projects in order to promote the best outcomes for society.

Chapter 3

3 Review of 2016 – 2018 Strategy

3.1 In this chapter, ComReg considers the implementation of its 2016-2018 Strategy Statement (i.e. radio spectrum work plan), as set out in Chapter 6 of Document 16/50), in the context of the following categories:

- ComReg's spectrum management function (i.e. programmatic work);
- Broadcasting services;
- Mobile, nomadic and fixed wireless broadband services;
- Satellite services;
- (point-to-point) radio links;
- Short range devices (including IoT);
- Business radio services (including PPDR and PMSE);
- Radio amateur services; and
- Aeronautical, maritime, scientific and defence services.

3.1 ComReg's spectrum management function

3.2 In section 6.2.1 of Document 16/50, ComReg identified that it would continue to take actions that encourages and ensures the efficient use of spectrum in Ireland including:

i. granting access to spectrum via licence-exemption or licensing as appropriate;

ii. authorising spectrum on a non-exclusive basis and encouraging sharing where appropriate and technically feasible;

iii. increasing transparency on licensees' spectrum assignments and usage via, for example, the publication of non-confidential licence or usage information;

iv. proactively monitoring compliance and taking enforcement action where appropriate;

v. investigating cases of radio interference, giving appropriate priority to cases that have safety-of-life implications;

vi. responding to requests from licensees for changes to licence conditions, including changes to technical conditions that would improve the efficient use of spectrum;

vii. responding to requests for putting in place new licence regimes or opening new bands for licensing;

viii. promoting Test and Trial Ireland and the benefits of using Ireland as a location to test or trial wireless products and services in a real world environment; and

ix. considering emerging spectrum management developments and taking appropriate action (including contributing to defining Ireland's position on such matters and the promotion of same in international fora).

3.3 More notable work plan items are broadly discussed below.

3.1.1 Licensing

3.4 Figure 2 below presents the total number of radio spectrum licences in force (i.e. 'live' licences) in Ireland over the past 6 years, and highlights that the demand for licences generally continues to increase. As of 30 June 2018, the number of licences totalled 17,875 representing a 15% increase over the 5 year period from 30 June 2013.

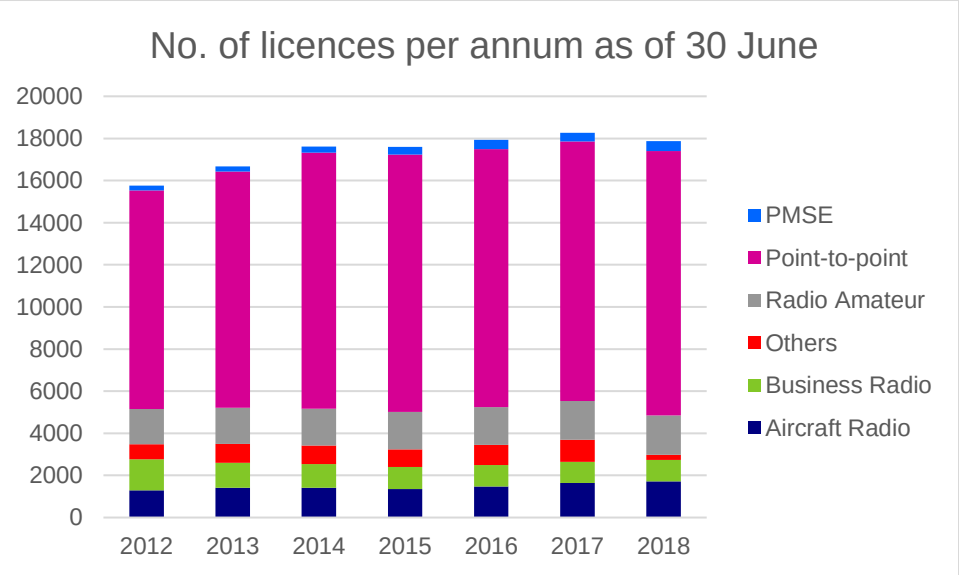

Figure 2: Number of live licences for the period 2012 to 2018

3.5 While licences are issued for a wide variety of purposes some radio spectrum licences are more in demand than others. As highlighted in Figure 1 above, there has been a 15% increase in the number of radio link licences in Ireland over the past 7 years, as of 30 June 2018, there were 12,556 radio link point-to-point licences, representing circa 70% of all live licences. Point-to-point radio links are used mainly by fixed and mobile operators, broadcasters, and utilities to provide transmission capacity and networks, and to provide redundancy and back-up for other networks.

3.6 Licences for business radio, aircraft radio and radio amateurs are the next most voluminous licence type. As of 30 June 2018, there were 4,607 live licences for these services, representing circa 25% of all live licences. The number of aircraft radio licences granted has increased by 26% since June 2012. This has been offset by a continuing decline in the number of business radio licences which has fallen by 31% over the same period. The number of radio amateur licences has increased to 1,868 licences in June 2018 an increase of 12% on June 2012.

3.7 The remaining 5% of radio licences cover a variety of licence types including the Fixed Wireless Access Local Area ("FWALA") licences (for fixed and nomadic broadband services), the 3G and Liberalised Use licences (which facilitate the provision of mobile services), trunked mobile radio and air traffic services and land-based maritime services licences (which facilitate the safe operation of air and sea transport).

3.8 While licences for mobile wireless broadband represent a small proportion of the total licences issued by ComReg, these licence types comprise a large proportion of ComReg's radio spectrum management workload.

3.1.2 Monitoring, compliance and enforcement

3.9 ComReg is also responsible for enforcing the 1926 Act and the Electromagnetic Compatibility (EMC) and Radio Equipment (RE) Directives within the State.

3.10 This work is handled by the Spectrum Intelligence & Investigations Unit within ComReg and includes:

- market surveillance, including compliance checks on items being imported to the State through cooperation with Customs;
- random surveys of transmission sites for compliance with licence conditions regarding non-ionising radiation;
- investigation of radio interference to safety-of-life services, such as emergency services and air traffic control;
- investigation of radio interference to licensed operators; and
- enforcement action, including the execution of search warrants and subsequent prosecutions.

3.11 In November 2017, ComReg published its annual report detailing its activities in respect of the above areas of interest and interested parties are directed to this publication for detailed information in respect of same.[27]

[27] ComReg Document 17/87 - *Spectrum Intelligence & Investigations: Annual Report 2016 – 2017*.

3.1.3 Non-Ionising Radiation Testing

3.12 Non-Ionising Radiation ("NIR") emissions from transmitter sites remain a matter of interest. ComReg requires - as a condition of a General Authorisation as well as of various Wireless Telegraphy licences - that operators of transmitting stations ensure that their installations comply with the NIR emission limits specified in the latest guidelines published by the International Commission on Non-Ionising Radiation Protection ("ICNIRP")[28]. In addition, the DCCAE is responsible for the health effects of NIR[29], and the Health and Safety Authority is responsible for occupational exposure to NIR[30].

3.13 Since 2003, ComReg has been conducting its Programme of Measurement of Non-Ionising Radiation, which entails annual audits of compliance by operators with their General Authorisation/Wireless Telegraphy Licence conditions relating to NIR. Each annual audit involves surveying a sample number (circa 80) of sites and transmitter types (broadcast, mobile telephony, wireless broadband etc.) countrywide. To-date, over 1,300 such individual site surveys have been conducted and emissions measured at all surveyed sites, without exception, have been found to fall well below the ICNIRP limits for general public exposure to NIR.

3.14 Results of all the site surveys are summarised and published in quarterly reports which are available on www.comreg.ie. Copies of individual site survey reports can be viewed on Siteviewer[31], an on-line map facility provided by ComReg, which allows the public to view details of mobile phone base stations throughout Ireland.

3.1.4 Test and Trial Ireland

3.15 Ireland has a capability and reputation for research and excellence in wireless innovation and technology. Wireless technologies, in the form of new products and services, are evolving to meet new communication trends. Developments in consumers' desire for ubiquitous connectivity, the crunch on available spectrum resources, future new efficient wireless systems and radio access technologies, and the so-called 'Internet of Things and Industries' are driving innovation in radio spectrum use.

---

[28] ICNIRP is a body of independent scientific experts and is formally recognised as an official collaborating non-governmental organization by the World Health Organization. For further information see: www.icnirp.org.

[29] See: http://www.dccae.gov.ie/en-ie/environment/topics/environmental-radiation/electromagnetic-fields/Pages/Frequently-Asked-Questions-on-Electomagnetic-Fields.aspx

[30] See: http://www.hsa.ie/eng/Topics/Physical_Agents/Electromagnetic_Fields/

[31] http://siteviewer.comreg.ie/

3.16 Through its Test and Trial Ireland service, ComReg enables entrepreneurs, researchers and developers to test or trial wireless technologies quickly and at a low cost in a wide variety of frequency bands in Ireland. The number of test and trial licences granted over the last seven years is shown in Figure 3.

3.17 Having regard to future trends, including the increased demands for advanced mobile services and potential impact of the internet of things ("IoT") and 5G etc, ComReg is committed to supporting Test and Trial Ireland for the benefit of new and returning Test and Trial Ireland clients.

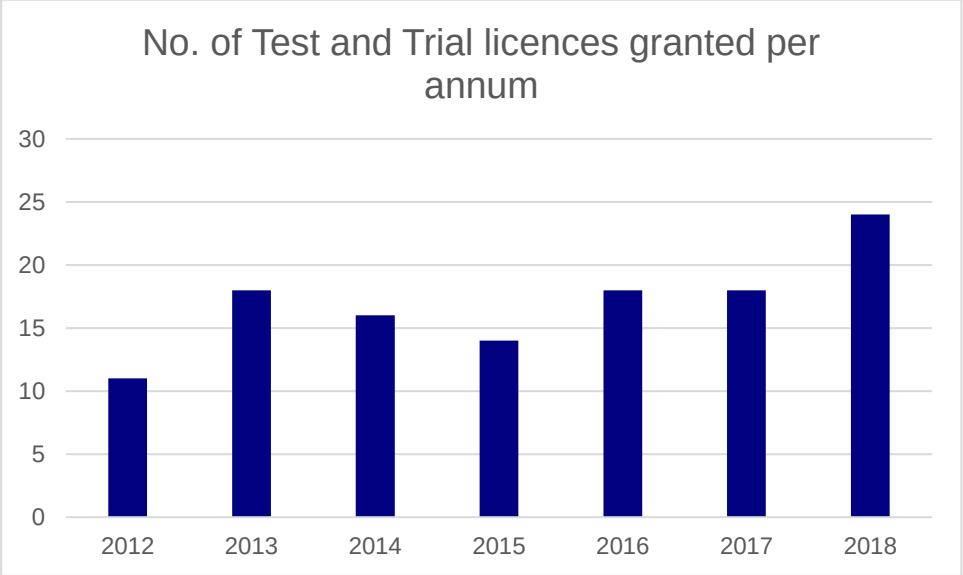

Figure 3: Test and Trial licences granted during the period 2012-2018

3.2 Broadcasting Services

3.18 Broadcasting is a major user of the radio spectrum. As identified in ComReg's Quarterly Report, there were almost 1.579 million TV households in Ireland as at January 2018.[32] The number of households which receive TV via an Internet Protocol television ("IPTV") platform increased by 58.8% in the year January 2017 to January 2018.

3.19 RTÉ, the public service broadcaster established under the Broadcasting Authority Act 1960, (as amended), provides national radio and television services. The Broadcasting Authority of Ireland ("BAI"), established under the Broadcasting Act 2009, is responsible for the authorisation of Irish broadcasting services other than those provided by RTÉ. The BAI is also responsible for the regulation of broadcast content within Ireland.

[32] ComReg Document 18/20 – *Quarterly Key Data Report Q4 2017*.

3.20 ComReg is responsible for the allocation, assignment and licensing of the associated radio frequencies under the various Broadcasting Acts and continues to work in close cooperation with both the BAI and RTÉ on the assignment of radio spectrum to ensure its continued efficient use.

3.21 In its 2016-2018 Strategy Statement, ComReg identified the following spectrum work plan items for broadcasting services:

i. continue to engage in the international coordination of broadcasting transmitter stations to support RTÉ and the BAI to facilitate the development of digital terrestrial television ("DTT") and analogue and digital sound broadcasting services;

ii. in collaboration with the BAI and 2RN [33], finalise internationally-coordinated spectrum and transition plans for DTT services in the UHF band below 694 MHz;

iii. commence a review of the licence conditions for some or all broadcasting licences; and

iv. monitor developments in relation to the broadcasting licences in the UHF, LF, VHF Band II, and VHF band III which are due to expire in 2019, and take actions as appropriate.

3.22 These work plan items are discussed below.

3.2.1 International coordination of broadcasting transmitter stations

3.23 In collaboration with 2rn (on behalf of RTÉ) and the BAI, ComReg continued to engage in the process of international coordination of broadcasting transmitter stations for DTT, Digital Sound Broadcasting ("DSB") and Analogue Sound Broadcasting ("ASB") services with Ireland's neighbours, in particular the UK and France.

3.2.2 Digital Television Terrestrial and the 700 MHz band

3.24 In March 2017, ComReg, on behalf of the State[34], completed the international coordination of its spectrum plans for DTT in the 470 – 694 MHz band with its equivalent regulatory bodies in the UK and France.[35] This was a significant milestone and was the result of four years of multilateral and bilateral negotiations between ComReg and those neighbouring regulatory bodies. The

[33] 2rn build and operate broadcast transmission networks in Ireland. 2rn is a wholly-owned subsidiary of RTÉ but operates independently of RTÉ and at commercial arms' length.

[34] Ireland's planning team was led by ComReg with active participation and collaboration from the BAI and 2rn throughout the process. Policy advice and support was provided by the DCCAE.

[35] See ComReg Documents 17/23, 17/23a, 17/23b, 17/23c and 17/23d.

DTT spectrum plan provides for the ongoing provision of DTT services in the 470 – 694 MHz band and for the migration of DTT services from the 700 MHz band, which is to be completed by 4 March 2020.

3.25 Since then, ComReg has continued to engage with the UK, France and the Western European Digital Dividend Implementation Platform ("WEDDIP"[36]) to deliver the timely execution of the agreed DTT plans and to facilitate the transition of current broadcasting services out of the 700 MHz band.

3.26 In Ireland, this transition includes a simulcast period of six months, beginning on 4 September 2019 and ending on 4 March 2020[37]. After this date, the 700 MHz band will be made available for services other than DTT, including mobile wireless broadband services, in line with the EU Decision on the 470-790 MHz band.[38]

3.27 Another importance aspect to releasing the 700 MHz band is the assessment of the efficiently incurred capital and operational costs likely to be incurred by 2rn, in migrating its DTT network from the 700 MHz band. In 2016 the DCCAE requested assistance from ComReg on this matter.[39] ComReg engaged Frontier Economics ("Frontier") to conduct that assessment and to develop a cost recovery mechanism ("CRM") to appropriately compensate RTÉ and facilitate the migration of its DTT multiplexes out of the 700 MHz band.

3.28 In December 2016, ComReg and DCCAE published the 2016 Frontier's assessment[40], which recommended that 2rn be paid compensation of €8.6m in three phases: Phase 1 (€5.2m) which was paid in early 2017, Phase 2 (€2.8m) which was paid in late 2017[41], and Phase 3 (€0.6m) which is to be paid in 2020.

3.29 The future use of the 700 MHz band for services other than DTT, including mobile wireless broadband services, is expected to provide significant benefits to Irish users of ECS[42]. Given the favourable propagation characteristics of this spectrum band, it will play an important part in addressing the continually growing demand for wireless broadband services and increased connectivity.

---

[36] WEDDIP facilitates multilateral meetings and negotiations between the administrations of Belgium, France, Germany, Ireland, Luxembourg, the Netherlands and the United Kingdom.

[37] The simulcast period is set out in the Letter of Entrustment of 15 December 2016 from the Minister DCCAE to RTÉ

[38] Decision (EU) 2017/899 of the European Parliament and of the Council of 17 May 207 on the use of the 470-790 MHz frequency band in the Union.

[39] ComReg Document 16/114c.

[40] ComReg Document 16/114a 700 MHz Repurposing Cost Compensation Report.

[41] In December 2017, ComReg published the 2017 Frontier Economics report (ComReg Document 17/111a).

[42] ComReg Document 15/62: A Cost benefit analysis of the change in use of the 700 MHz frequency band in Ireland.

The 700 MHz band is one of a number of bands that are the subject of a preliminary consultation on a proposed multi band spectrum award[43].

3.2.3 Review of licence conditions for some or all broadcasting licences

3.30 In July 2018, ComReg published a consultation to review RTÉ's radio and television broadcasting licences (Document 18/64).[44] This consultation reviews the conditions of RTÉ's current broadcasting licences, prior to their expiry in May 2019 (for sound broadcasting licences) and December 2019 (for television licences), and sets out ComReg's proposal to grant new licences to RTÉ in respect of its ASB, DSB, and DTT networks and services, to take effect once its current licences expire.

3.2.4 Monitor developments in relation to broadcasting licences in the UHF, LF, VHF Bands II and III

3.31 During the strategy period 2016 – 2018 ComReg continued to coordinate and engage with relevant stakeholders (Ofcom, BBC, BAI and RTÉ) to facilitate the ongoing provision of broadcasting services in the State. This is an ongoing activity that ComReg will take forward into the forthcoming strategy period.

3.32 ComReg notes that the Government has signalled its intention to revise the Broadcasting Act of 2009[45]. ComReg will work with, and provide advice to DCCAE staff as required, in this regard.

3.3 Mobile and Fixed Communications Network Services

3.33 Mobile and Fixed Communications Network ("MFCN") services continue to play and important role in the Irish telecommunications sector. For example, in its most recent Quarterly Report[46] ComReg noted that at the end of Q1 2018:

- there were 6,056,975 mobile subscriptions in Ireland (including mobile broadband and machine-to-machine ("M2M") subscriptions;
- there were 4,572,721 mobile voice and data subscribers using 3G/4G networks;
- based on a population of 4,805,900, mobile penetration was 125.5%;

[43] ComReg Document 18/60 – Proposed Multi Band Spectrum Award – Preliminary Consultation on which spectrum bands to award.

[44] ComReg Document 18/64 – Review of RTÉ's Radio and Television Broadcasting Licences

[45] https://www.dccae.gov.ie/en-ie/news-and-media/publications/Documents/20/Statement %20of%20 Strategy %202016-2019.pdf

[46] ComReg Document 18/49 – Quarterly key data report Q1 2018.

- mobile data volumes continue to rise, increasing by 48.6% in the year to Q1 2018 to reach 85,497 terabytes; and
- there were nearly 50,658 fixed wireless subscribers with associated data volumes in Q1 2018 of 13,498 terabytes.

3.34 These services are provided using a variety of licence types issued by ComReg including the "liberalised use" licences in the 800 MHz, 900 MHz and 1800 MHz bands, 3G licences in the 2.1 GHz GHz band, "liberalised use" licences in the 3.6 GHz band, and Fixed Wireless Access Local Area ("FWALA") licences in the 10.5 GHz and 26 GHz bands.

3.35 User demand for mobile data traffic has increased significantly in recent years and growth forecast predicts further significant increases in mobile traffic (see further in the following chapter). Such increases in end-user demand will likely result in increased demands for spectrum. In that regard, ComReg carried out a number of activities during the period 2016 – 2018 aimed at enabling this demand to be met, most particularly via its award of spectrum rights of use in the 3.6 GHz band.

3.36 In its 2016-2018 Strategy Statement, ComReg identified the following spectrum work plan items for mobile, nomadic and fixed wireless broadband services:

i. complete the assignment process for the 3.6 GHz band significantly in advance of the expiry of existing FWALA licences on 31 July 2017;

ii. actively engage with relevant stakeholders to progress the repurposing of the 700 MHz band so as to obtain clarity on its timing availability;

iii. further develop ComReg's award proposals in relation to the 700 MHz, 1.4 GHz, 2.3 GHz, and 2.6 GHz bands;

iv. continue ComReg's consultation process on liberalising the paired 2 GHz band with a view to completing this process within the time period of this spectrum management strategy;

v. set out a regulatory framework for the leasing of spectrum rights in the RSPP bands in advance of 31 July 2017;

vi. continue licensing the 10.5 GHz and 26 GHz bands under the existing FWALA licensing regime; and

vii. contribute, develop and promote Ireland's position in relation to the spectrum management aspects of 5G technology.

viii. consider administrative matters concerning the EC's spectrum divestment commitments in relation to the acquisition of Telefonica by Hutchison at the appropriate time;

ix. continue to monitor and supervise compliance by MNOs with their respective licence conditions, including via ComReg's drive-testing programme;

x. continue to publish non-confidential information relating to the results of ComReg's drive-testing programme of mobile networks in Ireland;

xi. facilitate a better understanding of the factors impacting on the actual mobile consumer experience and take appropriate measures on foot of same; and

xii. commence a consultation process on the future use of the 410-414 / 420-424 MHz band during the lifetime of this strategy management strategy.

3.37 These work plan items are briefly discussed below.

3.3.1 The 3.6 GHz Band Spectrum Award

3.38 The RSPG, in its opinion on a 5G roadmap (RSPG16-032), considers the 3.6 GHz band (i.e. 3400-3800 MHz) to be the primary band suitable for the introduction of "5G"-based services in Europe even before 2020.

3.39 In June 2017, ComReg published its Information Notice setting out the final frequency plan and results of its 3.6 GHz Band Spectrum Award Process.[47] This award, in which 594 lots spread over nine regions (four rural and five cities) were offered by way of auction, resulted in the assignment of all 350 MHz of available spectrum rights.

3.40 The award resulted in five winning bidders:

- Imagine Communications Ireland Ltd ("Imagine") – which obtained 60 MHz in each of the rural regions;
- Airspan Spectrum holdings Limited ("Airspan") - which obtained 25 MHz in the rural regions and 60 MHz in the cities;
- Meteor Mobile Communications Ltd ("Meteor") – which obtained 85 MHz in the rural regions and 85 MHz in the cities;
- Three Ireland Hutchison Ltd ("Three") - which 100 MHz nationally; and
- Vodafone Ireland Ltd ("Vodafone") - which obtained 85 MHz in the rural regions and 105 MHz in the cities.

3.41 All spectrum rights of use run for 15 years and will expire on 31 July 2032, by which time winning bidders will have paid over €78m, comprised of €60.5m in upfront fees and circa €17.7m in annual spectrum usage fees to be paid over the 15 year duration.

3.42 This award increased the total amount of harmonised spectrum for mobile, nomadic and fixed wireless broadband services assigned in Ireland by 86%.

[47] ComReg Document 17/46 – Results of ComReg's 3.6 GHz Band Spectrum Award – 1 June 2017.

3.43 ComReg is currently working with relevant parties to ensure the orderly and timely transition by existing FWALA licensees in this band to enable services to be provided by the winning bidders in the award, in accordance with the transition rules of the award.

3.3.2 Actively engage with relevant stakeholders to progress the repurposing of the 700 MHz band so as to obtain clarity on its timing availability

3.44 As noted in section 3.2.2 above, the completed DTT spectrum plan provides for the ongoing provision of DTT services in the 470 – 694 MHz band and for the migration of DTT services from the 700 MHz band, which is to be completed by 4 March 2020.

3.3.3 Further develop award proposals in relation to the 700 MHz, 1.4 GHz, 2.3 GHz, and 2.6 GHz bands

3.45 In September 2014, ComReg issued a consultation paper on a proposed award of spectrum rights of use suitable for the provision of wireless broadband (both mobile and fixed broadband) services ("WBB") (Document 14/101 [48]). In particular, the radio spectrum bands considered potentially suitable for award at that time were the 700 MHz, 1.4 GHz, 2.3 GHz, 2.6 GHz and 3.6 GHz bands.

3.46 Following that consultation and having regard to the views of interested parties who responded to same, ComReg published an Information Notice indicating that it intended to consider the possible release of rights of use in the 3.6 GHz Band in a separate competitive award process. As noted in section 3.2.1 above, ComReg finalised its 3.6 GHz Band Spectrum Award Process in June 2017.

3.47 In June 2018, ComReg issued a preliminary consultation (Document 18/60[49]) with a view to revisiting and further consulting upon this matter, with particular focus upon the issue of which spectrum bands should be included in the proposed award of spectrum rights of use suitable for the provision of WBB ECS. In summary, and in light of developments since the publication of Document 14/101, ComReg is of the preliminary view that the following bands should be included in the proposed award: 700 MHz Duplex; Paired 2.1 GHz; 2.3 GHz; and 2.6 GHz.

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

[49] ComReg Document 18/60 – *Proposed Multi Band Spectrum Award: Preliminary consultation on which spectrum bands to award*.

3.48 Interested parties are referred to Document 18/60 for further details on this matter.

3.3.4 Liberalisation of the Paired 2.1 GHz band

3.49 As noted above, ComReg set out, in Document 18/60, its preliminary view that the Paired 2.1 GHz band should form part of the proposed award of spectrum rights suitable for the provision of WBB ECS. In addition, ComReg observed that any inclusion of the Paired 2.1 GHz Band could also include, among other things, an "early liberalisation option" to allow some or all the existing licensees in this band the option to convert, via the proposed award, respective existing rights of use into new "liberalised" rights of use. Interested parties are referred to ComReg Document 18/60 for further details.

3.3.5 Regulatory framework for the leasing of spectrum rights in the RSPP bands

3.50 In October 2017, ComReg published Document 17/82, being its response to consultation and decision on a framework for the *ex-ante* review of proposed spectrum leases in the Radio Spectrum Policy Programme ("RSPP")[50] and 700 MHz[51] radio spectrum bands[52].

3.51 Following careful consideration of submissions received to Consultation Document 17/47 (as set out in Document 17/47s), and other relevant information, ComReg formed the view that it would be appropriate and justified to extend the existing procedures for reviewing notified spectrum transfers, as established under S.I. No. 34 of 2014, to encapsulate spectrum leases.

3.52 Requests by undertakings for a proposed spectrum lease in the RSPP and 700 MHz bands may be submitted to ComReg in accordance with the procedures specified in Document 17/82, and the document entitled *"Procedures and Guidelines and Notification"* (Document 14/11R) published alongside it.[53]

---

[50] The EU RSPP Decision (Decision No 243/2012/EU) requires EU Member States to allow the transfer or leasing of spectrum rights of use in the 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2.6 GHz and 3.6 GHz bands (the "RSPP Bands").

[51] Decision (EU) 2017/899 of 17 May 2017 on the use of the 470-790 MHz frequency band in the Union requires EU States to allow the transfer or leasing of spectrum rights of use in the 700 MHz (694-790 MHz) band.

[52] ComReg Document 17/82: *Spectrum leases in Ireland - Response to Consultation on the framework for spectrum leases in Ireland*.

[53] Though the draft regulations set out in Document 17/82 remain subject to the Minister of the DCCAE providing his consent to implement the finalised Spectrum Leasing Framework into law, ComReg would point out that there is no impediment to leasing applications being submitted in advance of the completion of that process, and that its competition assessment may proceed in accordance with ComReg's statutory functions objectives and duties in relation to spectrum.

3.3.6 Continue licensing the 10.5 GHz and 26 GHz bands under the existing FWALA licensing regime

3.53 Following the completion of the 3.6 GHz Band Spectrum Award Process in June 2017, the 3.6 GHz band was removed from the list of bands that can be licensed under the FWALA licence scheme[54].

3.54 The FWALA licensing regime continues to apply to the 10.5 GHz and 26 GHz bands. In that regard, ComReg observes that the number of licences in these bands has decreased over the last five years. See Figure 4 below.

3.55 In particular:

- the number of FWALA licences in the 10.5 GHz band fell from 38 licences in June 2014 to 33 licences in June 2018; and
- the large decrease in 26 GHz FWALA licences over the same period was due to Digiweb's acquisition of Smart Telecom in 2009 and its wind-down of its product offering using technology in this band.

3.56 In relation to the 26 GHz band more generally and as noted in chapter 4 – section 4.2.2:

- this band has been identified by RSPG as a pioneer band in Europe for "5G" services; and
- ComReg understands that there may be an obligation in the current draft of the EECC on Member States to allow the use of some of the 26 GHz band for WBB by end-2020.

[54] ComReg Document 06/17R9 – Guidelines: Revised Guidelines to Applicants for Fixed Wireless Access Local Area (FWALA) Licences.

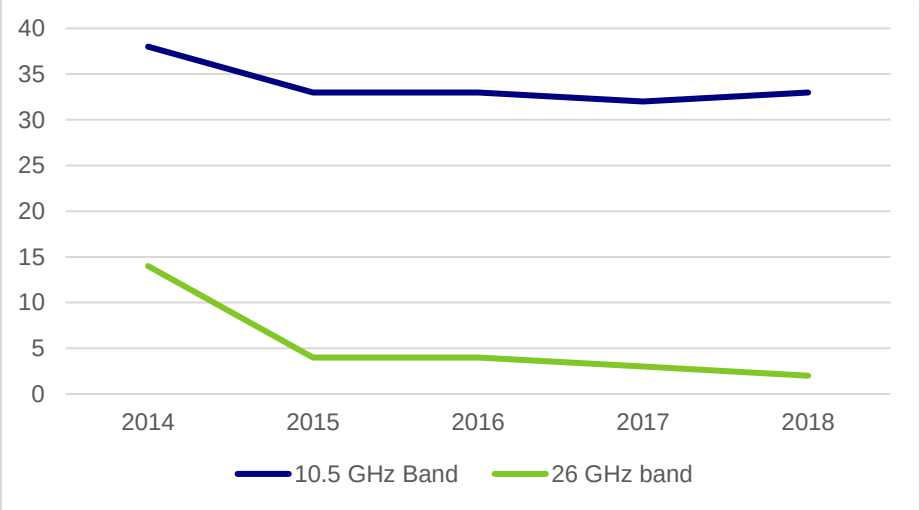

Figure 4: Number of FWALA licences in the 10.5 GHz and 26 GHz bands

3.57 In light of these developments, ComReg would expect considerations regarding the current 26 GHz FWALA licensing regime to form part of any consultation process that it may undertake on the entire 26 GHz band.

3.58 In relation to the 10.5 GHz FWALA licensing regime, ComReg is not aware of any EC or ECC Decisions, either planned or in development that would require any changes to be made to the existing regime.

3.3.7 Contribute, develop and promote Ireland's position in relation to the spectrum management aspects of 5G technology

3.59 As noted in section 3.3.1, the 3.6 GHz band is considered to be the primary spectrum band suitable for the "5G"-based services in Europe even before 2020 and ComReg finalised its award for rights of use in this band in June 2017. ComReg is currently working with relevant parties to ensure the orderly and timely transition by existing FWALA licensees in this band to enable services to be provided by the winning bidders in the award, in accordance with the transition rules.

3.60 The 700 MHz band was also identified by the RSPG as a pioneer band for 5G in Europe and, as noted above, in Document 18/60 ComReg set out its preliminary view that the 700 MHz duplex portion of this band should be included in the proposed award of spectrum rights of use suitable for the provision of WBB ECS.

3.61 More generally, ComReg has been actively involved in the work of international bodies including BEREC, the RSPG and CEPT, including CEPT/ECC Project Team 1, which has responsibility for issues relation to MFCN compatibility studies, development of band plans, development and review of ECC

deliverables as well as for the preparation of CEPT positions on a number of WRC-19 agenda items. These matters are discussed further in Chapter 4.

3.3.8 European Commission's spectrum divestment commitments in relation to the acquisition of Telefonica Ireland (O2) by Hutchison

3.62 iD Mobile, the first MVNO to enter as a result of the commitments accepted by the EC in its approval of the acquisition, launched on 20 August 2015. However, iD Mobile exited the market on 6 April 2018. ComReg is not aware of any other developments in relation to the EC's spectrum divestment commitments.[55]

3.63 In relation to the acquisition more generally, interested parties are referred to Document 18/61, published on 2 July 2018, regarding the *ex-post* analysis into the price impact of recent mobile mergers in Austria, Germany and Ireland conducted and published by the Body of European Regulators for Electronic Communications ("BEREC"). In particular, the BEREC study examines the acquisition of Telefónica Ireland Ltd (O2) by Hutchison 3G UK Holdings Limited.

3.3.9 Supervise compliance by mobile network operators with licence conditions, including via ComReg's drive-testing programme

3.64 ComReg authorises individual rights of use [56] for radio frequencies for ECN/ECS, including mobile network operators ("MNOs"), under the Authorisation Regulations and via licences issued under regulations made pursuant to the 1926 Act. Under the Authorisation Regulations, ComReg can attach conditions to such rights of use (which are detailed in each licence schedule) and ComReg is also obliged to monitor and supervise compliance with these conditions.

3.65 An important means by which ComReg monitors and supervises compliance by MNOs with a number of their respective licence conditions[57], and particularly any coverage and/or rollout obligations, is ComReg's "drive testing programme".

3.66 In general terms, "drive testing" is the reception and measurement of a radio signal, such as those used by MNOs, from a vehicle. In the context of ComReg's monitoring role, it provides a snapshot of how an individual MNO's

[55] See ComReg Documents 14/53 and 15/56 for further details.

[56] The MNOs that currently hold licences in Ireland are: Three; Meteor trading as eir, and Vodafone.

[57] These include: received field strength, call blocks, call drops, Ec/Io, Block Error Rate. Other measurements taken include: carrier to noise ratio, spectrum occupancy, download and upload throughput, and latency.

network performed, in relation to the licence conditions, at the point in time as the route was driven during when the test was conducted.

3.67 ComReg has been carrying out drive tests on MNOs' networks since 2003 and these tests have been expanded, both in terms of the route driven[58] and the technologies used, in response to developments in the mobile market.

3.68 The current drive test regime, which has been in place since 2015, is bi-annual and covers: GSM[59], 3G[60] and LTE[61], on all relevant frequency bands[62] licensed to the MNOs. Of the licence obligations assessed, coverage is estimated by measuring the received field strength as the route is driven. The results are presented graphically and published on ComReg's website as summary reports[63].

3.3.10 Facilitate a better understanding of the factors impacting on the actual mobile consumer experience and take appropriate measures on foot of same

3.69 In section 4.2 of Document 16/50, ComReg observed that there may be various potential factors contributing to the public perception that the mobile retail consumer experience has deteriorated, including:

- the increased use of mobile phones with poorer antenna sensitivity performance;
- changing consumer habits and expectations - given consumers' increasing consumption of 3G and 4G mobile data services, they may now expect such services to be provided on a nationwide basis similar to that of voice and text (i.e. 2G) services;

[58] The drive test route covers a total of 5500km including all Primary and Secondary National Routes in full and all towns and Motorway sections, along these routes.

[59] "GSM" means Global System for Mobile Communications from the European Telecommunications Standards Institute ("ETSI").

[60] "Third Generation" means a mobile and wireless communications system based on a standard within the IMT-2000 system capable of supporting innovative multimedia services beyond the capability of second generation systems such as GSM, and capable of supporting the characteristics referred to in Annex 1 of the UMTS Decision.

[61] "LTE" means the Long Term Evolution family of standards from the ETSI and Third Generation Partnership Project ("3GPP").

[62] The "800 MHz band" means the 791 to 821 MHz band paired with the 832 to 862 MHz band as set out in Annex 3 to ComReg Document 12/25; the "900 MHz band" means the 880 to 915 MHz band paired with the 925 to 960 MHz band as set out in Annex 3 to ComReg Document 12/25; the "1800 MHz band" means the 1710 to 1785 MHz band paired with the 1805 to 1880 MHz band as set out in Annex 3 to ComReg Document 12/25; and the "2100 MHz band" means the 1920 to 1980 MHz band paired with the 2110 to 2170 MHz band.

[63] ComReg Documents: 15/142R1, 16/27, 16/113, 17/25, 17/79 and 18/26R.

- the difference between outdoor and indoor signal level, including the use of better building insulation materials (e.g. window insulation/tinting, foil backed insulation) and the consequent reduction in indoor signal penetration; and
- the ability of the MNOs to find suitable sites and/or obtain planning permission for same by which to provide increased network coverage and/or capacity.

3.70 ComReg also stated that it would endeavour to develop a greater understanding of these and other issues affecting the mobile user experience, seek solutions to deliver improved outcomes, and support the Government's then proposed Task Force on Rural Mobile Coverage and Broadband ("Task Force") [64].

3.71 One of these initiatives, which aligned with a Task Force recommendation, involved the testing of the *voice* antenna performance of 71 mobile handsets available in the Irish market as of June 2017. These findings were published in ComReg Document 18/05.[65] ComReg expects to publish the results of the *data* antenna performance of the same 71 mobile handsets in Q3 of this year.

3.72 In addition to antenna performance, ComReg observed that the use of mobile phone repeaters could be one potential solution by which to address indoor mobile reception issues[66]. A repeater is a device that re-transmits amplified signals it receives; however such devices include filtering and interference mitigation that provide better coexistence with other spectrum users.

3.73 In that regard, ComReg conducted a public consultation on permitting the general use of mobile phone repeaters.[67] On foot of consultation process, ComReg has implemented a licence-exemption scheme for mobile phone

[64] https://www.dccae.gov.ie/en-ie/communications/topics/Broadband/mobile-phone-and-broadband-taskforce/Pages/Mobile-Phone-and-Broadband-Taskforce.aspx

[65] https://www.comreg.ie/publication/mobile-handset-performance-voice/ .

[66] Another solution identified is Native Wi-Fi calling, which is a service for Android and iOS smartphones enabling users to make and receive phone calls over a Wi-Fi connection. However, the ability for a user to avail of Wi-Fi calling is entirely at the discretion of the user's service provider (i.e the MNOs). In that regard:

- eir is currently the only MNO in Ireland which offers this facility to its customers (see: https://www.eir.ie/support/mobile/eir-wifi-calling/);
- whilst Vodafone and Three have each deployed this service to their customers in the UK, they have yet to do so in Ireland. See:
- https://www.vodafone.co.uk/network/calling-features/wi-fi-calling; and
- http://www.three.co.uk/discover/three_intouch .

[67] See ComReg Document 17/103 – Mobile Phone Repeaters – Consultation, and ComReg Document 18/58: Mobile Phone Repeaters - Response to Consultation and Final Decision.

repeaters that meet specific technical requirements. Within the bounds of these requirements, such repeaters will have no restrictions on the number of operators or technologies it may service, be it single/multi-operator or single/multi-band.[68]

3.74 A further initiative identified by ComReg was to study the impact of building materials on the penetration of signals indoors. In that regard, ComReg has conducted research to quantify the effects of some representative modern building materials on indoor radio signal performance. ComReg's findings on this issue are published in document 18/73[69].

3.3.11 Commence a consultation process on the future use of the 410-414 / 420-424 MHz band during the lifetime of this strategy management strategy.

3.75 See section 3.7.1 below in relation to Business Radio services.

3.4 Radio Links

3.76 Radio Links (or "Fixed Links"), which are wireless devices or systems that connect two fixed locations, form a major part of the infrastructure of electronic communications networks and are also the main category of licensed "apparatus for wireless telegraphy" in the State.

3.77 ComReg has two separate frameworks in place for the licensing of Radio links in Ireland:

- National block licences for point-to-point services in the 26 GHz band - issued under S.I 158 of 2018 - which enables operators to plan and deploy Radio Links in this band without needing to apply to ComReg for individual Radio Links; and
- Individual licences for point-to-point and point-to-multipoint services - issued under S.I. 370 of 2009 - which enable operators to apply for links as required to meet their needs.

3.4.1 Individual point-to-point radio links

3.78 Individual point-to-point radio links are used mainly by fixed and mobile operators, broadcasters and public utilities to provide transmission capacity and networks, and to provide redundancy and back up for other networks. Some

[68] Wireless Telegraphy Act 1926 (section 3) Exemption of Mobile Phone repeater order 2018 (S.I. No. 283 of 2018).

[69] ComReg document 17/83 – The effect of building materials on indoor mobile performance – 2 August 2018.

operators use radio links as an economic alternative to leased lines and optical fibre.

3.79 As shown in Figure 5 below, MNOs are the largest users of radio links in Ireland. However a number of smaller players continue to use radio links to meet both their front-haul and backhaul requirements.

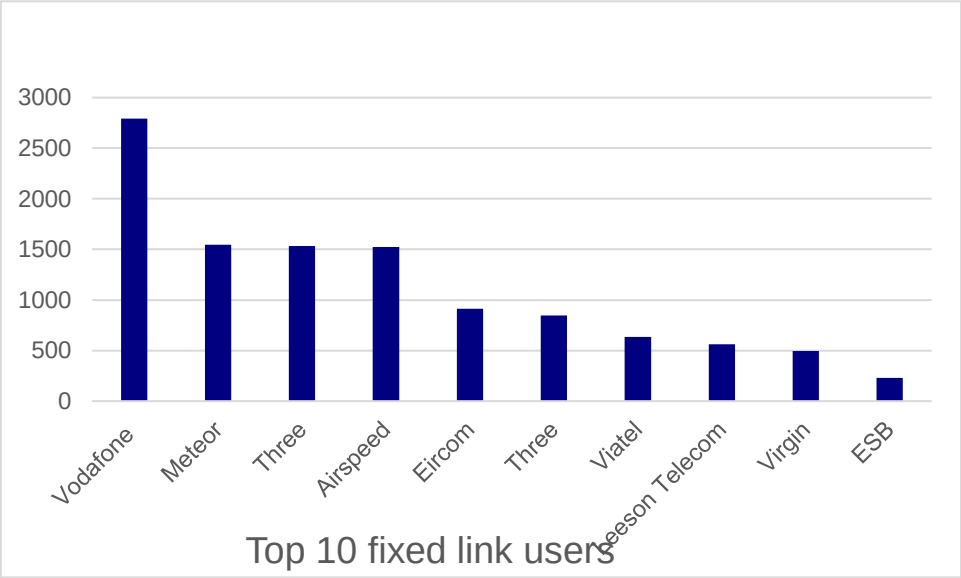

Figure 5: Top 10 fixed link users (based on individual licences)

3.80 During the 2016-2018 period, the demand for radio links continued to grow and there is in excess of 12,500 Radio Link licences in Ireland in the frequency bands ranging from 1.3 GHz to 80 GHz. The number of active licences is shown in Figure 6.

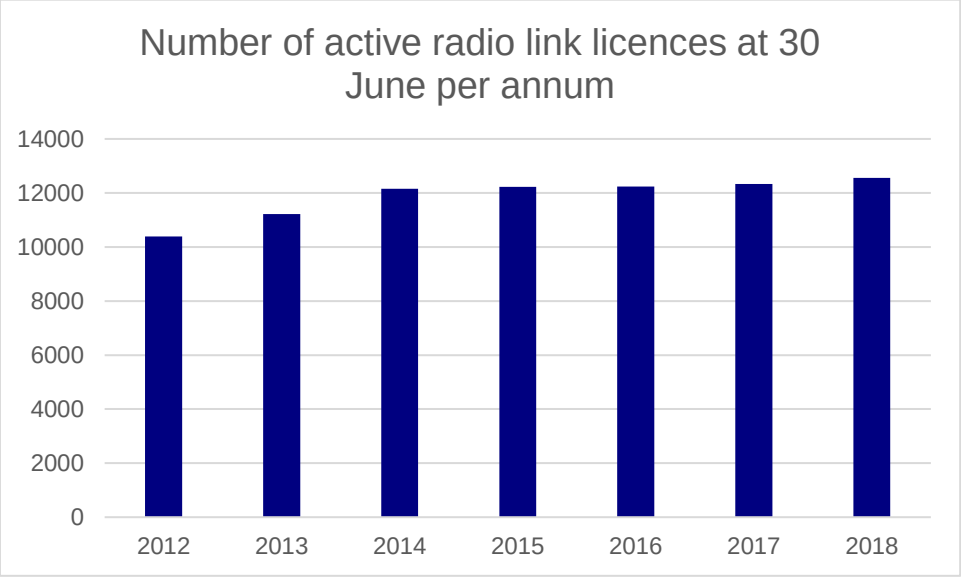

Figure 6: Number of radio link licences at 30 June per annum

3.4.2 Fixed Links in the 71 – 76 GHz and 81 – 86 GHz frequency bands

3.81 As consumer demand for data services has increased, the demand for greater transmission capacity by both fixed operators and MNOs has also increased. See, for example, Figure 7 below which illustrates a five-fold increase in the number of radio links licensed in the 71 – 76 GHz and 81 – 86 GHz frequency bands (E–Band) in the last 5 years (where channel bandwidths of 750 MHz are available).

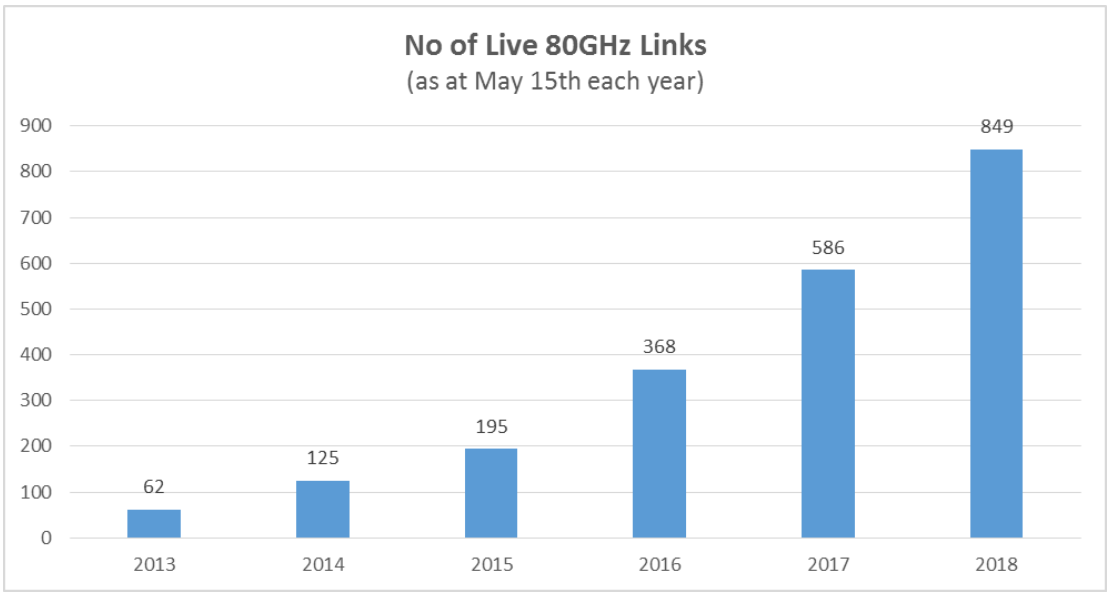

Figure 7: Number of E-band links licensed year on year.

3.82 Demand for assignments in the E-band for radio links has been enabled by technological developments which enable longer distance links at lower modulations than heretofore.

3.4.3 Review of current work plan items

3.83 In its 2016-2018 Strategy Statement, ComReg identified the following spectrum work plan items for point-to-point Radio Links:

i. consult on the award of national block licences in the 26 GHz band with a view to completing this process significantly in advance of the expiry of existing licences in 2018 and, if appropriate, consider establishing further national block licensing in the 42 GHz band;

ii. consider adding additional bands to the Radio Link licensing regime where new ECC Recommendations have been developed (e.g. 55.78 – 57 GHz and 57 – 64 GHz); and

iii. consider adding a number of bands in the range 5 – 30 MHz for HF fixed links to the radio link licensing list of bands.

Award of national block licences in the 26 GHz band

3.84 In June 2018, ComReg published an Information Notice[70] setting out the final frequency plan and results of its 26 GHz Band Spectrum Award, which ComReg commenced on 25 April 2018[71].

3.85 During the consultation process, operators highlighted the importance of the 26 GHz band[72] and existing point-to-point licences in the 26 GHz band allow for over 3000 point-to-point link sites.

3.86 The award consisted of a "sealed bid combinatorial auction" using a second price rule, and five blocks of 2 x 28 MHz of spectrum rights were granted to each of the three MNOs (i.e. Eir, Three and Vodafone).

3.87 The award (of 840 MHz[73]) resulted in a 25% increase in the amount of 26 GHz rights assigned to the market and will support the requirement for point-to-point radio links, a critical piece of backbone infrastructure for Ireland's mobile communications networks. The spectrum rights were assigned to the Winning Bidders via licences granted under the Wireless Telegraphy (National Point-to-Point Block Licences) Regulations 2018 (S.I. No. 158/2018).

3.88 All licences are of ten years' duration and will permit licensees to operate point-to-point links on a national basis utilising "Frequency Division Duplexing" technology.

Consider adding additional bands to the Radio Link licensing regime where new ECC Recommendations have been developed (e.g. 55.78 – 57 GHz and 57 – 64 GHz)

3.89 ComReg opened up the band 57 – 64 GHz for radio link applications in 2017. However, applications have been very limited to-date, suggesting a preference for rights of use in the E-band.

[70] ComReg Document 18/53 – Results of the 26 GHz spectrum award 2018.

[71] Following two rounds of public consultation and by publishing a Response to Consultation and Final Decision (Document 18/31 and D04/18) and an Information Memorandum (Document 18/32 - "the IM").

[72] ComReg Document 18/12b.

[73] Consisting of 2 × 420 MHz of paired spectrum.

Consider adding a number of bands in the range 5 – 30 MHz for HF fixed links to the radio link licensing list of bands

3.90 While in the previous strategy period this had not been required, renewed interest has been expressed recently and changes may be required to the Radio Link Licensing Guidelines[74] to make provision for HF fixed links in light of same.

3.5 Satellite Services

3.91 Satellite communications provide a variety of applications such as:

- broadcasting services such as direct-to-home multichannel television and satellite digital radio;
- satellite news gathering;
- satellite broadband;
- mobile and fixed telecommunications (satellite phones and intercontinental telecommunications links);
- meteorological services; and
- space research; earth exploration service (EES) applications.

3.92 In addition, satellite networks play a vital role in aeronautical and maritime safety by enabling the provision of services such as detection of Emergency Position indicating Radio Beacons (EPIRBs), radio navigation (global positioning systems) and global flight tracking.

3.93 In its 2016-2018 Strategy Statement, ComReg identified the following work plan items concerning satellite networks and services:

i. consult on establishing a regulatory framework for a complementary ground ("CGC") component for the 2GHz mobile satellite service ("MSS") (together "MSS with CGC") with a view to completing this process in 2017; and

ii. continue to facilitate the licensing of satellite earth stations (SES) operating in spectrum above 3 GHz and to determine the appropriate means of authorising SES below 3 GHz.

[74] ComReg 09/89 R2 Guidelines to applicants for radio links licences

3.5.1 Mobile Satellite with Complementary Ground Component (MSS with CGC)

3.94 In 2017, ComReg consulted on its proposed authorisation scheme for the CGC elements of MSS in the 2 GHz band.[75] This follows Decision 626/2008/EC of the European Parliament and of the Council of 30 June 2008[76], which requires Member States to authorise Inmarsat and Solaris (now EchoStar)[77] to provide MSS with CGC in their jurisdictions.

3.95 Following the recent publication of the regulations [78] that implement the licensing framework for MSS with CGC, ComReg is now in a position to issue licences in accordance with the requirements of the European Decision.

3.5.2 Licensing of satellite earth stations

3.96 During the period 2016 to 2018, ComReg continued to license SES above 3 GHz - where demand is mainly for short term use for events such as international sporting events – see **Error! Reference source not found.**.

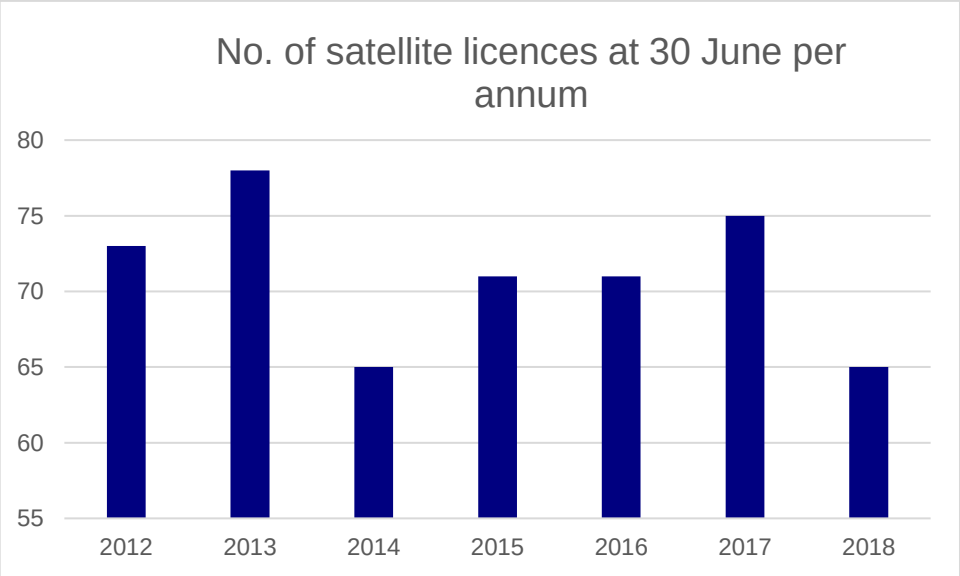

Figure 8: Number of satellite licences at 30 June per annum

[75] ComReg 17/97 - Mobile Satellite Services with Complementary Ground Component Authorisation Regime - Response to Consultation and Final Decision -27 November 2017

[76] Decision No. 626/2008/EC of the European Parliament and of the Council of 30 June 2008 on the selection and authorisation of systems providing mobile satellite services

[77] EchoStar purchased Solaris Mobile Limited in January 2014, from its then owners SES and Eutelsat: http://spacenews.com/38949echostar-buys-struggling-solaris-s-band-satellite-venture/

[78] Wireless Telegraphy (Mobile Satellite Service with Complementary Ground Component) Regulations (S.I. 282 of 2018).

3.97 With regard to the licensing of SES below 3 GHz, ComReg did not progress this work plan item due to other work item priorities. ComReg is not aware of any demand for a licensing regime for SES below 3GHz and, as such, does not propose to include this as a work plan item for the forthcoming strategy period.

3.6 Licence-Exempt Short Range Devices (including IoT)

3.98 Short Range Devices ("SRDs") occupy a range of frequency bands ranging from very low frequencies (kHz) to microwave frequencies (GHz). Due to their low power and localised usage, SRDs are generally regarded as having a low capability of causing interference. This is confirmed by extensive compatibility analysis studies which consider all the existing systems in the bands being considered. Consequently, SRDs have generally been made exempt from the need for individual licences, subject to compliance with certain technical conditions.

3.99 SRDs include devices such as inductive applications, model control, road transport and traffic telematics ("RTTT") systems, cordless telephones, alarms, field disturbance and Doppler apparatus ("FDDA") systems, wireless microphones, and wireless local area networks ("WLANs").

3.100 SRDs complying with the requirements set out in ComReg Document 02/71[79] may be operated without the need for an individual user licence in Ireland. Such requirements include that all SRDs operate on a non-interference and non-protected basis, and that all SRDs placed on the Irish market comply with the RE Directive.[80]

3.101 The Internet of Things ("IoT") refers to a network comprised of physical objects (such as people and machines) capable of gathering and sharing information. Most current IoT deployments, such as Sigfox[81] and LoRa[82], fall into the category of SRDs and operate in the licence-exempt frequency ranges. Other IoT technologies, include NB-IOT or LTE-M[83].

3.102 It is widely expected that the deployment of IoT, including Intelligent Transport Systems (ITS) and machine to machine (M2M), will increase over time and that this will impact economic growth and social development.

[79] ComReg 02/71R11 - Permitted Short Range Devices in Ireland – 5 February 2018

[80] DIRECTIVE 2014/53/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC – available on www.ecodocdb.dk.

[81] Sigfox is a proprietary IoT technology

[82] LoRa – LOng RAnge, low power wireless communications.

[83] NB-IOT: Narrowband-IOT , LTE-M is the abbreviation for LTE Cat-M1

3.103 ComReg identified the following work plan items concerning SRDs for the period 2016 to 2018:

i. continue to facilitate the use of SRDs in Ireland in line with international harmonisation measures and revise ComReg Document 02/71R in a timely manner following EC and ECC harmonisation updates to facilitate the introduction of new SRDs;

ii. consider supporting the 76 to 79 GHz frequency band for SRDs (to support anti-collision helicopter applications); and

iii. monitor, contribute to and promote Ireland's spectrum management position in relation to IoT.

3.104 These are briefly described below.

3.105 During the period 2016 to 2018, ComReg published two updates to Document 02/71, which were required to add new SRDs and reflect changes to the EU regulatory framework, and which:

- permit tracking, tracing and data acquisition SRDs access to the 870 – 875.6 MHz band; and
- permit ultra-wide band ("UWB") location tracking SRDs access to the 3.1 – 4.8 GHz band.

3.106 There were no developments within CEPT on the use of the band 76 – 79 GHz band for SRDs to support anti-collision helicopter applications. ComReg will, however, continue to participate in and contribute to the activities relating to IoT and SRDs and update Document 02/71 as appropriate.

3.107 See Chapter 4 for recent developments in relation to IoT.

3.7 Business Radio Services (including Public Safety Services and PMSE)

3.108 "Business Radio" is a generic term that incorporates a number of different licence types issued by ComReg, including private mobile radio ("PMR"), third party business radio and programme making and special events ("PMSE").

3.109 PMR continues to be a popular communication system in circumstances where groups of mobile terminals need to communicate on a "one to all" basis or where the traffic is between a control point and one or more mobile terminals. The main uses of PMR are for safety and security in large commercial premises (such as factories or building sites), and taxis, all of which need reliable means of communicating with personnel including those on the move.

3.110 In Ireland, the demand for PMR licences stabilised over the 2016-2018 period following considerable decline in the two years previous (see Figure 9 below). Demand for PMR services is likely to continue into the future.

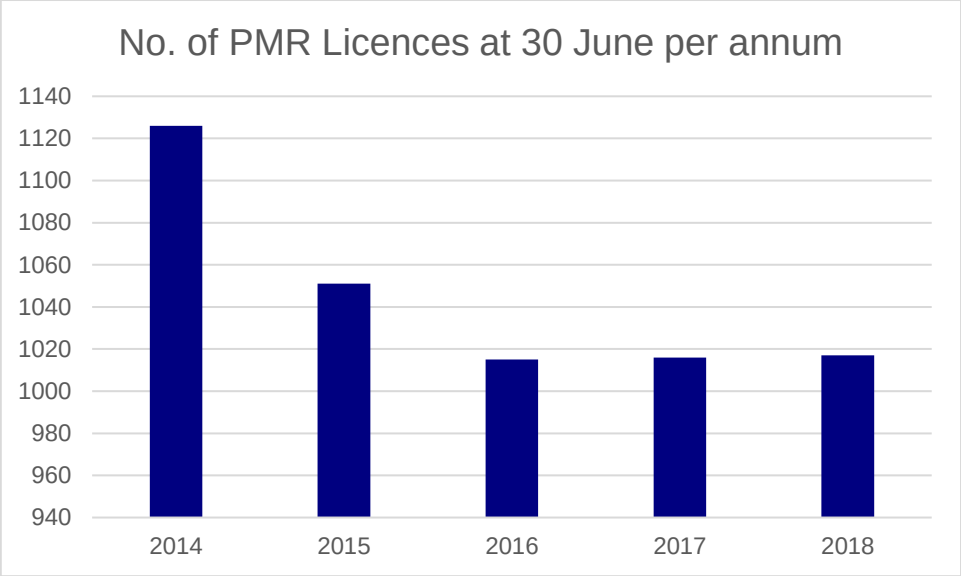

Figure 9: Number of PMR Licences at 30 June per annum

3.111 ComReg identified the following work plan items for business radio services for the period 2016 to 2018:

i. commence a consultation process on the future use of the 410-414 / 420-424 MHz band;

ii. consult on a licensing regime for tracing and asset tracking systems;

iii. consult on a business radio licensing regime to permit the use of national channels on a technology- and service-neutral basis;

iv. monitor and contribute to the spectrum management considerations of Programme Making and Special Events (PMSE) and take appropriate actions to implement harmonisation decisions; and

v. monitor and contribute to the spectrum management considerations in respect of broadband Public Protection and Disaster Relief (PPDR).

3.7.1 Future use of the 410-415.5 / 420-425.5 MHz band

3.112 In July 2017, ComReg published a consultation on the award of new spectrum rights of use for the 400 MHz band (410-415.5 / 420-425.5 MHz).[84] Among other things, ComReg observed that there were a number of potential uses for the

[84] ComReg Document 17/67 - Consultation on Proposed Release of the 410-415.5 / 420-425.5 MHz sub-band.

400 MHz band and explored the various award mechanisms that could be used to assign spectrum rights of use in that band.

3.113 Based on responses received to this consultation, including the apparent level of interest shown in the 400 MHz band, ComReg considered there to be sufficient merit in further developing its award proposals.[85]

3.114 ComReg has now procured technical services to examine in detail the potential uses of the 400 MHz band and the likely spectrum requirements of same. In addition, independent economic and spectrum award design services have been procured which will inform ComReg's further consultation, currently expected to be published in the latter part of 2018.

3.7.2 Licensing regime for asset tracking and tracing

3.115 In the 2016 – 2018 Strategy Statement, ComReg identified an intention to consult upon a licensing regime for asset tracking and tracing systems. This reflected potential demand for the use of dedicated licensed spectrum in the VHF band for the provision of high power systems enabling the tracking and tracing of goods leading to their recovery in the event of loss or theft.

3.116 Rapid developments in IoT technology in recent years, however, has meant that asset tracking and tracing systems can be installed in numerous devices and operated at such powers that they fall within the category of SRDs.

3.117 Given this, ComReg made provision for the licence-exemption of asset tracking and tracking devices in Table 3.2 of Document 02/71 R11 *"Permitted Short Range Devices in Ireland"*[86].

3.7.3 National licences for business radio use

3.118 Licences for PMR systems are granted under the Wireless Telegraphy (Business Radio Licence) Regulations (S.I. 340 of 1949). These licences are local in nature and only enable the licensee to operate on a specific channel in a specified location or area. It is not possible to grant a PMR licence for national use under these regulations.

3.119 In its 2016-2018 Strategy Statement, ComReg identified an intention to consult on a business radio licensing regime to permit the use of national channels on a technology and service-neutral basis. However, due to the prioritisation of

[85] ComReg Document 17/105 - Response to Consultation on the Proposed Release of the 410-415.5/420-425.5 MHz Sub-band.

[86] ComReg Document 02/71 R11 – Permitted Short Range Devices in Ireland.

other work streams, this activity was not commenced during the period under review.

3.120 ComReg observes that national licences for business radio use would provide greater flexibility to users meet their respective needs (in similar fashion to national block licences for radio links). Therefore, subject to resourcing, ComReg intends to consult on a business radio licensing scheme to permit the use of national channels on a technology and service neutral basis in the 2019-2021 period.

3.7.4 Programme Making and Special Events (PMSE)

3.121 PMSE services encompasses a range of wireless services, such as wireless cameras and wireless microphones, used in the production of multi-media content or the staging of live events.

3.122 The use of these devices support diverse activities including news gathering, sports events and outside broadcasts, live concerts, theatre and other events. To facilitate this activity, a wide variety of spectrum bands[87] are made available in Ireland for PMSE use under the Temporary Business Radio licensing scheme (ComReg Document 08/08R6).

3.123 Figure 10 below highlights that demand for spectrum for PMSE use continues to grow and has almost doubled over the last five years. This reflects the increase in the number and size of events that require PMSE devices.

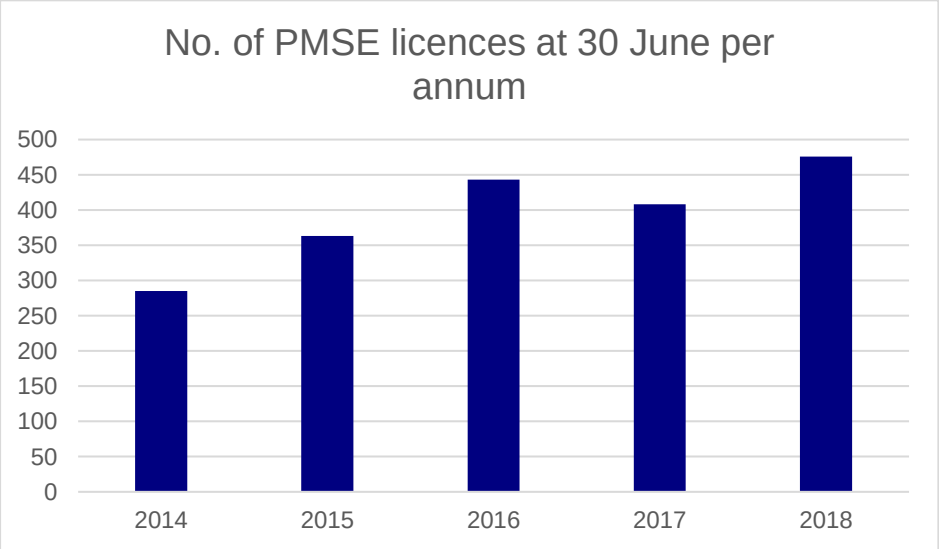

Figure 10: Number of PMSE Licences at 30 June per annum

3.124 At a national level, large scale events (such as UEFA 2020) need tailored solutions which may require the use of bands not covered by ComReg

[87] ComReg Document 08/08R - Guidance Notes: Radio Licensing for Programme Making and Special Events use in Ireland.

Document 08/08R6. For example, for the Giro d'Italia cycle race in 2014 ComReg allocated an additional 18 channels in both the VHF and UHF bands, in addition to utilising the VHF high band channels allocated to PMSE in ComReg Document 08/08 to meet the communications needs of the event. ComReg envisages continuing to address such situations on a case-by-case basis, while retaining the flexibility for both ComReg and PMSE users within Ireland.

3.125 In November 2017, the Radio Spectrum Policy Group ("RSPG") of the European Commission published its opinion on the long term strategy for the future use of spectrum for PMSE applications[88]. ComReg supports many of opinions in same including:

- that due to the local and temporary nature of PMSE, especially for peak demand situations, requirements are best addressed on a case-by-case basis at a national level using the "tuning range concept" developed by CEPT;
- welcoming the deployment of PMSE equipment that can operate with larger tuning ranges, which provides flexibility for operation especially for peak demand events, though recognising the risk of higher cost and complexity of equipment;
- encouraging the PMSE industry and academia to continue to research and develop more advanced and spectrally-efficient technologies, including digital, and to implement these technologies using ETSI harmonised standards; and
- that operational advances (such as greater detailed planning and better on-site coordination), coupled with the adoption by PMSE users of more efficient working practices and technologies, can achieve high density spectrum use at peak demand events.

3.126 In addition, ComReg welcomes the EU level harmonisation[89] of the band 2010 – 2025 MHz for PMSE use and the recognition that on the basis of national needs the core frequency band (i.e. 470 – 694 MHz) may continue to be an important band for audio PMSE until at least 2030. These developments should provide certainty for the industry regarding spectrum availability for PMSE use.

3.127 To date, Ireland has not experienced a shortage in available spectrum for PMSE. However, given the demand for spectrum by other uses, the spectrum

[88] RSPG17-037 FINAL REV1 - *Opinion on a long-term strategy on future spectrum needs and use of wireless audio and video PMSE applications*.

[89] EC Decision 2016/339/EU - Commission Implementing Decision (EU) 2016/339 on the harmonisation of the 2 010-2 025 MHz frequency band for portable or mobile wireless video links and cordless cameras used for programme making and special events.

demands of PMSE may need further consideration over the coming years, including the implementation of any future PMSE-related harmonisation measures.

3.7.5 Public Protection and Disaster Relief (PPDR) services

3.128 In Ireland, a narrowband PPDR network is operated on behalf of the Government by Tetra Ireland Communications Ltd using Terrestrial Trunked Radio (TETRA) technology in the 380-385 / 390-395 MHz frequency band. This band is harmonised by ECC Decision (08)05 for narrowband PPDR applications. [90]

3.129 ComReg observes that ongoing work within the CEPT[91] indicates that the next generation PPDR technologies, such as broadband PPDR ("BB PPDR"), will require bandwidths of 1.4 MHz, 3 MHz and 5 MHz depending on the application. An example of BB PPDR applications include high resolution video communications for various security and human wellbeing applications, live video feeds, and high resolution imagery.

3.130 As noted in Document 18/60[92] and Chapter 4, the 700 MHz EC Decision[93] gives Member States flexibility in terms of the potential uses of the 700 MHz Duplex Gap and 700 MHz Guard Bands, including its possible use for PPDR.

3.8 Radio Amateur Services

3.131 The Amateur Service and Amateur-Satellite Service is recognised by the ITU as a service for the purpose of self-training and technical investigations and has specific spectrum allocated in the International Radio Regulations.

3.132 ComReg's Amateur Station licensing regime allows suitably qualified persons, known as radio amateurs, to use radio equipment for the purpose of conducting experiments and communicating via wireless telegraphy. Currently, there are over 1 800 radio amateurs licensed by ComReg.

---

[90] ECC Decision (08)05 - *ECC Decision of 17 June 2016 on the harmonisation of frequency bands for the implementation of digital Public Protection and Disaster Relief (PPDR) narrow band and wide band radio applications in bands within the 380-470 MHz range*.

[91] ECC Report 218 on "*Harmonised conditions and spectrum bands for the implementation of future European broadband PPDR systems*".

[92] ComReg Document 18/60 – *Proposed Multi Band Spectrum Award: Preliminary consultation on which spectrum bands to award*.

[93] EC Decision 2016/687/EU - *COMMISSION IMPLEMENTING DECISION on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the EU*.

3.133 The qualification process involves an examination based on the Harmonised Amateur Radio Examination Certificate[94] (HAREC) standard as set down by CEPT. The Irish Radio Transmitter Society [95] ("IRTS") manage these examinations on behalf of ComReg. Table 1 below shows the continuing demand for radio amateur certification in Ireland.

Exam Dates	Candidates	Pass	Fail
2017	46	33	13
2016	41	27	14
2015	35	29	6
2014	25	22	3
	147	**111**	**36**

Table 1: Radio Amateur Theory Exam Statistics

3.134 A range of spectrum bands are available in Ireland for use by radio amateurs. These are set out in ComReg's Amateur Station Licence Guidelines (Document 09/45R4)[96].

3.135 In its 2016-2018 Strategy Statement, ComReg identified the following work plan items for radio amateur services:

i. to make available the band 5351.5 – 5366.5 kHz in line with the outcome of WRC agenda item 1.4 of the World Radiocommunication Conference of 2015;

ii. to make available the 30 – 49 MHz, 54 - 69.9 and 69.9 - 70.125 bands to facilitate propagation beacons, digital amateur television repeaters and to align current allocations to Irish Radio Amateurs with those in the European Common Allocation ("ECA") table; and

iii. to make available the 70.45 – 70.50 MHz band to align current allocations to Irish Radio Amateurs with those in the ECA table.

3.136 These matters were addressed in April 2018 by way of an update to the Amateur Station Licence Guidelines.

3.137 In same month, ComReg also introduced its online application facility for all Radio Amateur licence types via its secure website[97]. This should provide for

[94] Recommendation T/R 61-02 - Harmonised Amateur Radio Examination Certificate – Feb 2018 and available at www. ecodocdb.dk

[95] See the IRTS website for more information www.irts.ie

[96] ComReg Document 09/45R4 - Amateur Station Licence Guidelines.

[97] https://www.elicensing.comreg.ie/login.aspx

more efficient processing of applications and ready access to licence documentation for each licensee.

3.9 Aeronautical, Maritime, Scientific and Defence Services

3.138 In its 2016-2018 Strategy Statement, ComReg identified the following work plan items concerning the aeronautical, maritime, scientific and defence services:

i. continue to liaise with relevant stakeholders, including the IAA, MRAU, Met Éireann and the Irish Defence Forces, to encourage and ensure the efficient use of spectrum and to promote Ireland's interest at international fora; and

ii. consult with a view to establishing a licensing regime for a number of miscellaneous services. For example, the licensing of apparatus for gathering metrological information such as RadioSondes.

3.139 The safety and efficiency of air and maritime transport is dependent on navigation and communications services that use the radio spectrum. Due to the global nature of air travel and maritime services, the management of radio spectrum for same is largely planned and governed by international bodies such as ICAO[98] for the aviation sector and the ITU for the maritime sector.

3.9.1 Aeronautical Services

3.140 ComReg issues licences for radio equipment on-board Irish aircraft under the Wireless Telegraphy (Aircraft Station Licence) Regulations 2009 (S.I. 193 of 2009). In doing so, ComReg liaises closely with the Irish Aviation Authority ("IAA") which has overall responsibility for regulation of aeronautical services in Ireland.

3.141 Figure 11 below identifies the number of active aircraft radio licences in recent years. As at June 2017, there were 1,636 licensed aircraft radio licences in Ireland representing a 26% increase since 2012.

3.142 In respect of ground-based equipment used in the support of aeronautical service, ComReg has a regime in place to license radar, beacons and air traffic operations.[99] The number of licences issued for such operations have remained

[98] The International Civil Aviation Organisation (ICAO) is a UN agency consisting of 192 Member States and industry groups that work together to reach consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector.

[99] ComReg Document 11/07 – Guidelines for Radiodetermination, Air Traffic and Maritime services licences.

constant since 2009 when the regime was first established.

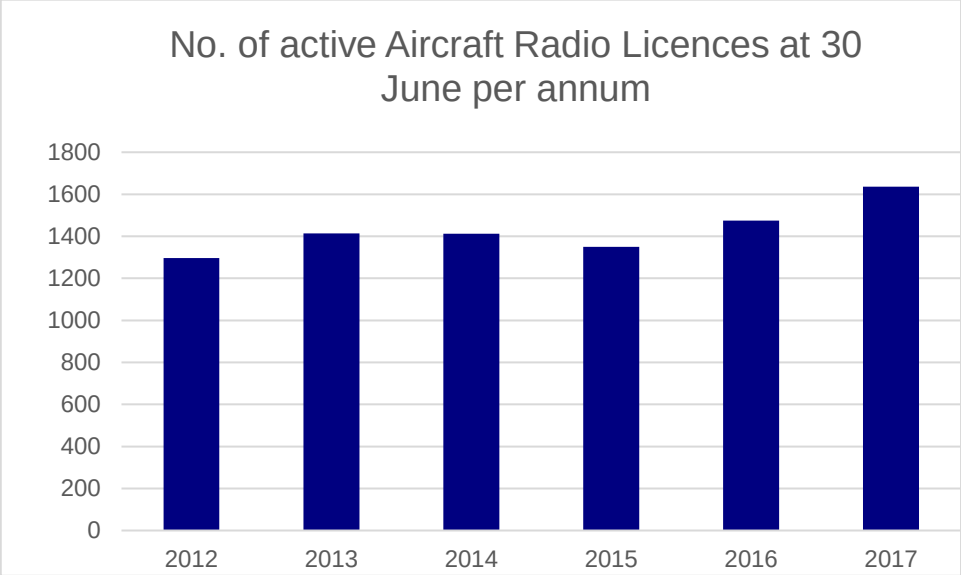

Figure 11: The number of aircraft radio licenses at 30 June per annum

3.143 In respect of ground-based equipment used in the support of aeronautical service, ComReg has a regime in place to license radar, beacons and air traffic operations. [100] The number of licences issued for such operations have remained constant since 2009 when the regime was first established.

3.9.2 Maritime Services

3.144 The Maritime Radio Affairs Unit ("MRAU") of the Department of Transport is responsible for radio communication equipment used on on-board vessels.

3.145 ComReg is responsible for the licensing of equipment and systems (utilising wireless telegraphy apparatus operating in the maritime frequency bands) which are not installed on-board vessels.

3.146 There are 174 maritime services licences in force in Ireland issued to various bodies, such as yacht clubs, ports and the Commissioner of Irish Lights. Maritime services licences are issued for the lifetime of the apparatus and the number of licences granted is broadly unchanged since the introduction of this licensing scheme in 2009.

[100] ComReg Document 11/07 – Guidelines for Radiodetermination, Air Traffic and Maritime services licences.

3.9.3 Scientific Services

3.147 Radio spectrum is used for a wide range of applications that operate under the description of "scientific services", including radio astronomy, earth exploration-satellite services ("EESS"), space research and meteorological aids.

3.148 Radio spectrum plays an important role in the research and development activities taking place within the scientific community in Ireland. For example, Trinity College Dublin operates, as part of the international low frequency array ("I-LOFAR")[101] Consortium, a LOFAR antenna array operating at 10-90 and 110-240 MHz at a site in Birr Castle, Co. Offaly, which ComReg registered with the ITU for co-ordination purposes.

3.9.4 Defence Forces

3.149 Defence forces have actively utilised radiocommunications from the earliest days and their use of radio spectrum is considered critical to national security.

3.150 There are no specific service allocations for defence applications in the International Radio Regulations because defence communications are recognised as the prerogative of each sovereign nation. The Irish Defence Forces, comprising the army, naval service and air corps, use radio in a variety of ways, most notably in relation to maritime, aeronautical and tactical applications. In accordance with the 1926 Act, apparatus for wireless telegraphy kept by or in the possession of the Minister for Defence, for the purpose of the Defence Forces, do not require a licence.

3.151 In its 2016-2018 Strategy Statement ComReg set out its intention to continue to liaise with the Irish Defence Forces to encourage and ensure the efficient use of spectrum and to promote Ireland's interest at international fora.

3.152 ComReg continues to maintain the necessary contacts, at the appropriate level, within the Irish Defence forces to ensure that matters of common interest can be discussed and issues of interference and management of spectrum can be addressed effectively.

[101] See: http://lofar.ie/ .

Chapter 4

4 Factors informing ComReg's proposed work plan for 2019 - 2021

4.1 A wide range of factors affect the demand for and the supply of radio spectrum including: end-user demand, technology changes or advancements, the international harmonisation of radio spectrum, and relevant national or international policies.

4.2 These general factors also influence each other. For example, increasing end-user demand for a service incentivises advancements in technologies used to provide these services and the development of international harmonisation measures or national/international policies, and vice versa.

4.3 In this chapter, ComReg discusses various factors which have informed its draft radio spectrum work plan for 2019 to 2021, including:

- International harmonisation of radio spectrum;
- World Radiocommunication Conference of 2019;
- European Commission harmonisation decisions;
- End-user demand (and, in particular, for mobile broadband);
- Technology changes and advancements (service specific); and
- The expiry of existing licences in the near future (e.g. within the next 5 years).

4.1 International harmonisation of radio spectrum

4.4 The international harmonisation process plays a key role in determining the demand for and the supply of radio spectrum, given its benefits in terms of facilitating economies of scale in the manufacture of radio equipment (which lowers both the cost of deploying wireless networks and the cost of wireless devices for consumers), and the minimisation of interference between users.

4.5 International harmonisation, and benefits provided from same, is particularly important for countries with a small population, such as Ireland, and, therefore, limited ability to affect the technology roadmaps adopted by often global suppliers of radio equipment.

4.6 In ComReg's experience, the appropriate release of harmonised spectrum bands has proven to be generally very successful in facilitating the delivery of services to end-users.[102]

4.7 Harmonised radio spectrum measures are set by a number of bodies including the ITU (and/or the constituent regional groups), the CEPT and the EU bodies. These bodies generally set a forward looking work programme and this provides an indication of future harmonisation measures. For example see the work plans of CEPT [103] and RSPG. [104] In some instances, harmonisation decisions are obligatory on Member States thereby directly increasing the supply of spectrum at a national level with a defined timeframe.[105]

4.8 In addition to the harmonisation of radio spectrum bands, the setting of harmonised radio equipment standards play a major facilitating role in spectrum management, particularly in terms of minimising the risk of interference between users. Within Europe, the main stakeholders responsible for setting these standards are the European Committee for Standardisation ("CEN"), the European Committee for Electrotechnical Standardisation ("CENELEC") and the European Telecommunications Standards Institute ("ETSI"). These bodies also work alongside national technical committees and various industry bodies. For example, the Institute of Electrical and Electronics Engineers ("IEEE") and the WiMAX Forum.

[102] In Ireland, harmonised spectrum bands support a wide range of services, include those provided by mobile operators.

[103] For example, the ECC CEPT work plan for 2018 to 2020 identifies the following major topics:

- Assess the feasibility of M2M/IoT through satellite from a technical and regulatory point of view;
- Spectrum for wireless broadband (including 5G); and
- The use of MFCN for UAS.

[104] The draft RSPG work programme for 2018 and beyond includes the following work items:

- EECC;
- RSPG structure and working methods;
- Peer review and Member State cooperation on authorisation and awards;
- 5G Implementation Challenges;
- Common Policy objectives for WRC-19;
- "Good offices" to assist in bilateral negotiations between EU countries; and
- European Spectrum Strategy.

[105] In Europe, EU/EC decisions are obligatory on Member States, while CEPT decisions are non-binding and voluntarily adopted by its members.

4.1.1 The World Radiocommunication Conference of 2019

4.9 Led by the DCCAE, Irish preparations for World Radiocommunications Conference 2019 ("WRC-19") are underway. ComReg is involved in this work and will assist the DCCAE to meet objectives and goals that will be established in the national preparatory process.

4.10 The major agenda items of interest to Ireland at WRC-19 are expected to be:

- Broadband applications in the Mobile Services - I. The following bands, which are already allocated to Mobile Services are being studied with a view to an IMT-2020 identification:
    a) 24.25 - 27.5 GHz
    b) 37 - 40.5 GHz
    c) 42.5 - 43.5 GHz
    d) 45.5 - 47 GHz
    e) 47.2 - 50.2 GHz
    f) 50.4 - 52.6 GHz
    g) 66 - 76 GHz
    h) 81 - 86 GHz
- Broadband applications in the Mobile Services – II. In addition, the following bands will also be studied, although they do not currently have global mobile allocations:
    a) 31.8 - 33.4 GHz
    b) 40.5 - 42.5 GHz
    c) 47- 47.2 GHz
- To take appropriate regulatory actions (which included additional Mobile Service allocations), for Wireless Access Services / Radio LANs in the bands between 5 150 - 5 925 MHz;
- To take necessary actions, as appropriate, to facilitate global or regional harmonised bands to support railway radiocommunication systems between train and trackside within existing Mobile Service allocations;
- Studies to consider possible global or regional harmonised bands, to the maximum extent possible, for implementation of evolving Intelligent Transport Systems ("ITS") within existing Mobile Service allocations;
- To consider possible regulatory actions to support Global Maritime Distress and Safety Systems ("GMDSS") modernisation and the introduction of additional satellite systems into the GMDSS;

- Studies to consider regulatory actions within the band 156 - 162.05 MHz for autonomous maritime radio devices to protect GMDSS and Automatic Identification System ("AIS");
- To consider new Maritime-Mobile Satellite Service (MMSS E-s and s-E) allocations, preferably within 156.0125 - 157.4375 MHz & 160.6125-162.0375 MHz to enable a new VHF data exchange system ("VDES") satellite component;
- Studies to consider the spectrum needs & regulatory provisions for the introduction and use of the Global Aeronautical Distress and Safety System ("GADSS");
- To consider the use of the bands 17.7-19.7 GHz (s-E) and 27.5 29.5 GHz (E-s) by earth stations in motion communicating with GSO space stations in the FSS and take appropriate action; and
- Studies on development of a regulatory framework for non-GSO FSS systems that may operate in the bands 37.5-39.5 GHz (s-E), 39.5-42.5 GHz (s-E), 47.2-50.2 GHz (E-s) and 50.4-51.4 GHz (E-s).

4.11 The outcome of WRC-19 will influence the work plans of the relevant bodies of the EC and CEPT and consequently ComReg.

4.2 European Commission harmonisation decisions

4.2.1 Existing EC harmonisation decisions

M2M Cellular IoT Technologies

4.12 Machine to Machine ("M2M") communication and the Internet of Things ("IoT") are widely considered to be applications with significant growth potential. Among M2M/IoT technologies, some are designed to operate in the spectrum bands assigned to MFCN.

4.13 In this regard, ComReg notes:

- that in June 2017, CEPT published ECC Report 266[106] which concluded that certain M2M technologies (i.e. LTE-MTC, LTE-eMTC, EC-GSM-IoT and NB-IoT) can co-exist with the technologies currently deployed in certain frequency bands currently harmonised for MFCN;
- that pursuant to the findings of ECC Report 266, the Radio Spectrum Committee ("RSC") of the EC is developing an implementing decision to

[106] ECC Report 266 on the Suitability of the current ECC Framework for the usage of Wideband and Narrowband M2M in the frequency bands 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz.

amend Decision 2009/766/EC to enable the deployment of IoT technologies in the 900 MHz and 1800 MHz bands;

- that on 20 April 2018 Commission Implementing Decision (EU) 2018/637 was adopted amending Decision 2009/766/EC on the harmonisation of the 900 MHz and 1800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community as regards relevant technical conditions for the Internet of Things. that the technical conditions for terrestrial systems operating in the 790 – 862 MHz band (as set out in EC Decision 2010/267/EU) stipulate a Block Edge Mask ("BEM") requirement for this band;
    - on the basis of the findings of Report 266, that the M2M technologies referred to above can be deployed in the 800 MHz band without a requirement to amend EC Decision 2010/267/EU; and
    - that it has granted licences for the provision of ECS in the 800 MHz, 900 MHz and 1800 MHz Bands to eir, Three and Vodafone which are governed by the Wireless Telegraphy (Liberalised Use and Preparatory Licences in the 800 MHz, 900 MHz and 1800 MHz Bands) Regulations 2012 (S.I. 251 of 2012).

4.14 On the basis of the above, ComReg observes that there would not appear to be impediments to eir, Three and Vodafone deploying the M2M technologies defined in ECC Report 266 in the 800 MHz band. In relation to the 900 MHz and 1800 MHz bands, ComReg has identified the implementation of Decision (EU) 2018/637 as a work plan item for the 2019-2021 strategy period.

700 MHz Band Duplex Gap

4.15 The 700 MHz Band is harmonised at three levels within Europe: (i) by the CEPT, (ii) by the EC and (iii) by the European Parliament and Council, as follows:

i. the least restrictive technical conditions ("LRTC") and frequency arrangements for the introduction of MFCN in the 700 MHz Band are harmonised at CEPT level by way of ECC Decision 15(01) of 6 March 201554 ;

ii. the above LRTC and frequency arrangements are reflected in EC Implementing Decision (EU) 2016/687 of 28 April 201655 ("700 MHz EC Decision"); and

iii. Decision 2017/899 of the European Parliament and Council of 17 May 2017 on the use of the 470-790 MHz frequency band in the EU ("UHF Band EP&C Decision") which:

4.16 Article 3(1)b of UHF Band EP&C Decision provides that, when Member States designate and make available the 700 MHz Band for use other than high-power broadcasting networks, they shall:

> *"**subject to national decisions and choice**, designate and make available the [700 MHz Duplex Gap[107] and 700 MHz Guard Bands[108]] portions of the 700 MHz frequency band, for use in compliance with the parameters set out in Sections A.2 to A.5 of the Annex"* [emphasis added]

4.17 In that regard, the 700 MHz EC Decision gives Member States flexibility in terms of the potential uses of the 700 MHz Duplex Gap and 700 MHz Guard Bands (which are not mutually exclusive) as follows[109]:

- Supplemental Downlink ("SDL"): of up to 20 MHz within the frequency range 738-758 MHz (i.e. up to 20 MHz of the 700 MHz Duplex Gap);
- PPDR[110]: where the frequency arrangement could consist of:
  d) 2 × 5 MHz in the frequency range 698-703 MHz (i.e. part of the 700 MHz Lower Guard Band) and 753-758 MHz (i.e. part of the 700 MHz Duplex Gap); and/or
  e) 2 × 3 MHz in the frequency range 733-736 MHz (i.e. part of the 700 Duplex Gap) and 788 – 791 MHz (i.e. the 700 MHz Upper Guard Band);
- M2M radio communications[111]: the frequency arrangement could consist of 733-736 MHz (i.e. part of the 700 MHz Duplex Gap) and 788 – 791 MHz (i.e. the 700 MHz Upper Guard Band); and

[107] In the frequency range 733–758 MHz.

[108] The 700 MHz Guard Bands comprises:

- the "700 MHz Lower Guard Band": in the frequency range 694 – 703 MHz; and
- the "700 MHz Upper Guard Band": in the frequency range 788 – 791 MHz.

[109] As set in Sections A.2 to A.5 of the Annex to the 700 MHz EC Decision.

[110] Which is defined in the 700 MHz EC Decision as follows:

> "'public protection and disaster relief (PPDR) radio communications' means radio applications used for public safety, security and defence used by national authorities or relevant operators responding to the relevant national needs in regard to public safety and security including in emergency situations."

[111] Which is defined in the 700 MHz EC Decision as follows:

> "'machine-to-machine (M2M) radio communications' means radio links for the purpose of relaying information between physical or virtual entities that build a complex ecosystem including the internet of Things; such radio links may be realised through electronic communications services (e.g. based on cellular technologies) or other services, based on licensed or unlicensed use of spectrum."

- wireless PMSE[112] ("PMSE"): the frequency arrangement could consist, in full or in part, of 694 – 703 MHz (i.e. the 700 MHz Lower Guard Band) and/or 733 – 758 MHz (i.e. the 700 MHz Duplex Gap).

4.18 In Document 18/60[113], ComReg stated its intention to address the issue of engaging with stakeholders with a view to obtaining greater clarity on national policy on the use of the 700 MHz Duplex Gap in Ireland in its forthcoming Radio Spectrum Strategy Statement consultation and, accordingly, this has been identified as a work plan item in Chapter 5 of this document.

1.4 GHz Band (1.4 GHz Centre Band and 1.4 GHz Extension Bands)

4.19 The 1452-1492 MHz frequency band ("1.4 GHz Centre Band") has remained unused in most European countries for the past two decades. Since 2002, the 1452-1479.5 MHz sub-band has been harmonised for terrestrial audio broadcasting systems (T-DAB) through the Maastricht 2002 Special Arrangement.

4.20 In 2003, the 1479.5-1492 MHz sub-band was harmonised for satellite digital audio broadcasting (S-DAB). This harmonisation was withdrawn in 2013, however, given the lack of substantial developments in this sub-band by the broadcasting-satellite service within the CEPT.

4.21 In late 2010, the ECC undertook a review of the use of the 1.4 GHz Centre Band with the aim of enabling its use for new services and applications that could bring substantial social and economic benefits for Europe. The ECC concluded that it should be harmonised for mobile broadband/mobile supplemental downlink ("SDL").[114]

4.22 At WRC-15, the two frequency bands adjacent to 1452-1492 MHz (i.e. 1427-1452 MHz and 1492-1517 MHz) (together the "1.4 GHz Extension Bands") were identified globally for IMT. The 1.4 GHz Extension Bands were harmonised in November 2017 by the ECC[115] for Mobile/Fixed Communications Networks Supplemental Downlink ("MFCN SDL"). In April 2018, the EC issued an

[112] Which is defined in the 700 MHz EC Decision as follows:

> 'wireless audio PMSE equipment' means radio equipment used for transmission of analogue or digital audio signals between a limited number of transmitters and receivers, such as radio microphones, in-ear monitor systems or audio links, used mainly for the production of broadcast programmes or private or public social or cultural events."

[113] ComReg Document 16/80 – Proposed multiband spectrum award – preliminary consultation on which bands to award.

[114] ECC Report 188 - *Future Harmonised Use of the 1452-1492 MHz in CEPT* – 19 February 2013: available at www.ecodocdb.dk .

[115] ECC/DEC/(17)06 - The harmonised use of the frequency bands 1427-1452 MHz and 1492-1518 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL) – 17 November 2017: available at www.ecodocdb.dk .

implementing decision which harmonises the entire 1.4 GHz Band (i.e. 1427 – 1517 MHz) for terrestrial systems capable of providing ECS in the EU ("1.4 GHz EC Decision").[116]

4.23 These actions have made the 90 MHz in the 1427 – 1517 MHz band available for wireless broadband SDL. However, in Ireland the 1.4 GHz Extension Bands are used to facilitate low-bandwidth links used predominantly by radio broadcasters and utilities. As of June 2018, there are 103 fixed links licenced in the 1.4 GHz Extension Bands.

4.24 The 1.4 GHz EC Decision provides that Member States should have national flexibility to use portions of the 1.4 GHz Extension Bands to cater for international military agreements or to respond in a time-limited manner to specific national needs for the continued operation of terrestrial fixed wireless services. The 1.4 GHz EC Decision also emphasises that the technical work undertaken in developing the harmonisation decision has shown that co-frequency operation of mobile and fixed services is not feasible. Where a Member State designates and makes available only a portion of the 1.4 GHz Extension Bands to ECS, Article 1(4) of the 1.4 GHz EC Decision clarifies that, following 1 January 2023, this is subject to the Member State identifying no national demand for wireless broadband ECS.

4.25 The future use of the 1.4 GHz band is part of an ongoing ComReg consultation (Document 18/60)[117]. For the reasons detailed in this document, ComReg's preliminary view is that the 1.4 GHz Band (both the 1.4 GHz Centre Band and the 1.4 GHz Extension Bands) should not be included in the Proposed Award. While this issue is currently subject to consultation, ComReg considers it appropriate to include a work plan item for 2019-2021 to monitor developments in the 1.4 GHz Band and to consider the current and future use of the band in the event that it is not ultimately included in the Proposed Award.

[116] Commission Implementing Decision (EU) 2018/661 of 26 April 2018 amending Implementing Decision (EU) 2015/750 on the harmonisation of the 1452-1492 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Union as regards its extension in the harmonised 1427-1452 MHz and 1492-1517 MHz frequency bands.

[117] See section 3.2 of ComReg Document 18/60 – Proposed Multi Band Spectrum Award: Preliminary consultation on which spectrum bands to award.

4.2.2 Forthcoming EC Harmonisation Decisions

3.6 GHz and 26 GHz frequency bands

4.27 In July 2018, the ECC adopted CEPT Reports 67[118] and 68[119] which were developed in response to an EC mandate[120] to develop harmonised technical conditions for the 3.6 GHz and 26 GHz frequency bands to support the introduction of next generation wireless systems in those bands.

4.28 On foot of CEPT Report 67, the RSC has developed a draft implementing decision to amend Decision 2008/411/EC[121] to ensure that the technical conditions as set out in the annex to that decision enable the roll out of 5G technology in the 3.6 GHz band. As currently drafted, Member States will be required to implement this Decision by mid-2019. Consequently, provision has been made in the draft work plan for the implementation of this decision during the forthcoming strategy period.

4.29 In addition, ComReg expects the RSC to develop an implementing decision to enable the roll out of next generation terrestrial wireless systems in the 26 GHz band. ComReg understands that Member States will be obliged to implement same during the period 2019 – 2021 and, therefore, provision has been made for the implementation of said implementing decision in the draft work plan.

4.30 In line with the mandate on the 3.6 GHz and 26 GHz bands (and the associated reports and decisions), and in order to ensure that all of the bands identified for MFCN are capable of supporting next generation wireless technologies, the RSC is currently drafting a mandate to CEPT to develop harmonised technical conditions for the 900 MHz, 1800 MHz, paired terrestrial 2 GHz and 2.6 GHz bands suitable for next-generation (5G) terrestrial wireless systems.

4.31 ComReg anticipates that a number of CEPT Reports will be developed on foot of this mandate and that these CEPT reports will, in turn, give rise to associated EC harmonisation decisions that Member States will be obliged to implement

[118] CEPT REPORT 67 Report A from CEPT to the European Commission in response to Mandate "to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union. Review of the harmonised technical conditions applicable to the 3.4-3.8 GHz ('3.6 GHz') frequency band.

[119] CEPT Report 68 Report B from CEPT to the European Commission in response to Mandate "to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union. Review of the harmonised technical conditions applicable to the 24.25-27.5 GHz ('26 GHz') frequency band.

[120] Mandate to CEPT to develop harmonised technical conditions for spectrum use in support of the introduction of next-generation (5G) terrestrial wireless systems in the Union.

[121] EC Decision 2008/411/EC on the harmonisation of the 3400 – 3800 MHz frequency band for terrestrial systems capable of providing electronic communications series in the Community.

during the period 2019 – 2021. As such, provision has been made for the implementation of such EC harmonisation decision/s in the draft work plan.

4.3 End user demand for mobile data

4.32 Mobile data traffic in Ireland has increased by over 900% in the five years to 2017 (from 8 million GB per quarter to 77 million GB per quarter), representing an average growth rate of around 60% per year – see Figure 12.

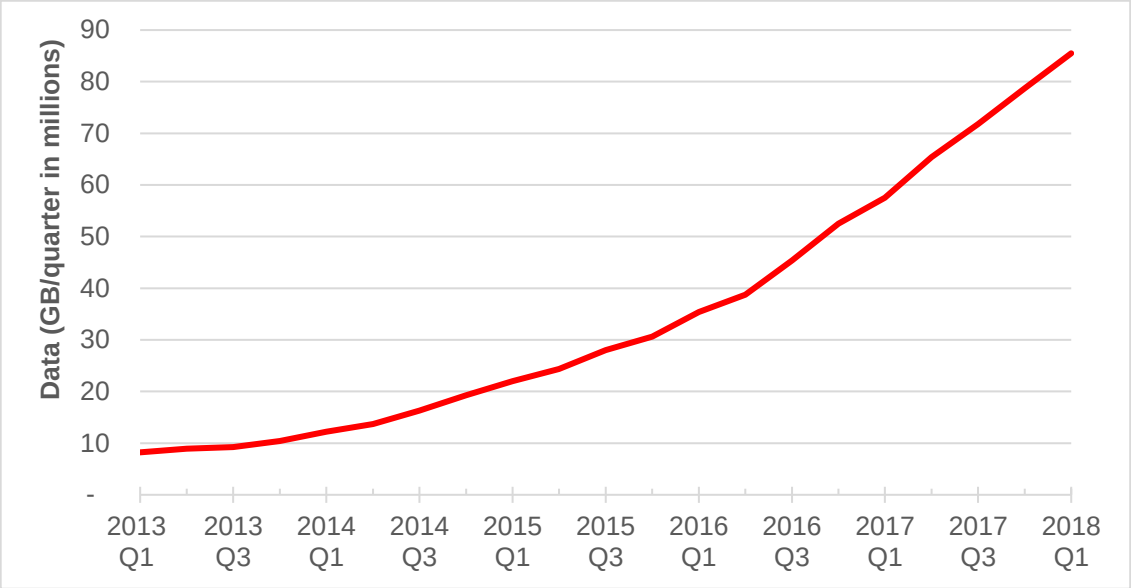

Figure 12: Total mobile data traffic in Ireland (GB/quarter)

Source: 2018 ComReg 'Quarterly Key Data Report' (Document 18/49)

4.33 This period of rapid growth coincides with expansion of 3G networks in 2013[122] and the launch of the 4G networks following the assignment of "liberalised" spectrum rights of use in 800 MHz, 900 MHz and 1800 MHz bands in ComReg's Multiband Spectrum Award ("MBSA") in November 2012.

4.34 As at Q1/2018, the average traffic per smartphone user reached 5GB of data per month, while the average traffic per dedicated mobile broadband subscriber was 11.4 GB of data per month. This represents a 50% year-on-year increase for smartphone usage and a 25% year-on-year increase for mobile broadband usage. By way comparison, in the same period in 2013, the average traffic per smartphone user was 400 MBs of data per month and 3.8 GBs per month for mobile broadband per month.

[122] In particular, ComReg notes that deployment of UMTS in the 900 MHz band allowed MNOs to offer 3G services across a wider geographic area.

4.35 Further increases in the demand for mobile data is expected, with an average annual growth of 32% predicted to 2022[123]. Total annual mobile data traffic is forecast to increase from 268 million GB/year in 2017 to 888 million GB/year in 2021 (see Figure 13).

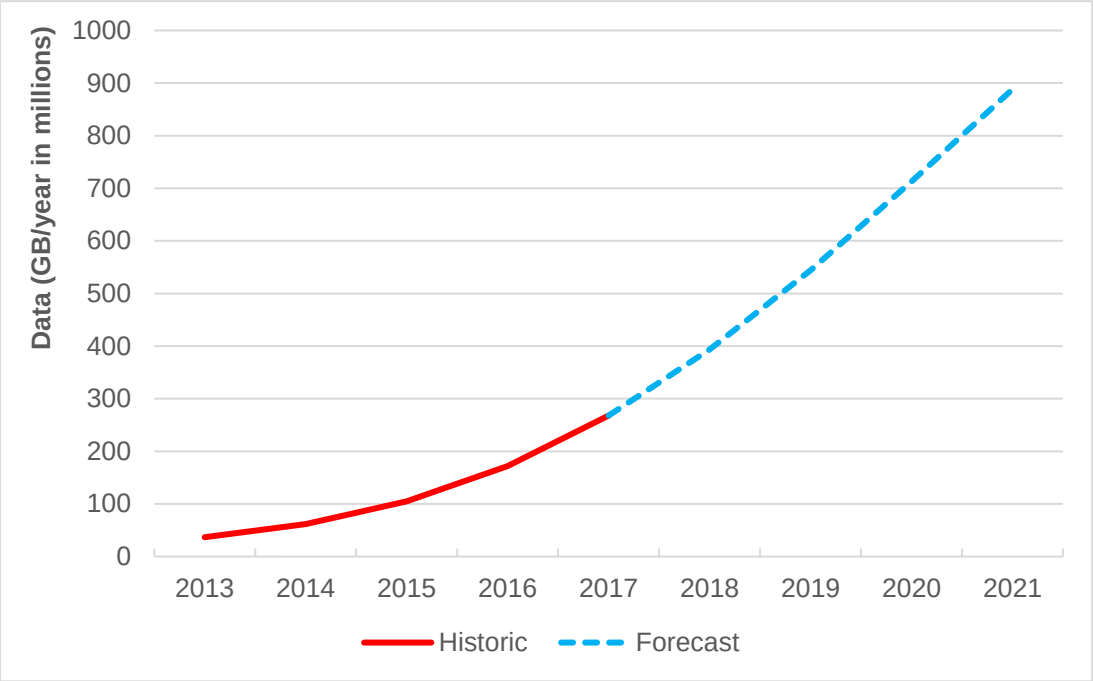

Figure 13: Base forecast of mobile data traffic in Ireland (GB/Year)

Source: 2018 Frontier 'Mobile Data Traffic Forecast in Ireland' (Document: 18/35)

4.3.1 Factors driving mobile data usage

4.36 The increase in the demand for mobile data is driven by a number of factors – see Figure 14:

- On the demand side, the growing use of mobile devices for audio-visual content and sending data-rich content via social networks is increasing data usage; and
- On the supply side, increased availability of 4G services and sophisticated devices entering the market along with the declining cost of data plans driven by retail competition (including "all you can eat" plans) will continue to impact consumption patterns.

4.37 The various demand- and supply-side factors are briefly discussed below.

[123] Document 18/35: https://www.comreg.ie/?dlm_download=mobile-data-traffic-forecast-in-ireland

Demand side factors

- **Demographic** - mobile phones are ubiquitous in Ireland, with 102% penetration as at 2017. Hence, population growth contributes to mobile data consumption. Patterns of usage differ across age groups, with smartphone ownership averaging 94% for mobile phone users below 50 years of age, compared to 62% for users above 50. As more than 60% of the Irish population are aged below 45, the prevalence of smartphones in this group seems likely to sustain the rise in mobile data consumption.
- **Handset upgrades** - the median age of mobile phones in Ireland was one to two years in 2017, with users typically upgrading their handsets every two years, and 40% of users were upgrading handsets even more frequently. As users continue to update their handsets to more sophisticated versions (e.g. with higher screen resolution and faster processing power), demand for mobile data will likely continue to grow.
- **Consumption trends** - consumption of video on mobile devices has been a key driver of increased mobile data usage, with 64% of mobile phone users watching video-on-demand in 2017, compared to 49% in 2015. This is attributed to the rising popularity of social media and embedded short videos, which is expected to endure.
- **Richer web pages** - websites have been, and will continue to become, more sophisticated, with richer content such as embedded videos, higher resolution images and embedded video advertising. With internet browsing taking up the most mobile data time for users (averaging 44 minutes daily), this will extend the data consumption impact.

Supply side factors

- **Increased coverage** - an increase in mobile network coverage can be expected to augment mobile data consumption, by allowing access to a larger number of users. Hence, the roll-out of 3G and 4G networks have contributed to the consumption of mobile data by previously large unserved areas of the population. Further network roll outs will augment the demand for mobile data.
- **Increased network speed** – increases in network speed enhance the ease of mobile usage by shortening download speeds. This raises mobile data consumption as consumers spend more of their time browsing or watching videos.
- **Improved devices** - mobile phones specifications have progressively improved as they have developed into converged multimedia devices. These improvements include higher screen resolution and better processing power, which enable faster loading and streaming of

webpages and videos. These higher specifications also require greater data requirements to operate.

- **Tariff changes** - consumers increase their mobile data usage as the price of mobile data declines. MNOs are increasingly offering '*all you can eat*' tariffs and/or larger data usage allowances. These have lowered the cost of mobile data consumption to the point where they have shifted consumption behaviour towards more frequent use of mobile data.

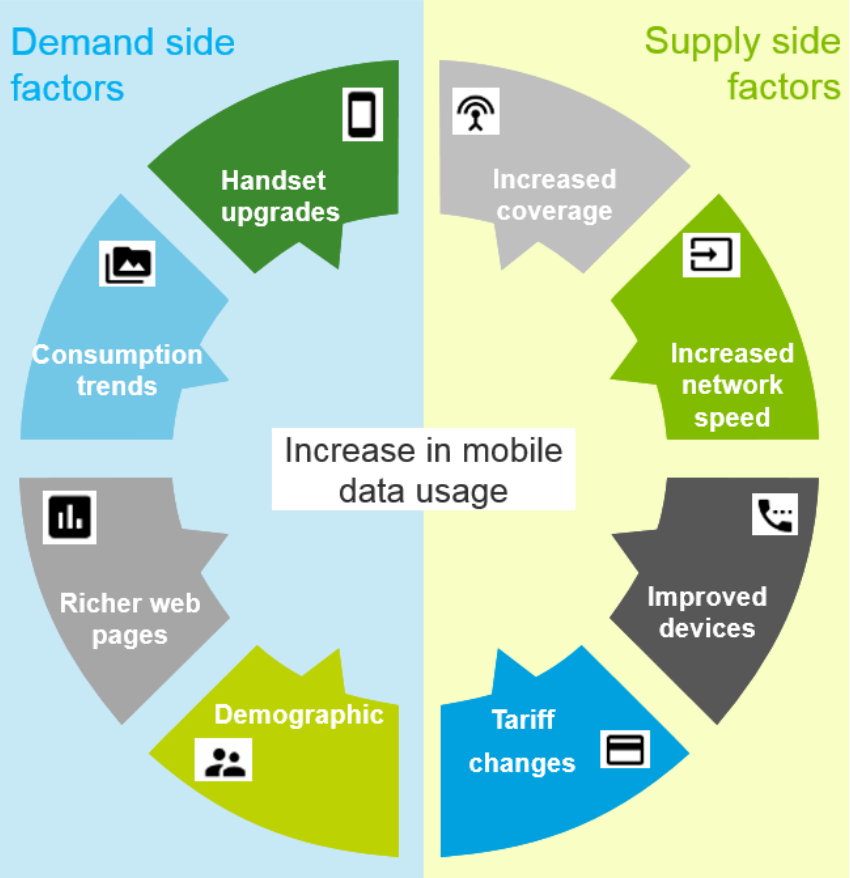

Figure 14: Factors driving mobile data usage

4.4 Technology changes and advancements

4.38 Technology changes[124] and advancements can affect both the demand for and supply of radio spectrum. Under normal circumstances such changes lead to a more efficient use of the radio spectrum and, in some instances, can result in faster or higher quality services being provided which may be sufficient to

[124] Technology changes happen on a less frequent basis than technology advancements. For example, the free-to-air analogue terrestrial television technology operated for over 50 years in Ireland before this technology was replaced by the free-to-air digital terrestrial television technology.

address increasing end-user demand for services. In other instances, this can result in spectrum being released from one service to another.[125]

4.39 Technology advancements can take many forms including the use of improved modulation or sharing techniques, and the ability for one service to use multiple spectrum bands at the same time using carrier aggregation.

4.4.1 M2M and IoT

4.40 As noted in section 4.2.1 it is widely predicted that the deployment of IoT, including M2M communications, will increase over the coming years[126]. While certain M2M/IoT technologies, such as NB-IoT, are designed to operate in the spectrum bands assigned to MFCN the vast majority of M2M and IoT technologies will operate in the licence exempt frequency bands. IoT devices include thermostats, smart meters, light bulbs, door locks, fridges, cars and implants for Radio Frequency Identification and pacemakers. ComReg observes that predictions estimate that the number M2M and IoT devices will increase from 8.4 billion units in 2017 to 20 billion units by 2020 worldwide[127].

4.4.2 Spectrum for 5G

4.41 While the final requirements for all aspects of 5G have yet to be finalised[128], there is common agreement on the main families of usage scenarios and applications that 5G might support, being:

- enhanced WBB connectivity;
- connectivity of millions of devices that would enable massive machine type communications; and
- resilient, instantaneous connectivity, that would enable ultra-reliable and low latency communications.

4.42 In its response to consultation and decision on the 26 GHz Spectrum Award 2018 (Document 18/12), ComReg set out its views on spectrum that could be used for 5G services[129]. ComReg observed that 5G spectrum award matters

[125] For example, the switch-off of analogue TV broadcasting in 2012 allowed both more TV programme services to be delivered to Irish viewers and released the 800 MHz band for terrestrial networks capable of providing ECS and, in particular, mobile WBB services.

[126] https://ovum.informa.com/resources/product-content/press-release-2017-iot-predictions

[127] https://www.gartner.com/newsroom/id/3598917

[128] Noting that the 3GPP have finalised on June 2018 the 5G NR standalone specifications. https://www.mobileworldlive.com/featured-content/top-three/3gpp-clears-5g-for-take-off-with-standalone-nr-specs/

[129] See section 2.2.

generally would be considered as part of the next Radio Spectrum Management Strategy Statement consultation.

4.43 ComReg notes that, for spectrum below 6 GHz, the RSPG's first (RSPG 16-032) and second (RSPG 18-005) opinions:

- identify the 3.6 GHz Band as the primary band for 5G (which has already been awarded by ComReg); and
- identify that 5G will need to be deployed in bands already harmonised below 1GHz, including, in particular, the 700 MHz Band.

4.44 In Document 18/12[130], ComReg noted that spectrum bands already licensed (in particular the 3.6 GHz Band) and spectrum bands identified for potential award (in particular the 700 MHz Band) will be part of the specifications for 5G[131] that are due to be released by the third Generation partnership Project ("3GPP") in mid-2018 and that this may delay interest in, and demand for, spectrum in the 26 GHz Band for 5G.

4.45 For spectrum above 6 GHz, in respect of a Strategic Roadmap towards 5G for Europe, the RSPG has published two opinions on this matter.

4.46 In its first opinion[132] the RSPG:

- recommended the 26 GHz band as a pioneer band for 5G above 24 GHz in Europe;
- recognised that the band 31.8 - 33.4 GHz looked promising and could be made available relatively easily by many European administrations, taking into account the existing fixed service deployment in this band, for future deployment of 5G services; and
- considered that the band 40.5 - 43.5 GHz (42 GHz) was a viable option for 5G in the longer term, taking into account the support from mobile industry and the need to take into account the general balance between mobile and satellite sector to access the 40/50 GHz range.

4.47 In its second opinion[133] the RSPG:

- reaffirmed its view that the 26 GHz Band is the key mmWave pioneer band for 5G in Europe;

[130] See paragraphs 2.19 and 2.20.

[131] Specifically, the specifications will refer to the 5G New Radio (NR) bands.

[132] RSPG16-032 – RSPG strategic roadmap towards 5G for Europe, Opinion on spectrum related aspects for next generation wireless systems (5G) – 9 November 2016.

[133] RSPG18-005 – RSPG strategic roadmap towards 5G for Europe, RSPG second opinion on 5G networks – 30 January 2018.

- noted that, having considered sharing studies, industry interest and the size of the band, that the 31.8 - 33.4 GHz band should no longer be considered as a priority;
- whilst still of the opinion that the 42 GHz band is a priority band for Europe for 5G, there is no urgency in potential harmonisation of this band; and
- considered that the 66 - 71 GHz band should now also be prioritised in terms of studies for second stage mm-Wave 5G bands.

4.48 In that second opinion, the RSPG noted that in relation to the 26 GHz "pioneer" band:

- Member States should make by 2020 *a sufficiently large portion of the band, e.g. 1 GHz, available for 5G* in response to market demand, taking into account that 5G deployment in this frequency range is expected to be used for local coverage; and
- Regulatory flexibility for the progressive release of the 26 GHz band will facilitate an efficient introduction of 5G *without having an unnecessary negative impact on the current users of the band*. [Emphasis added]

4.49 ComReg observes that the finalisation of the CEPT ECC Decision (18) 06[134] on harmonised conditions for MFCN in the 26 GHz band will form the basis of the EU harmonisation action in respect of this band, and notes that initial MFCN deployments in many CEPT countries is expected in the 26.5 – 27.5 GHz frequency range.

4.50 ComReg also understands that there may be an obligation in the current draft of the EECC which would oblige Member States to allow the use of some of the 26 GHz Band for WBB by end-2020 and has noted this in its consideration of the 26 GHz Band in Document 18/60[135].

4.51 ComReg notes that the 26.5 – 27.5 GHz frequency range is unassigned in Ireland in the event that the 26 GHz band will be required for 5G MFCN services.

4.4.3 Technological developments in the fixed link frequency bands

4.52 With mobile networks expected to achieve data throughputs in the region of gigabit-per-second ("GBit/s") to end-users in the future, and taking into account associated small cell deployments and increased macro-cell capacity requirements, ComReg anticipates that this will have a significant bearing on

[134] https://www.ecodocdb.dk/document/3361

[135] ComReg Document 18/60 – Proposed Multi Band Spectrum Award: Preliminary consultation on which spectrum bands to award.

backhaul capacity requirements in both existing and new fixed link microwave bands. ComReg views the upper frequency bands (i.e. 50 GHz and above) as being potential key facilitators for such high traffic volumes.

4.53 Backhauling needs to satisfy apparently conflicting requirements such as:

- increase of capacity that can be supported on the link;
- increased spectrum efficiency to maximise the use of the radio spectrum;
- low power consumption to reduce the costs of operations; and
- low environmental impact to satisfy planning rules.

4.54 Due to technology evolution and availability of wide channel bandwidths at higher frequencies, the use of frequency bands in the V-Band, E-Band, W-band and D-Band appear to be of interest for the future needs for backhaul networks as they are promising in term of providing multi-Gbit/s channels.[136]

4.55 Given the different nature of these frequency bands, different scenarios might be foreseen for each band, including macro- and small cell backhaul, front-haul applications, line of sight ("LoS") today, and possibly near line of sight (nLoS) in the future.

4.56 Timely consideration is required in order to efficiently and effectively cater for the expected increase in backhaul capacity requirements. At the same time, the projected increase in backhaul capacity requirements may also potentially be

[136] There is some confusion about microwave frequency band letter definitions, since there is no unique view in literature and the satellite industry and fixed-link industry designators do not align. Each letter definition is widely variable depending on the standardisation / development body that first used the designation. See annex 2 for a list of commonly used spectrum designators used in the satellite communications.

For the purpose of fixed links:

- the V-band is characterized by a continuous block of 9 GHz of spectrum between 57 and 66 GHz (however, the lower portion spanning from 48.5 GHz to 57 GHz is generally included in the V- band definition). In this band oxygen absorption can aid link designers in providing additional resistance to radio interference as well as enhanced frequency reuse;
- The E-Band (which covers 71 - 76 GHz and 81-86 GHz) enables Gbit/s data rates given the large amount of available spectrum (10 GHz) without any oxygen absorption, thus allowing longer distances compared to the V-Band.
- The W-band (92-114.25 GHz) has been indicated as the possible complement for the E-Band when the latter reaches saturation; and
- The D-band (130 – 174.8GHz) has been suggested as a possible additional band to the V-band.

offset by further developments in fixed link technologies, such as the emergence of more efficient modulation techniques.

Fixed links in the E-Band (71 – 76 GHz and 81 – 86 GHz)

4.57 As set out in Chapter 3, there has been significant growth in the number of applications for fixed links in the E-band in recent years. Of the 849 fixed links currently licensed in this band, 76% are located in the Dublin region. This demand of E-band links for the Dublin region has, in recent weeks, resulted in limited channel availability for new applications. As such, ComReg is of the view that this band is reaching saturation in the Dublin region and that it may be necessary to close this band to new applications shortly.

4.58 In order to inform any decision that it might make with regard to the E-band, a thorough analysis of the existing links, including geographical distribution and channel bandwidth, is required. As such ComReg has included this as a proposed work plan item in Chapter 5.

4.59 Until recently the maximum channel spacing that has been requested in the E-Band has been 750 MHz, with modulations schemes ranging from 4QAM up to 256QAM. However, recent representations made to ComReg suggests that:

- operators are seeking higher channel spacings of 1000 MHz and 2000 MHz and also lower modulation schemes such as 4FQAM, 4HQAM and 4SQAM;
- path lengths at these lower modulations can reach up to 8Km;
- in order to achieve these longer path lengths, larger channel spacings and lower modulation schemes are required;
- these lower modulation schemes result in a reduction in link availability below the level currently permitted in ComReg's Radio Links Guidelines (of 99.95% in this band);
- the relevant ETSI standard (EN 302 217 – 3) currently has no interference provisions for 1000 MHz and 2000 MHz spacing over 16QAM, which results in ComReg's interference analysis in this band being less than 100% accurate; and
- ETSI is currently drafting a revision to the standard for E-Band interference analysis to address the aforementioned issues.

4.60 Consequently, and in order to consider accommodating longer links with lower modulation and the minimum availability, ComReg has made provision in its draft work plan to amend its Radio Links Guidelines once the revised ETSI standards are in place.

Fixed links in the 30 - 134 GHz, 141-148.5 GHz, 151.5-164 GHz and 167 - 174.8 GHz bands

4.61 Alternative bands to the E-band for future use for high capacity links include the W-Band (92-114.25 GHz) and D-band (130 – 174.8GHz). Both bands exhibit good propagation characteristics with low atmospheric gas attenuation. The band path loss of D-band is only 6 dB worse than that of E-Band, making D-band suitable for meeting the requirements of ultra-high capacity links.

4.62 While the current ETSI document (EN 302 217) does not cover frequencies above 86 GHz, ComReg is aware that ETSI is currently preparing technical material for possible inclusion of the range 130 GHz to 174.8 GHz in this series.

4.63 In addition, the CEPT has adopted a recommendation detailing out the channelling arrangements for National Regulatory Authorities wishing to make these bands available for fixed links.[137]

4.64 ComReg would intend to implement this recommendation once equipment for fixed links in these bands becomes available, and has included a work item to this effect in the draft work plan in Chapter 5.

Fixed links in the V-Band (57 – 64 GHz)

4.65 As noted above, propagation of radio waves in the V-band is limited due to oxygen-absorption attenuation. This aspect favours a high frequency reuse factor within the band with reduced requirements for frequency coordination.

4.66 Applications for this band have been very limited and preference appears to be for the E-band where propagation is not affected by oxygen-absorption to the same extent. Notwithstanding ComReg is aware that:

- there are a large number of well-known manufacturers of equipment for point-to-point, point-to-multipoint and mesh networks that utilise this band;
- this band is favoured by a number of these manufacturers for future small-cell deployments to meet expected connectivity demands[138,139]; and

[137] ECC Recommendation 18(01) Radio frequency channel/block arrangements for Fixed Service systems operating in the bands 130 - 134 GHz, 141-148.5 GHz, 151.5-164 GHz and 167 - 174.8 GHz.

[138] https://www.siklu.com/custom-blog/e-band-vs-v-band-batman-or-invisible-man-you-choose/

[139] http://www.intracom-telecom.com/en/products/wireless_network_systems/4G_smallcell_son_backhaul/ streetnodeV60.htm

- an ECC Recommendation is in place that facilitates the use of this band while providing protection for other users in the band.[140]

4.67 In light of the above, a review of the licensing regime currently in place for radio links appears warranted, with a view to implementing, if required, an appropriate licensing regime to facilitate the future use of this band. ComReg welcomes views on these issues.

4.4.4 WRC-19

4.68 Given the nature of the above services, international harmonisation processes plays a significant role in determining the demand for and supply of spectrum for services. In that regard, following WRC-19 and the completion of several agenda items involving spectrum matters relating to services, ComReg will implement changes to the Radio Frequency Plan for Ireland and address any changes that may affect licensees' use of this spectrum.

4.5 Licences expiring in the near future

4.69 Where existing spectrum rights of use are due to expire within the near future (e.g. the next five years) ComReg endeavours to set out its proposals on the future use of such bands well in advance of expiry including, where appropriate, defining and carrying-out an assignment process for same.

4.70 There are a number of licences that will expire in the period 2019 – 2024 (i.e. three years following the 2019 – 2021 timeframe of this consultation). ComReg sets out the current status of these bands and envisaged next steps in respect of same below.

4.5.1 2.1 GHz band

4.71 The frequency range 1900-1920 MHz, 1920-1980 MHz and 2110- 2170 MHz ("the 2.1 GHz band) consists of 140 MHz of spectrum and is currently licensed in Ireland for the provision of Universal Mobile Telecommunications System ("UMTS" or "3G") services. These licences were issued following competitions in 2002 and 2007 and included two parts:

- paired FDD spectrum rights in the frequency range 1920 -1980 MHz and 2110 -2170 MHz ("Paired 2.1 GHz Band"); and
- unpaired TDD spectrum rights in the frequency range 1900-1920 MHz ("Unpaired 2.1 GHz Band").

[140] ECC/REC/(09)01 – Use of the 57 – 64 GHz frequency band for point-to-point fixed wireless systems – January 2009

4.72 Spectrum rights in the Paired 2.1 GHz Band are currently licensed to Three, Vodafone and Meteor. The licences held by Three and Vodafone will expire in 2022 as follows:

- Three holds two licences in the 2.1 GHz Band, referred to as the "A Licence" (which expires on 24 June 2022) and the "B Licence" (which expires on 1 October 2022)[141]; and
- Vodafone holds one licence which expires on 15 October 2022.

4.73 The licence held by Meteor expires on 11 March 2027.

4.74 In Document 18/60, ComReg set out its preliminary view that the Paired 2.1 GHz Band should be included in its proposed award of spectrum rights of use suitable for the provision of WBB.

4.5.2 All Island Licence in the 1785 – 1805 MHz band

4.75 In 2007, a joint ComReg/Ofcom spectrum award was concluded which resulted in the granting of a licence for the 1785 – 1805 MHz frequency band for mobile wireless services on an all-island basis. On foot of same, a separate licence was issued in both jurisdictions to a single entity, Personal Broadband[142], for a period of 15 years. In Ireland, the licence was granted on 25 April 2007 under the Wireless Telegraphy (1785–1805 MHz Wireless Access Services) Regulations (S.I. 172 of 2007). This licence is due to expire on 24 April 2022.

4.76 In considering potential future uses of this band, ComReg notes:

- Regulation 6(1) of S.I. 172 of 2007 provides states that all licences shall expire after 15 years;
- there is no provision in S.I. 172 of 2007 for the renewal of licences granted under same;
- that commercial services have not been deployed in either jurisdiction using the spectrum rights held under the licence;
- in 2014, the EC adopted Implementing Decision 2014/641/EU which requires Member States to designate and make available the 1785 – 1805 MHz band for audio PMSE on a non-interference, non-protected basis;
- ComReg has implemented this decision for PMSE use in Ireland;

[141] Three also holds spectrum rights for an additional 5 MHz block in the Unpaired 2.1 GHz Band as part of its B Licence. Vodafone and Meteor previously held an equivalent 5 MHz block in the Unpaired 2.1 GHz Band, which were returned to ComReg on 11 March 2011 and 28 February 2013, respectively.

[142] Personal Broadband was purchased by Netiv Ltd. In 2016, which is now the licence holder.

- the 1785-1805 MHz band is not subject to any harmonisation decision within CEPT or the EU for MFCN; and
- there are no plans at either an EU or ITU level to allocate the band for MFCN; and
- ComReg has set out its general position on the issue of licence expiry/ renewal in a number of publications[143].

4.77 ComReg envisages that, following engagement with Ofcom, it will make a determination on the future of this band during the forthcoming strategy period.

4.5.3 Third Party Business Radio

4.78 ComReg launched its Third Party Business Radio ("TPBR") licensing scheme in 2005 for the provision of private mobile radio ("PMR") services to third parties in the UHF and VHF frequency bands. Licences under this scheme are national in scope and are granted for a period of 5 years.

4.79 Since the scheme was launched, it was re-opened in 2011 and again in 2016, enabling both existing licensees whose licenses are expiring, and new licensees, to apply for new licences for a further 5 year period. Following the re-launch of the scheme in 2016, ComReg granted licences for 43 channels, each of 12.5 kHz bandwidth, to 12 licensees. The demand for TPBR licences is shown in **Error! Reference source not found.**.

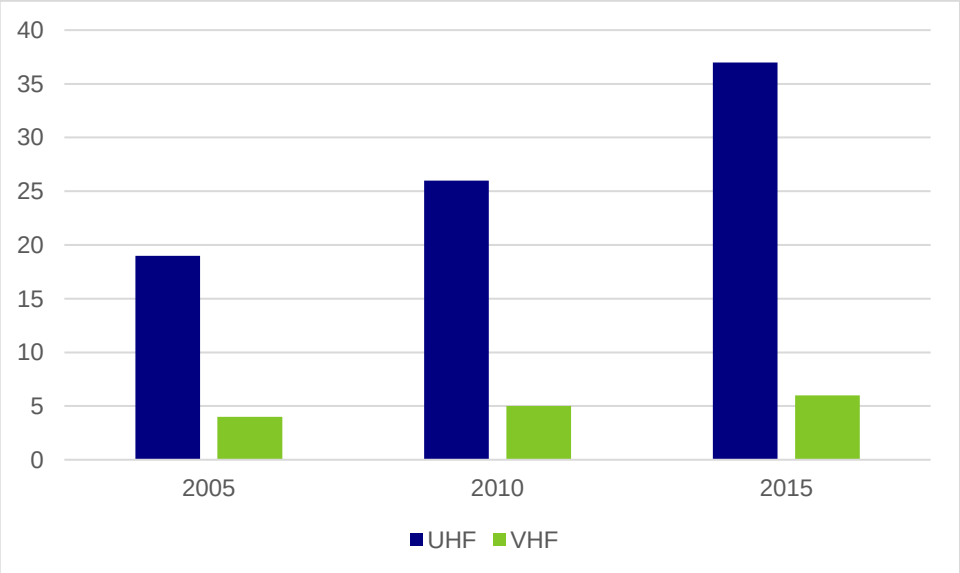

Figure 15: Number of TPBR licences issued.

[143] See, for instance, ComReg 16/50 – Radio Spectrum Management Strategy Statement 2016 – 2018.

4.80 In light of the constant demand for spectrum under this licensing scheme and the inefficiencies associated with periodically opening and closing the licensing scheme[144], ComReg intends to consult on keeping the TPBR licensing scheme open on an ongoing basis (including, for example, issuing 5 year licences on a first-come-first-served basis, with a simple mechanism to address demand exceeding supply on any given day). ComReg has made provision for this work in its draft work plan as set out in Chapter 5.

4.5.4 National Telemetry Licences

4.81 Following a public consultation process[145], in July 2014 ComReg introduced a licensing scheme for telemetry systems operating on a local or national level.[146]

4.82 On foot of this process, ComReg granted three national telemetry licences, two to ESB and one Irish Water under the Wireless Telegraphy (Licensing of Telemetry Systems) Regulations (S.I. 240 of 2014). Each licence comprises a block of 12 channels of 2 x 12.5 kHz of spectrum in the UHF band. Each licence has a duration of 10 years and will expire in July 2024. Table 2 and Table 3 set out the details of these licence assignments.

[144] For example:

- spectrum is readily available in the VHF and UHF bands that could be assigned to TPBR; and
- opening and closing the scheme may act as a barrier to existing and potential users efficiently acquiring spectrum rights of use as required.

[145] ComReg Document 13/77 – The introduction of a licencing framework for VHF and UHF telemetry systems.

[146] Telemetry system means a wireless telegraphy system by which automated measurements are made and other data collected at remote or inaccessible locations, and transmitted to receiving stations for monitoring, recording or remote control purposes.

Licensee	Cell	Freqency Block 1 MHz		Frequency Block 2 MHz		Licence Commencement	Licence Expiry
		Base	Outstation	Base	Outstation		
ESB	A	457.64375	463.14375	458.20625	463.70625	09-Jul-14	08-Jul-24
	B	457.75625	463.25625	457.00625	462.50625		
	C	457.85625	463.35625	457.99375	463.49375		
	D	457.65625	463.15625	457.69375	463.19375		
	E	457.83125	463.33125	457.86875	463.36875		
	F	458.00625	463.50625	458.24375	463.74375		
	G	457.61875	463.11875	457.63125	463.13125		
	H	457.60625	463.10625	457.91875	463.41875		
	J	457.84375	463.34375	458.14375	463.64375		
	K	457.98125	463.48125	458.21875	463.71875		
	L	457.59375	463.09375	457.19375	462.69375		
	M	458.15625	463.65625	457.23125	462.73125		

Table 2: ESB's National Telemetry Assignments

Licensee	Cell	Freqency Block 3 MHz		Licence Commencement	Licence Expiry
		Base	Outstation		
Irish Water	A	458.23125	463.73125	09-Jul-14	08-Jul-24
	B	457.25625	462.75625		
	C	458.11875	463.61875		
	D	458.10625	463.60625		
	E	457.95625	463.45625		
	F	457.05625	462.55625		
	G	457.73125	463.23125		
	H	457.96875	463.46875		
	J	458.16875	463.66875		
	K	457.18125	462.68125		
	L	457.44375	462.94375		
	M	457.28125	462.78125		

Table 3: Irish Water's National Telemetry Assignments

4.83 While ComReg will not be making a determination on the future use of this band during the forthcoming strategy period, ComReg observes that:

- these are non-harmonised bands;
- ComReg is not aware of any plans to harmonise these bands in Europe prior to 2024; and
- each licensee has rolled out extensive national telemetry networks to support its operations.

4.84 In light of the above, a work plan item to address the future of the National Telemetry licensing regime does not appear to be required for the period 2019-2021, although ComReg expects such an item to appear in the subsequent strategy period.

Chapter 5

5 Proposed Radio Spectrum work plan for the period 2019 - 2021

5.1 In light of the matters discussed in the preceding chapters, this chapter sets out ComReg's proposed radio spectrum work plan for the period 2019 – 2021.

5.2 As spectrum is a finite and valuable resource, it must be managed in an effective manner so that efficient use can be made of it. While ComReg strives to meet the spectrum demands of all users, inevitably this is not possible because, among other things:

- two or more services/potential users may have competing demands for the same spectrum resource;
- the timing of demand for the same spectrum resource may differ between services/potential users; and/or
- at any one time there may be demand for multiple spectrum bands or multiple spectrum management activities (e.g. the amendment of a licence) by a variety of potential users. Given practical considerations, such as resourcing, it may not be possible to carry out all of these actions at the same time.

5.3 As discussed in the previous chapter, ComReg's radio spectrum workload is driven by a wide range of items including:

- the expiry of existing licences - where existing spectrum rights of use are due to expire within the near future[147] (e.g. within the next 3 years), ComReg endeavours to set out its proposals on the future use of such bands well in advance of expiry including, where appropriate, defining and carrying-out an assignment process for same;
- the potential for additional spectrum bands to be released - given developments such as the harmonisation of a spectrum band[148] or the potential for re-farming a spectrum band[149], it may be appropriate to

[147] For example, the Paired 2.1 GHz band, which has licences expiring in 2022, is being consulted upon in ComReg Document 18/60.

[148] For example, in 2018 EU Decision 2018/661 amended EU Decision 2015/750 to add the 1427-1452 MHz and 1492-1517 MHz frequency bands to the already harmonised 1452-1492 MHz frequency band for terrestrial systems capable of providing electronic communications services.

[149] For example, the 700 MHz band is currently in the process of being re-farmed in Europe.

consider the release of additional spectrum bands; and

- other developments - this can relate to a wide range of external developments including national or EU legislation/policy developments[150], sector-specific or licensee requests etc.

5.1 Appropriate prioritisation of spectrum work activities

5.4 Given the above, ComReg aims to manage its workload in a manner that seeks to appropriately and pragmatically address the needs of a diverse range of stakeholders. Relevant considerations in this regard include:

- The capacity within the existing radio spectrum bands to meet spectrum needs. Where capacity exists, it may be possible to meet this demand via the existing spectrum assignments or to award new assignments using existing authorisation processes;
- The timing of the expiry of existing rights of use and the requirement for an appropriate re-assignment process in light of factors such as end user demand, harmonisation status, equipment availability and availability of related spectrum bands;
- The international harmonisation status of a spectrum band including any future harmonisation plans;
- The harmonisation status and appropriate timing for release of spectrum bands that are currently unassigned;
- The potential to liberalise the current restrictions placed on licensees which could increase the efficient use of spectrum, facilitate innovation and potential free up capacity which could be made available for other uses;
- The potential for including multiple spectrum bands in a single award process where appropriate to meet ComReg's statutory objectives;
- The adoption in of legislation (national or European) which requires ComReg to take defined actions within a set timeframe; and
- The potential for market mechanisms to address spectrum management issues.

[150] For example, it is expected that current European Common Regulatory Framework for ECN and ECS will to be superseded by the European Electronic Communications Code ("EECC") during the course of this forthcoming strategy period.

5.2 ComReg's draft spectrum work plan 2019 to 2021

5.5 The following outlines the indicative spectrum work plan that ComReg intends to carry out within the time period 2019 to 2021.

5.2.1 ComReg's spectrum management function (i.e. programmatic work)

5.6 ComReg has identified the following programmatic work items for the period 2019 - 2021:

- Continue to issue licences for wireless telegraphy in accordance with the 1926 Act and the regulations associated with each licence type;
- Continue to conduct market surveillance on items being imported to the State through customs;
- Continue to conduct surveys of transmission sites for compliance with licence conditions;
- Continue to monitoring compliance and taking enforcement action where appropriate;
- Continue to investigate radio interference, giving appropriate priority to cases that have safety-of-life implications;
- Continue to publish an annual report detailing activities in respect of market surveillance, investigations of radio interference and enforcement action;
- Continue its programme of measurement of NIR testing and publication of surveys on Siteviewer;
- Continue to promote Test and Trial Ireland and the benefits of using Ireland as a location to test or trial wireless products and services in a real world environment; and
- Assist the DCCAE in the transposition of the EECC, and implement same as appropriate.

5.2.2 MFCN

5.7 ComReg has identified the following work plan items for MFCN for the period 2019 - 2021:

- Develop and finalise award proposals for the release of spectrum in the proposed multi-band award process (as being consulted upon in ComReg Document 18/60), and implement same;
- Take appropriate administrative measures arising from the adoption of Decision (EU) 2018/637 which amends Decision 2009/766/EC to enable the deployment of M2M technologies in the 900 MHz and 1800 MHz frequency bands;
- Implement relevant EC harmonisation decisions in the bands for MFCN in support of next generation terrestrial wireless systems;
- Engage with the relevant stakeholders with a view to obtaining greater clarity on national policy on the use of the 700 MHz Duplex Gap in Ireland and, in particular, for PPDR;
- Monitor developments in the 1.4 GHz band for MFCN and consider the current and future use of the band in Ireland;
- Publish non-confidential information regarding ComReg's drive testing programme of mobile networks in Ireland;
- Continue to measure the performance of all new makes and models of mobile handsets that become available on the Irish market for both voice and data on a regular and ongoing basis;
- Continue to examine the overall effect of different materials on all elements of the construction of buildings and will consider how to best establish the aggregate effect of building materials on signal propagation including collaboration with other research bodies;
- Continue to liaise with MNO's to gather network architecture data for the generation of coverage prediction maps and make these available on its consumer website;
- Consider administrative matters concerning the EC's spectrum divestment commitments in relation to the acquisition of Telefonica by Hutchison at the appropriate time;
- Continue to work with relevant parties to ensure the orderly and timely transition by existing FWALA licensees in the 3.6 GHz band to enable

services to be provided by the winning bidders in the award, in accordance with the transition rules of the award; and

- Monitor the progress of the developments in respect of 5G with a view to making a portion of the 26 GHz band available, if and when it is required.

5.8 ComReg observes that arising from its work plan item to generate mobile coverage maps for publication on its website it will consider other means of monitoring the MNO's compliance with their mobile coverage obligations.

5.2.3 Broadcasting Services

5.9 ComReg has identified the following work plan items for the Broadcasting service for the period 2019 - 2021:

- Assist the DCCAE, RTÉ and 2rn as appropriate in facilitating the migration of DTT services from the 700 MHz band by 4 March 2020;
- Continue to manage and oversee the cost recovery mechanism for the migration of DTT services below the 700 MHz band;
- Continue to engage in the international coordination of broadcasting transmitter stations;
- Issue and amend DTT, DSB and ASB broadcasting licences as requested in line with the broadcasting licensing framework; and
- Provide advice as required to DCCAE in relation to spectrum for broadcasting services.[151]

5.2.4 Terrestrial Fixed Services

5.10 ComReg has identified the following work plan items for the Fixed service for the period 2019 - 2021:

- Consider opening up the 130 – 134 GHz, 141 – 148.5 GHz, 151.5 – 164 GHz and 167 – 174 GHz frequency bands for fixed links in accordance with ECC Recommendation (18)01;
- Consider amending the radio links guidelines to enable longer link path lengths with lower modulation and availability requirements;
- Consider the future of the continued licensing of fixed links in the E-band in the Dublin area;

[151] For example, the government has signalled an intention to revise the Broadcasting Act 2009, ComReg will assist DCCAE staff as appropriate. See www.dccae.gov.ie.

- Following a call for inputs on the future use of the V-band (57-64 GHz), consider further if a review of the licencing regime currently in place for this band is required and if so to consult on this matter;

- Consider adding a number of bands in the 5 – 30 MHz for HF fixed links to the radio link licensing list of bands; and

- Consider the publication of fixed link data on Siteviewer.

5.2.5 Licence Exempt Short Range Devices

5.11 ComReg has identified the following work plan items for SRDs for the period 2019 - 2021:

- Continuing to facilitate the use of SRDs to Ireland in accordance with international harmonisations measures and where necessary, revise ComReg document 02/71 on foot of EC and ECC harmonisation updates to facilitate the introduction of new SRDs;

- Monitor, contribute to and promote Ireland's spectrum management position in relation to IoT.

- Monitor the outcome of CEPT studies on the feasibility of extending the use Radio Local Area Networks (RLANs) to the 5925 – 6425 MHz band for the provision of wireless broadband services.

5.2.6 Satellite Services

5.12 ComReg has identified the following work plan items concerning satellite networks and services for the period 2019 – 2021:

- Continue to facilitate the licensing of satellite earth stations (SES) operating in spectrum above 3 GHz; and

- Pending any authorisation of Inmarsat and Echostar, to monitor MSS with CGC operators to ensure compliance with conditions of EC Decision 2007/98/EC.

5.2.7 Business Radio Services

5.13 ComReg has identified the following work plan items for Business Radio for the period 2019 - 2021:

- Conclude the consultation process and if appropriate proceed to the award for the use of the 400 MHz band;

- Consult on a business radio licensing regime to permit the use of national channels on a technology and service neutral basis;
- Monitor and contribute to the spectrum management considerations of PMSE and take appropriate actions to implement harmonisation decisions;
- Monitor and contribute to the spectrum management considerations in respect of broadband PPDR; and
- To relaunch the Third Party Business Radio Licensing scheme prior to the expiry of existing licences in 2021 having consulted on keeping the TPBR licensing scheme open on an ongoing basis.

5.2.8 Radio Amateur Services

5.14 ComReg has identified the following work plan item for Radio Amateur services for the period 2019 – 2021:

- Consider allocating the 76-81 GHz, 134-141 GHz and 241-250 GHz bands to the amateur service in Ireland – this would align the Irish Table of Frequency Allocations with the European Common Allocation table and the ITU Radio Regulations.

5.2.9 Aeronautical, Maritime and Scientific Services

5.15 ComReg's proposed strategy for the duration of this period is to:

- Continue to liaise with relevant stakeholders including IAA, MRAU, Met Éireann and the Irish defence forces to encourage and ensure efficient use of spectrum to promote Irelands interest at international fora;
- Continue to liaise and assist relevant stakeholders including Universities and other Third Level institutes to encourage and ensure efficient use of spectrum to promote Irelands interest at international fora;
- Consider developing an appropriate licensing mechanism to licence apparatus used for scientific services by third level institutes; and
- Consider whether it is possible to promote and potentially establish "quiet zones" for particular frequency bands around specific areas of radio spectrum research such as Birr Castle.

5.2.10 Defence Forces Use of Spectrum

5.16 ComReg will maintain awareness of international developments, particularly in CEPT through the Civil-Military Frequency Management Forum which brings

together civil and military spectrum managers across Europe to address issues of mutual interest.

5.17 ComReg will continue to liaise with the Irish Defence Forces as required to resolve issues of mutual concern.

5.18 ComReg will explore with the relevant authorities opportunities to further enhance spectrum efficiency.

Chapter 6

6 The economic contribution of radio spectrum to Ireland

6.1 In its 2016-2018 Strategy Statement, ComReg estimated the economic contribution of radio spectrum to Ireland at approximately 2.4% of Gross Domestic Product ("GDP") in 2013[152].

6.2 Frontier was commissioned by ComReg to provide an update for the period 2013 – 2016 and the Frontier Report is published alongside this document (as Document 18/74a).

6.3 In doing so, Frontier first outlined and considered the various approaches that could be used, and recommended a preferred approach with regard to providing an accurate, reliable and repeatable estimate of spectrum-related activity.

6.4 This section provides an overview of:

- The potential approaches which can be used to estimate the economic contribution of spectrum; and
- Having regard to Frontier's analysis, ComReg's preferred approach.

6.5 Following an assessment of responses to this consultation, ComReg will finalise its approach and update or change the preferred methodology. The economic contribution of the radio spectrum will be calculated and included in the finalised Radio Spectrum Management Strategy Statement 2019 – 2021 which be published in due course.

6.1.1 Potential approaches

6.6 Measuring the economic impact of radio spectrum is a difficult exercise as spectrum is embedded in many production processes and commercial practices across many sectors of the economy. More specifically, its effects are difficult to isolate for the following reasons:

i. Radio spectrum is used in different goods and services which are, in turn, inputs in a complex supply chain downstream;
ii. It is not a discrete sector but one of a number of factors of production used in the production of goods and services, each of which

[152] This assessment will also include an estimation of the number of persons directly employed as a result of radio spectrum.

contribute to a varying extent to the added value of those goods and services;

iii. The output resulting from the use of radio spectrum is not uniform and depends on factors such as location, population and time (i.e. the output produced from a unit of spectrum input is not predicable in the same way as other factors of production); and

iv. The use of radio spectrum typically has larger "spillover" impacts, such as productivity improvements and/or social benefits, than other sectors or factors of production.

6.7 The Frontier Report considers a number of different approaches in order to develop a methodology which can benefit from the most comprehensive sources of data, and leverage the latest research methods. In relation to point (iv) above, the use of radio spectrum, through its ability to facilitate new technologies and innovation, also positively contributes to improvements in productivity. Accordingly, a separate estimate of the "spillover" impacts that radio spectrum makes to productivity appears warranted.

6.8 Figure 16 below provides a summary of each approach assessed by Frontier. It is not proposed to fully repeat Frontier's discussion and analysis of these methodologies and readers are referred to the Frontier Report for same.

APPROACH	DESCRIPTION	COMMENT
✓ Micro (Company Based)	• Identify sectors in the economy which 1. require spectrum as an essential input or 2. where demand is dependent on spectrum related features. • Calculate GVA for the companies in these sectors using financial data from the Irish Companies Registration Office.	Tractable approach, and access to data from authoritative source. However, smaller firms and suppliers of services which use spectrum as a minor input will be excluded.
✓ Macroeconomic (National Accounts)	• Identify sectors in the economy which 1. require spectrum as an essential input or 2. for which demand is spectrum related. • Use CSO National Accounts data to calculate GVA.	Authoritative source.
Consumer Surplus	• Estimate consumer surplus from the provision of spectrum services. This requires estimating the spectrum demand curves for all services that use spectrum	Highly notional and sensitive to assumptions used.
Counterfactual	• Estimate the impact of no spectrum on demand, supply and hence output of the economy. • This requires approximating the demand and supply curves for all potential uses of spectrum in the economy.	Difficult to estimate demand and supply curves for different services that use spectrum, and estimate the impact of an absence of spectrum on demand and supply.
Opportunity Cost	• Build a series of engineering based cost models to assess the cost saved by the use of spectrum instead of its next best alternative, across the economy.	Very resource intensive, and sensitive to assumptions used.
✓ Productivity	• Use existing literature on the relationship between ICT investment and productivity to estimate the impact of spectrum related investments in Ireland on productivity in the Irish economy.	Relies on availability of robust empirical evidence which is relevant to the Irish economy.

Figure 16: Alternative approaches to value spectrum contribution

6.1.2 Preferred approach

6.9 All approaches could, theoretically, be used to estimate the contribution of the radio spectrum to the economy in different ways. However, data limitations and methodological issues which are inherent in the different approaches affect how they can be used to measure the contribution of radio spectrum to the economy. Different approaches can be used to provide complementary analyses from different perspectives, although the results from the different approaches may not be fully comparable.

6.10 In light of this, Frontier considers that a combination of **Method One** (Micro) and **Method Two** (Macroeconomic) would be an appropriate approach for estimating the direct economic contribution of spectrum.

6.11 The direct economic contribution approach measures the "value added" in the production of goods and services which use spectrum, using both Micro and Macroeconomic approaches. Conceptually, "value added" represents the company's final output less intermediate inputs consumed in the production of its goods and services. The steps in the development of this model are outlined below.

6.12 Separately, Frontier will assess the productivity impacts of the radio spectrum (using techniques as described in **Method Six)**.

6.13 The proposed methodology for Frontiers preferred approach is outlined below in Figure 17.

6.1.2.1 Proposed Methodology

Figure 17 Proposed methodology

Step 1 Define Target Sectors

6.14 The use of spectrum in the production of goods and services can vary significantly for different sectors, with some sectors being more reliant on spectrum than others. For certain sectors, spectrum is an essential input (i.e. there are no substitutable inputs) meaning that without spectrum, these sectors would not be able to produce those goods and services.

6.15 Frontier's proposed approach estimates the contribution that spectrum makes to the Irish economy by identifying the economic value added in sectors where spectrum is "core" to the supply or demand of goods or services. These are

economic activities where in the absence of spectrum, economic output would be zero or close to zero[153].

Step 2 Identify Target Sectors

6.16 The Target Sectors identified by Frontier are set out below in Table 4: Identified Target Sectors[154].

6.17 This allows financial data to be collected more efficiently and allows ComReg to measure the contribution of the radio spectrum with reference to broader macroeconomic aggregates.

Sector	Rationale for inclusion
Operation of mobile services	Mobile services clearly rely on radio spectrum to support mobile communication services. Mobile network operators provide mobile services (such as calls and data) which are entirely dependent on the use of spectrum.
Manufacture, Sale and Distribution of Mobile Devices	The manufacture, sale and distribution of mobile devices are activities generated by the demand for mobile hardware to enable spectrum transmission. There would be little no demand for their services in the absence of spectrum.
Satellite Communications Services	Satellite services provide connectivity using a combination of ground based stations and space satellites. They provide services ranging from high-speed internet access, to mobile television or radio, and public protection and disaster relief. Satellite services are entirely dependent on the use of spectrum.
Fixed Wireless	Fixed wireless technologies use spectrum in transmitting information between wireless links and these services are entirely dependent on the use of spectrum.
Professional Mobile Radio	Spectrum-based mobile communication services are often used by police forces and fire brigades, as well as certain commercial sectors. Professional Mobile Radio services are entirely dependent on the use of spectrum.

[153] This analysis excludes the contribution that spectrum makes in sectors where it is not "core" to the supply. In this way the analysis can be considered conservative in that it underestimate the economic contribution of spectrum.

[154] These sectors are mapped to NACE codes, which classify economic activities used by National Statistics Agencies. NACE is a four-digit classification providing the framework for collecting and presenting a large range of statistical data according to economic activity in the fields of economic statistics (e.g. production, employment and national accounts) and in other statistical domains developed within the European statistical system (ESS). See Figure 12 of the accompanying Frontier Report.

Aviation	Aviation relies on spectrum for specialist communication, safety, data broadband links, and navigation. The aviation industry would be significantly diminished in the absence of spectrum.
Radio and Television Broadcasting	Radio and Television broadcasting relies on spectrum to transmit live streaming of audio/audio-visual information. Radio and Television Broadcasting services are currently entirely dependent on the use of spectrum.
Mobile Content Creation and Advertising	Content creators and advertisers who are solely based on the development of mobile content and advertising. There would be little no demand for their services in the absence of spectrum.

Table 4: Identified Target Sectors

Step 3 Identify Target Companies with each Target Sector

6.18 Target Companies within each Target Sector are then identified and assessed in the following way:

- Assess those companies identified by ComReg as relying on spectrum in its previous analysis.
- Review companies which identify their activities by reference to a NACE code which is related to spectrum (for example 61.20 wireless telecommunications). Where data is available these NACE codes will be used to extract data from the National Accounts.
- Consider whether there are a range of ancillary economic activities which do not rely on spectrum directly, but which support spectrum-related activities. These could be supply of mobile applications and content, and or supply of mobile advertising.

Step 4 Obtain Financial Information on Target Companies

6.19 Financial information on the Target Companies within each Target Sector is taken from the following two main sources:

- Relevant financial statements for the Target Companies from the Companies Registration Office Ireland ("CRO")[155]; and
- Taxes on production less subsidies from the Central Statistics Office ("CSO").

[155] Limitation: Note that we are unable to calculate the GVA for smaller companies, which are not required to submit the full reporting requirements. Hence, our Target Companies exclude smaller companies which satisfy any two of the following conditions: Balance sheet total not exceeding €6 million; Turnover not exceeding €12 million; Employees not exceeding 50.

6.20 The use of financial statements will be consistent with how the Quarterly National Accounts statistics are compiled by National Statistics Agencies[156].

Step 5 Estimate Economic Contribution

6.21 The direct economic contribution of spectrum is the Gross Value Added ("GVA") of suppliers of goods and services that use spectrum. GVA is defined as output[157] (at basic prices) minus intermediate consumption (at purchaser prices), and can be used to measure output in a given sector.

6.22 Frontier recommends the use of the income approach to measuring GVA in a given sector[158]. This measures the contribution to the economy of individual companies or industries, such that the economic contribution in GVA terms is the sum of all income generated by the Target Companies as shown below.

6.23 Separately, Frontier will use an appropriate macroeconomic aggregate(s) in order to provide appropriate context to the estimated contribution to the radio spectrum. For example, ComReg is of the view that the publication of modified GNI (Gross National Income)[159], which excludes some of the statistical distortions arising from globalisation, could enable a more meaningful analysis of the contribution of spectrum over time. Any additional estimates that are consistent with the use of Gross National Income or other aggregates will also be provided.

Gross Value Added = Gross Operating Surplus + Compensation of Employees + Mixed Income + (Taxes on Products - Subsidies on Products)

Equation 1: Gross Value Added

6.24 The income generation by Target Companies has a wider "spillover" or "multiplier effect" on the economy by increasing:

- the output of suppliers in their value chain; and
- overall activity in the economy, as the increase in employment (and wages earned) by workers causes overall expenditure to rise.

[156] https://www.imf.org/external/pubs/ft/qna/pdf/2017/QNAManual2017.pdf

[157] In principle the economic contribution of spectrum could be measured as the contribution to economic value added within Ireland; or could in addition include the economic value added in the supply of goods and services outside Ireland of suppliers that are domiciled within Ireland.

[158] GVA can be estimated using an income approach or a production approach. The income approach has the strong advantage that reliable information is available and accessible at a granular level suitable for measuring the contribution of the radio spectrum.

[159] https://www.finance.gov.ie/wp-content/uploads/2018/05/180504-GDP-and-Modified-GNI-Explanatory-Note-May-2018.pdf

6.25 This “multiplier effect” will be calculated using input-output tables provided by CSO.

6.26 ComReg agrees with the approach recommended by Frontier for reasons including that it:

- uses available, accurate and reliable data from relevant companies and national macro-economic aggregates from the CSO and CRO which is not suitable for other approaches;
- allows for comparisons to appropriate macroeconomic aggregates from the national accounts (i.e. GNI, GDP);
- is repeatable in subsequent years as data is published and available on an annual basis;
- allows for Target Companies and Target sectors to be classified according to their NACE clarification;
- allows for employment to be calculated directly from the Target Sectors and Target Companies; and
- calculates the “multiplier effect” using information provided by the CSO.

6.27 ComReg welcomes views from interested parties on the above matters, including any alternative methodology which may, in their view, better estimate the economic contribution of the radio spectrum to Ireland. Following an assessment of responses to this consultation, ComReg will finalise its approach and update the methodology accordingly.

6.28 In that regard, ComReg requests that any such submissions:

- clearly identify the methodology (or methodologies) which the respondent thinks ought to be considered; and
- explain the perceived likely benefits of such a methodology or methodologies (over and above ComReg’s preferred methodology) along with any supporting material available.

Chapter 7

7 Next Steps and Submitting Comments

7.1 Submitting Comments

7.1 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.

7.2 Please also provide reasoning and supporting information for any views expressed.

7.3 The four week period for comment will run until 16:00 on Friday 31 August 2018, during which time ComReg welcomes written comments on any of the issues raised in this paper.

7.4 Responses must be submitted in written form (post or email) to the following recipient, clearly marked —Submissions to ComReg 18/74:

Suzanne Power
Commission for Communications Regulation
One Docklands Central
Guild Street
Dublin 1
D01 E4XO
Email: marketframeworkconsult@comreg.ie

7.5 We would request that electronic submissions be submitted in an unprotected format so that they can be included in the ComReg submissions document for electronic publication.

7.6 ComReg appreciates that respondents may wish to provide confidential information to support their views. In order to promote openness and transparency, ComReg will publish all respondents' submissions to, and substantive correspondence relating to, this consultation, subject to the provisions of ComReg's guidelines on the treatment of confidential information[160]. In that regard, respondents are requested to provide both a confidential and non-confidential version of their submission to the consultation, with reasons as to why material marked as confidential is considered to be

[160] ComReg Document 05/24 - *Response to Consultation - Guidelines on the treatment of confidential information*.

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.

7.2 Next Steps

7.7 Following receipt and consideration of submissions in response to this, and other relevant material, ComReg intends to finalise its strategy for managing the use of radio spectrum in Ireland for the period 2019 – 2021 and publish same alongside a response to consultation document.

Annex 1: Summary of legal framework and statutory objectives relevant to the management of the radio spectrum

A 1.1 The Communications Regulation Acts 2002 as amended [161] (the "2002 Act"), the Common Regulatory Framework (including the Framework and Authorisation Directives [162] as transposed into Irish law by the corresponding Framework and Authorisation Regulations[163]), and the Wireless Telegraphy Acts1926 to 2009[164] 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 licensing and making regulations in relation to licences, ComReg's functions include the management of Ireland's radio frequency spectrum in accordance with ministerial Policy Directions under Section 13 of the 2002 Act, having regard to its objectives under Section 12 of the 2002 Act, Regulation 16 of the Framework Regulations and the provisions of Article 8a of the Framework Directive. ComReg is to carry out its functions effectively, and in a manner serving to ensure that the allocation and assignment of radio frequencies is based on objective, transparent, non-discriminatory and proportionate criteria.

A 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

[161] The Communications Regulation Act 2002 (as amended), the Communications Regulation (Amendment) Act 2007, the Communications Regulation (Premium Rate Services and Electronic Communications Infrastructure) Act 2010 and the Communications Regulation (Postal Services) Act 2011.

[162] 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")

[163] 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.

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

postal services, premium rate services or market analysis). For the avoidance of doubt, however, the inclusion of particular material in this Annex does not necessarily mean that ComReg considers same to be of specific relevance to the matters at hand.

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

A2.1 Primary Objectives and Regulatory Principles under the 2002 Act and Common Regulatory Framework

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

- promote competition[165];
- contribute to the development of the internal market[166];
- promote the interests of users within the Community[167];
- 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[168]; 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 [169] in particular those designed to ensure effective competition [170].

A2.1.1 Promotion of Competition

[165] Section 12 (1)(a)(i) of the 2002 Act.

[166] Section 12 (1)(a)(ii) of the 2002 Act.

[167] Section 12(1)(a)(iii) of the 2002 Act.

[168] 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.

[169] 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).

[170] Regulation 16(1)(a) of the Framework Regulations.

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:

- 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.

A2.1.2 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.

A2.1.3 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 needs of specific social groups, in particular, elderly users and users with special social needs, and
- promote the ability of end-users to access and distribute information or use applications and services of their choice.

A2.1.4 Regulatory Principles

A 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.

A2.1.5 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.

A2.1.6 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;[171]

- 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[172]; 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.[173]

A2.1.7 Policy Directions[174]

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.

A 1.17 The Policy Directions which are most relevant in this regard include the following:

Policy Direction No.3 on Broadband Electronic Communication Networks

A 1.18 ComReg shall in the exercise of its functions, take into account the national objective regarding broadband rollout, viz, the Government wishes to ensure

[171] Section 12(3) of the 2002 Act.

[172] Section 12(5) of the 2002 Act.

[173] Section 12(6) of the 2002 Act .

[174] ComReg also notes, and takes due account of, the Spectrum Policy Statement issued by the Department of Communications Energy and Natural Resources in September 2010.

the widespread availability of open-access, affordable, always-on broadband infrastructure and services for businesses and citizens on a balanced regional basis within three years, on the basis of utilisation of a range of existing and emerging technologies and broadband speeds appropriate to specific categories of service and customers.

A 1.19 ComReg is conscious that the three year objective described in this policy direction has now expired making this direction less relevant currently.

Policy Direction No.4 on Industry Sustainability

A 1.20 ComReg shall ensure that in making regulatory decisions in relation to the electronic communications market, it takes account of the state of the industry and in particular the industry's position in the business cycle and the impact of such decisions on the sustainability of the business of undertakings affected.

Policy Direction No.5 on Regulation only where Necessary

A 1.21 Where ComReg has discretion as to whether to impose regulatory obligations, it shall, before deciding to impose such regulatory obligations on undertakings, examine whether the objectives of such regulatory obligations would be better achieved by forbearance from imposition of such obligations and reliance instead on market forces.

Policy Direction No.6 on Regulatory Impact Assessment

A 1.22 ComReg, before deciding to impose regulatory obligations on undertakings in the market for electronic communications or for the purposes of the management and use of the radio frequency spectrum or for the purposes of the regulation of the postal sector, shall conduct a Regulatory Impact Assessment in accordance with European and International best practice and otherwise in accordance with measures that may be adopted under the Government's Better Regulation programme.

Policy Direction No.7 on Consistency with other Member States

A 1.23 ComReg shall ensure that, where market circumstances are equivalent, the regulatory obligations imposed on undertakings in the electronic communications market in Ireland should be equivalent to those imposed on undertakings in equivalent positions in other Member States of the European Community.

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

A 1.24 ComReg shall ensure that, in its management of the radio frequency spectrum, it takes account of the interests of all users of the radio frequency spectrum.

General Policy Direction No.1 on Competition (2004)

A 1.25 ComReg shall focus on the promotion of competition as a key objective. Where necessary, ComReg shall implement remedies which counteract or remove barriers to market entry and shall support entry by new players to the market and entry into new sectors by existing players. ComReg shall have a particular focus on:

- market share of new entrants;
- ensuring that the applicable margin attributable to a product at the wholesale level is sufficient to promote and sustain competition;
- price level to the end user;
- competition in the fixed and mobile markets;
- the potential of alternative technology delivery platforms to support competition.

A2.2 Other Relevant Obligations under the Framework and Authorisation Regulations

A2.2.1 Framework Regulations

A 1.26 Regulation 17 of the Framework Regulations governs the management of radio frequencies for electronic communications services. Regulation 17(1) requires that ComReg, subject to any directions issued by the Minister pursuant to Section 13 of the 2002 Act and having regard to its objectives under Section 12 of the 2002 Act and Regulation 16 of the Framework Regulations and the provisions of Article 8a of the Framework Directive, ensure:

- the effective management of radio frequencies for electronic communications services;
- that spectrum allocation used for electronic communications services and issuing of general authorisations or individual rights of use for such radio frequencies are based on objective, transparent, non-discriminatory and proportionate criteria; and
- ensure that harmonisation of the use of radio frequency spectrum across the EU is promoted, consistent with the need to ensure its effective and efficient use and in pursuit of benefits for the consumer such as economies of scale and interoperability of services, having regard to all decisions and measures adopted by the European Commission in accordance with Decision No. 676/2002/EC of the European Parliament and of the Council

of 7 March 2002 on a regulatory framework for radio spectrum policy in the EU.

A 1.27 Regulation 17(2) provides that, unless otherwise provided in Regulation 17(3), ComReg must ensure that all types of technology used for electronic communications services may be used in the radio frequency bands that are declared available for electronic communications services in the Radio Frequency Plan published under Section 35 of the 2002 Act in accordance with EU law.

A 1.28 Regulation 17(3) provides that, notwithstanding Regulation 17(2), ComReg may, through licence conditions or otherwise, provide for proportionate and non-discriminatory restrictions to the types of radio network or wireless access technology used for electronic communications services where this is necessary to—

- avoid harmful interference,
- protect public health against electromagnetic fields,
- ensure technical quality of service,
- ensure maximisation of radio frequency sharing,
- safeguard the efficient use of spectrum, or
- ensure the fulfilment of a general interest objective as defined by or on behalf of the Government or a Minister of the Government in accordance with Regulation 17(6).

A 1.29 Regulation 17(4) requires that, unless otherwise provided in Regulation 17(5), ComReg must ensure that all types of electronic communications services may be provided in the radio frequency bands, declared available for electronic communications services in the Radio Frequency Plan published under Section 35 of the Act of 2002 in accordance with EU law.

A 1.30 Regulation 17(5) provides that, notwithstanding Regulation 17(4), ComReg may provide for proportionate and non-discriminatory restrictions to the types of electronic communications services to be provided, including where necessary, to fulfil a requirement under the International Telecommunication Union Radio Regulations (“ITU-RR”).

A 1.31 Regulation 17(6) requires that measures that require an electronic communications service to be provided in a specific band available for electronic communications services must be justified in order to ensure the fulfilment of a general interest objective as defined by or on behalf of the Government or a Minister of the Government in conformity with EU law such as, but not limited to—

- safety of life,
- the promotion of social, regional or territorial cohesion,
- the avoidance of inefficient use of radio frequencies, or
- the promotion of cultural and linguistic diversity and media pluralism, for example, by the provision of radio and television broadcasting services.

A 1.32 Regulation 17(7) provides that ComReg may only prohibit the provision of any other electronic communications service in a specific radio spectrum frequency band where such a prohibition is justified by the need to protect safety of life services. ComReg may, on an exceptional basis, extend such a measure in order to fulfil other general interest objectives as defined by or on behalf of the Government or a Minister of the Government.

A 1.33 Regulation 17(8) provides that ComReg must, in accordance with Regulation 18, regularly review the necessity of the restrictions referred to in Regulations 17(3) and 17(5) and must make the results of such reviews publicly available.

A 1.34 Regulation 17(9) provides that Regulations 17(2) to (7) only apply to spectrum allocated to be used for electronic communications services, general authorisations issued and individual rights of use for radio frequencies granted after the 1 July 2011. Spectrum allocations, general authorisations and individual rights of use which already existed on the 1 July 2011 Framework Regulations are subject to Regulation 18.

A 1.35 Regulation 17(10) provides that ComReg may, having regard to its objectives under Section 12 of the 2002 Act and Regulation 16 and its functions under the Specific Regulations, lay down rules in order to prevent spectrum hoarding, in particular by setting out strict deadlines for the effective exploitation of the rights of use by the holder of rights and by withdrawing the rights of use in cases of non-compliance with the deadlines. Any rules laid down under this Regulation must be applied in a proportionate, non-discriminatory and transparent manner.

A 1.36 Regulation 17(11) requires ComReg to, in the fulfilment of its obligations under that Regulation, respect relevant international agreements, including the ITU Radio Regulations and any public policy considerations brought to its attention by the Minister.

A2.2.2 Authorisation Regulations

Decision to limit rights of use for radio frequencies

A 1.37 Regulation 9(2) of the Authorisation Regulations provides that ComReg may grant individual rights of use for radio frequencies by way of a licence where it considers that one or more of the following criteria are applicable:

- it is necessary to avoid harmful interference,
- it is necessary to ensure technical quality of service,
- it is necessary to safeguard the efficient use of spectrum, or
- it is necessary to fulfil other objectives of general interest as defined by or on behalf of the Government or a Minister of the Government in conformity with EU law.

A 1.38 Regulation 9(10) of the Authorisation Regulations provides that ComReg must not limit the number of rights of use for radio frequencies to be granted except where this is necessary to ensure the efficient use of radio frequencies in accordance with Regulation 11.

A 1.39 Regulation 9(7) also provides that:

- where individual rights of use for radio frequencies are granted for a period of 10 years or more and such rights may not be transferred or leased between undertakings in accordance with Regulation 19 of the Framework Regulations, ComReg must ensure that criteria set out in Regulation 9(2) apply for the duration of the rights of use, in particular upon a justified request from the holder of the right.
- where ComReg determines that the criteria referred to in Regulation 9(2) are no longer applicable to a right of use for radio frequencies, ComReg must, after a reasonable period and having notified the holder of the individual rights of use, change the individual rights of use into a general authorisation or must ensure that the individual rights of use are made transferable or leasable between undertakings in accordance with Regulation 19 of the Framework Regulations.

Publication of procedures

A 1.40 Regulation 9(4)(a) of the Authorisation Regulations requires that ComReg, having regard to the provisions of Regulation 17 of the Framework Regulations, establish open, objective, transparent, non-discriminatory and proportionate procedures for the granting of rights of use for radio frequencies and cause any such procedures to be made publicly available.

Duration of rights of use for radio frequencies

A 1.41 Regulation 9(6) of the Authorisation Regulations provides that rights of use for radio frequencies must be in force for such period as ComReg considers appropriate having regard to the network or service concerned in view of the objective pursued taking due account of the need to allow for an appropriate period for investment amortisation.

Conditions attached to rights of use for radio frequencies

A 1.42 Regulation 9(5) of the Authorisation Regulations provides that, when granting rights of use for radio frequencies, ComReg must, having regard to the provisions of Regulations 17 and 19 of the Framework Regulations, specify whether such rights may be transferred by the holder of the rights and under what conditions such a transfer may take place.

A 1.43 Regulation 10(1) of the Authorisation Regulations provides that, notwithstanding Section 5 of the Wireless Telegraphy Act,1926, but subject to any regulations under Section 6 of that Act, ComReg may only attach those conditions listed in Part B of the Schedule to the Authorisation Regulations. Part B lists the following conditions which may be attached to rights of use:

- Obligation to provide a service or to use a type of technology for which the rights of use for the frequency has been granted including, where appropriate, coverage and quality requirements.
- Effective and efficient use of frequencies in conformity with the Framework Directive and Framework Regulations.
- Technical and operational conditions necessary for the avoidance of harmful interference and for the limitation of exposure of the general public to electromagnetic fields, where such conditions are different from those included in the general authorisation.
- Maximum duration in conformity with Regulation 9, subject to any changes in the national frequency plan.
- Transfer of rights at the initiative of the rights holder and conditions of such transfer in conformity with the Framework Directive.
- Usage fees in accordance with Regulation 19.
- Any commitments which the undertaking obtaining the usage right has made in the course of a competitive or comparative selection procedure.

- Obligations under relevant international agreements relating to the use of frequencies.

- Obligations specific to an experimental use of radio frequencies.

A 1.44 Regulation 10(2) also requires that any attachment of conditions under Regulation 10(1) to rights of use for radio frequencies must be non-discriminatory, proportionate and transparent and in accordance with Regulation 17 of the Framework Regulations.

Procedures for limiting the number of rights of use to be granted for radio frequencies

A 1.45 Regulation 11(1) of the Authorisation Regulations provides that, where ComReg considers that the number of rights of use to be granted for radio frequencies should be limited it must, without prejudice to Sections 13 and 37 of the 2002 Act:

- give due weight to the need to maximise benefits for users and to facilitate the development of competition, and

- give all interested parties, including users and consumers, the opportunity to express their views in accordance with Regulation 12 of the Framework Regulations.

A 1.46 Regulation 11(2) of the Authorisation Regulations requires that, when granting the limited number of rights of use for radio frequencies it has decided upon, ComReg does so *"…on the basis of selection criteria which are objective, transparent, non-discriminatory and proportionate and which give due weight to the achievement of the objectives set out in Section 12 of the 2002 Act and Regulations 16 and 17 of the Framework Regulations."*

A 1.47 Regulation 11(4) provides that where it decides to use competitive or comparative selection procedures, ComReg must, inter alia, ensure that such procedures are fair, reasonable, open and transparent to all interested parties.

Fees for spectrum rights of use

A 1.48 Regulation 19 of the Authorisation Regulations permits ComReg to impose fees for rights of use which reflect the need to ensure the optimal use of the radio frequency spectrum.

A 1.49 ComReg is required to ensure that any such fees are objectively justified, transparent, non-discriminatory and proportionate in relation to their intended purpose and take into account the objectives of ComReg as set out in Section 12 of the 2002 Act and Regulation 16 of the Framework Regulations.

Amendment of rights and obligations

A 1.50 Regulation 15 of the Authorisation Regulations permits ComReg to amend rights and conditions concerning rights of use, provided that any such amendments may only be made in objectively justified cases and in a proportionate manner, following the process set down in Regulation 15(4).

A2.3 Other Relevant Provisions

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

A 1.51 Under Section 5(1) of the 1926 Act, ComReg may, subject to that Act, and on payment of the prescribed fees (if any), grant to any person a licence to keep and have possession of apparatus for wireless telegraphy in any specified place in the State.

A 1.52 Section 5(2) provides that, such a licence shall be in such form, continue in force for such period and be subject to such conditions and restrictions (including conditions as to suspension and revocation) as may be prescribed in regard to it by regulations made by ComReg under Section 6.

A 1.53 Section 5(3) also provides that, where it appears appropriate to ComReg, it may, in the interests of the efficient and orderly use of wireless telegraphy, limit the number of licences for any particular class or classes of apparatus for wireless telegraphy granted under Section 5.

A 1.54 Section 6 provides that ComReg may make regulations prescribing in relation to all licences granted by it under Section 5, or any particular class or classes of such licences, all or any of the following matters:

- the form of such licences,
- the period during which such licences continue in force,
- the manner in which, the terms on which, and the period or periods for which such licences may be renewed,
- the circumstances in which or the terms under which such licences are granted,
- the circumstances and manner in which such licences may be suspended or revoked by ComReg,
- the terms and conditions to be observed by the holders of such licences and subject to which such licences are deemed to be granted,

- the fees to be paid on the application, grant or renewal of such licences or classes of such licences, subject to such exceptions as ComReg may prescribe, and the time and manner at and in which such fees are to be paid, and

- matters which such licences do not entitle or authorise the holder to do.

A 1.55 Section 6(2) provides that Regulations made by ComReg under Regulation 6 may authorise and provide for the granting of a licence under Section 5 subject to special terms, conditions, and restrictions to persons who satisfy it that they require the licences solely for the purpose of conducting experiments in wireless telegraphy.

Broadcasting Act 2009 (the "2009 Act")

A 1.56 Section 132 of the 2009 Act relates to the duties of ComReg in respect of the licensing of spectrum for use in establishing digital terrestrial television multiplexes and places an obligation on ComReg to issue:

- two DTT multiplex licences to RTÉ by request (see Sections 132 (1) and (2) of the 2009 Act); and

- a minimum of four DTT multiplex licences to the BAI by request (see Sections 132 (3) and (4) of the 2009 Act) for the provision of commercial TV content.

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

A 1.57 Article 4 of the Competition Directive provides that:

"Without prejudice to specific criteria and procedures adopted by Member States to grant rights of use of radio frequencies to providers of radio or television broadcast content services with a view to pursuing general interest objectives in conformity with Community law:

- Member States shall not grant exclusive or special rights of use of radio frequencies for the provision of electronic communications services.

- The assignment of radio frequencies for electronic communication services shall be based on objective, transparent, non-discriminatory and proportionate criteria."

Radio Spectrum Policy Programme

A 1.58 On 15 February 2012, the European Parliament adopted the five-year Radio Spectrum Policy Programme which establishes a multi-annual radio spectrum policy programme for the strategic planning and harmonisation of the use of spectrum. The objective is to ensure the functioning of the internal market in

the Union policy areas involving the use of spectrum, such as electronic communications, research, technological development and space, transport, energy and audiovisual policies.

A 1.59 Among the activities being undertaken in the context of the RSPP is a comprehensive inventory of spectrum use in the range 400 MHz to 6 GHz in order to identify developing and potentially significant uses of that spectrum.

Annex 2:Spectrum Designators

A 2.1 For administrative convenience the ITU has divided the radio spectrum bands into the frequency bands[175] shown in Table 5.

Band number	Symbol	Frequency Range (lower limit exclusive, upper limit inclusive)	Corresponding metric Subdivision
4	VLF	3 – 30 kHz	Myriametric waves
5	LF	30 – 300 kHz	Kilometric waves
6	MF	300 – 3000 kHz	Hectometric waves
7	HF	3 – 30 MHz	Decametric waves
8	VHF	30 – 300 MHz	Metric waves
9	UHF	300 – 3000 MHz	Decimetric waves
10	SHF	3 – 30 GHz	Centimetric waves
11	EHF	30 – 300 GHz	Millimetric waves
12		300 – 3000 GHz	Decimillimetric waves

Table 5: ITU radio spectrum bands

A2.2 In respect of satellite communications, but not fixed links, the following band designators are commonly used as shown below :

Band Designator	Frequency Range
P-band	0.23 – 1 GHz
L-band	1 – 2 GHz
S-band	2 – 4 GHz
C-band	4 – 8 GHz
X-band	8 – 12 GHz
KU-band	12 – 18 GHz
K-band	18 – 27 GHz
KA-band	27 – 40 GHz
O-band	40 – 50 GHz (also known sometimes as Q-band)
V-band	50 – 75 GHz

Table 6: Satellite band designators.

[175] Taken from The ITU Radio Regulations 2016, Article 2, section 2.1.