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Ofcom's response to Vodafone's and Telefónica's requests to update the technical conditions of their mobile licences to enable the deployment of newer technologies including 5G

Variation of certain licences held by Vodafone and Telefónica in the 900 MHz, 1800 MHz, 2100 MHz and 2.6 GHz bands

CONSULTATION:

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Annex

1. Overview

Ofcom is responsible for managing the UK's radio spectrum, which is the range of radio frequencies essential for all wireless communications.

We manage the spectrum by issuing licences, for example to mobile phone network operators, or by exempting certain devices, such as WiFi routers, from requiring licences. Our licences specify, among other things, technical parameters to which licensees transmissions must adhere, including the frequencies they may use and the maximum power they may transmit.

What we are proposing – in brief

In response to requests from Vodafone and Telefónica, we are proposing to make changes to some licences they hold. The changes would allow them to deploy new technologies, including 5G, and deliver the next generation of connectivity and services to their users. The changes we propose are as follows:

Updating the technical conditions of licences held by Vodafone in the 900 MHz, 1800 MHz, 2100 MHz and 2.6 GHz bands: The proposed variations would amend the licences with updated parameters that reflect the latest technologies. We are also proposing to remove technology restrictions in the licences to make them technology neutral.

Removing a restriction placed on Telefónica's unpaired spectrum in the 2.6 GHz band: Telefónica has requested that we remove a restriction on the 5 MHz block within its unpaired spectrum allocation adjacent to Vodafone's unpaired allocation. Vodafone has contacted us to confirm its agreement with the request. This would allow Telefónica to use an unrestricted 20 MHz of spectrum compared with the 15 MHz currently available. To make this arrangement work, the two licensees need to synchronise transmissions and both of their licences will need to be varied.

Subject to consultation responses, Ofcom is currently minded to make similar changes available to the licences of other licensees operating in these bands, upon request.

1.1 In this consultation we are proposing changes to the technical conditions for the following mobile licences:

a) Vodafone's licences in the 900 MHz, 1800 MHz, 2100 MHz and 2.6 GHz spectrum bands to make them technology neutral, to enable the deployment of the next generation of mobile technologies; and

b) Vodafone's and Telefónica's 2.6 GHz licences in the 2570 to 2620 MHz sub-band to relax the technical parameters between the two operators.

1.2 Subject to the responses to this consultation, we are minded to agree to the licence changes requested by Vodafone and Telefónica by varying their respective licences as proposed in this document.

1.3 Vodafone has requested changes to its licences in the 900 MHz, 1800 MHz and 2100 MHz bands to enable it to deploy the next generation technologies, including 5G, on its network. While the proposed changes set out in this document are to vary Vodafone's licences, we propose to make available similar changes to the licences of other licensees

operating in these spectrum bands, if they so request. For these potential additional requests for licence variation, our approach would be to consult directly with the relevant licensees on the precise drafting of updated terms at the time, although we anticipate the updates would be substantially similar to what we have proposed in this document.

1.4 This consultation also sets out proposals to change the licences held by Vodafone and Telefónica in the 2.6 GHz band, at the request of Telefónica. Currently, Telefónica's licence is subject to a restriction intended to protect the adjacent user, Vodafone. Due to developments in technology and both parties reaching an agreement, we are minded to agree to Telefónica's request to relax this condition to allow Telefónica to make better use of its 20 MHz spectrum allocation.

1.5 Our policy goal is to remove the regulatory barriers that prevent the deployment of the latest available technology, where appropriate. In considering Vodafone's and Telefónica's requests, we have therefore aimed to ensure that their licences are as technology neutral as possible and contain provisions to allow the networks to deploy 5G whilst ensuring other users are protected from undue interference.

1.6 Our technical work in this document has been informed by various European Conference of Postal and Telecommunications Administrations (CEPT) Reports,[1] recommendations and decisions. This CEPT work also forms the basis of the technical provisions set out in harmonisation decisions of the European Union (EU), including harmonised technical conditions which are now part of UK law.[2] In pursuit of our policy goal we have actively promoted and participated in the CEPT work that has led to the adoption of common technical conditions to enable liberalisation of the mobile licences to deploy new technologies.

1.7 These CEPT and EU decisions support the technically efficient use of spectrum in the region through harmonisation of technical standards and spectrum use. This in turn provides certainty for manufacturers and service providers, enabling the benefits of economies of scale to be realised.

1.8 We have already noted that the deployment of 5G will enable MNOs to provide greater capacity and faster speeds across the UK mobile networks. For users it means existing applications can be carried out more quickly and to a higher standard of quality. In addition, we are also aware of the great potential for 5G to support new and innovative services. 5G is already being used and tested across a number of different sectors benefitting people and businesses such as in farming, manufacturing and transport.

1.9 We also consider that the resulting improved capacity and speed that the networks will be able to provide, aligns with our commitment to bring tangible benefits to UK citizens, consumers and businesses through enabling wireless services in the broader economy.

[1] CEPT is the European body responsible for setting and co-ordinating harmonised technical limits to facilitate interoperability and enable economies of scale to be realised across Europe

[2] Commission Implementing Decision (EU) 2020/667 and Commission Implementing Decision (EU) 2020/636 continue to be part of UK law, following Brexit, by virtue of section 3 of the EU Withdrawal Act 2018.

1.10 In the UK, the UK Health Security Agency (UKHSA) leads on health matters related to radiofrequency electromagnetic fields (EMF), or radio waves. On 5G, UKHSA's view[3] is that 'the overall exposure is expected to remain low relative to guidelines and, as such, there should be no consequences for public health'. UKHSA's main advice about radio waves from base stations is that the guidelines of the International Commission on Non-Ionizing Radiation Protection (ICNIRP) should be adopted for limiting exposures.

1.11 Vodafone's and Telefónica's licences contain a clause that requires compliance with these guidelines, the proposals in this consultation would not change that requirement. Further information on this topic can be found on Ofcom's website.[4]

1.12 The overview section in this document is a simplified high-level summary only.

[3] 5G technologies: radio waves and health - GOV.UK (www.gov.uk)
[4] Electromagnetic fields (EMF) - Ofcom

2. Introduction

Licence variation requests received

2.1 Ofcom has received requests from two mobile network operators (MNOs) to vary their licences. A request from Vodafone and another from Telefónica.

2.2 In April 2021 we received an initial request from Vodafone to vary its 900 MHz and 1800 MHz licence "to incorporate reference to an interface requirement facilitating 5G usage" and to amend certain terms and conditions to align with the format of Ofcom's more recently awarded licences. In addition, Vodafone requested Ofcom to review the interface requirements relating to the 800 MHz, 1400 MHz, 2100 MHz and 2.6 GHz bands and to make any changes necessary to make them technology neutral and allow 5G usage.

2.3 At the time of Vodafone's request, significant work to develop suitable technical conditions for 5G and other technologies was already underway in CEPT. We decided to wait for this work to conclude before making any technical change to Vodafone's licences.

2.4 After a review of their licences, we found that Vodafone's 800 MHz and 1400 MHz, bands were already technology neutral and capable of deploying the next generation of services. However, on the basis of our initial analysis, we considered that Vodafone's 900 MHz, 1800 MHz and 2100 MHz licences may need to be updated and that its 2.6 GHz licence may also need amendments to ensure that it could deploy the latest technologies.

2.5 In September 2021 we received a request from Telefónica to remove restrictions in one 5 MHz block of its 2.6 GHz licence which involved a degree of coordination between Telefónica and Vodafone as described above. Vodafone has confirmed to us that it supports this licence variation request.

2.6 Table 1 below shows the current spectrum holdings of the MNOs in each of the bands that are subject to the proposed changes in this consultation and the associated licences (which are published on Ofcom's website[5]).

[5] Mobile and wireless broadband below 5 GHz - Ofcom

Table 1: Current UK MNO mobile spectrum holdings in bands that are subject to the proposed changes in this consultation. (*) indicates the specific licences that will be affected by the proposed changes

Spectrum band/ Licensee	EE	H3G/UKB	Telefónica	Vodafone
900 MHz	-	-	34.8 MHz Licence No. 0249663	34.8 MHz *Licence No. 0249664
1800 MHz	90 MHz Licence No. 0249666	30 MHz Licence No. 0931984	11.6 MHz Licence No. 0249663	11.6 MHz *Licence No. 0249664
2100 MHz	40 MHz Licence No. 0207128	29.5 MHz Licence No. 0207130	20 MHz Licence No. 0207127	29.6 MHz *Licence No. 0207131
2.6 GHz Paired	100 MHz Licence No. 0943533	-	-	40 MHz *Licence No. 0943538
2.6 GHz Unpaired	-	-	25 MHz *Licence No. 1238565	25 MHz *Licence No. 0943538

History of mobile technology developments

2.7 At present, some spectrum licences have technology neutral conditions while others have one or more specific technologies authorised, such as:

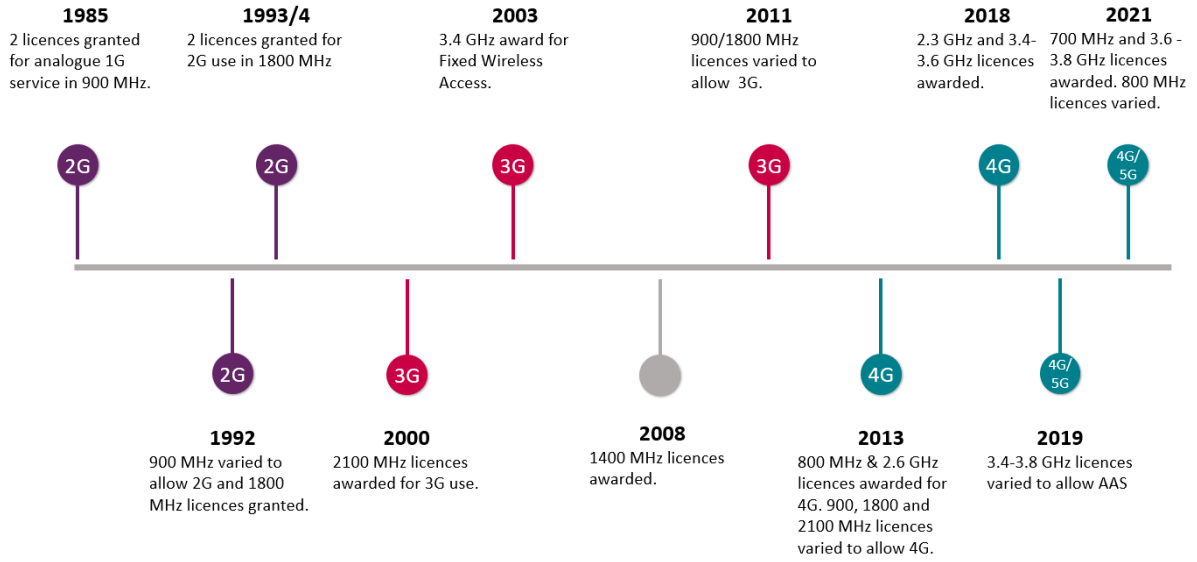
- 2G (GSM), which is suitable for voice and low speed data services;
- 3G (UMTS/HSPA3), which is suitable for voice and the higher speed data services currently available; and
- 4G (LTE/WiMAX), which is most suitable for high-speed data services.

2.8 Licences that were issued in the mid-1990s in the 900 MHz and 1800 MHz bands supported 2G GSM (Global System for Mobile Communications). As Third Generation Mobile' (3G) technology became available, further spectrum was made available in the 2100 MHz band which was awarded in 2000. In 2011, as requested by a licensee, we reviewed the 900 MHz and 1800 MHz licence conditions to allow the use of 3G technologies in addition to 2G.[6]

[6] https://www.ofcom.org.uk/__data/assets/pdf_file/0020/74702/statement.pdf

2.9 In 2013, Ofcom made spectrum available for 4G in the 800 MHz and 2.6 GHz bands as part of a spectrum award. In order to facilitate the deployment of wider 4G technologies we also in that year liberalised the 900 MHz, 1800 MHz and 2100 MHz bands so that they too could use the latest technology.[7] In 2018 and 2021 Ofcom released more spectrum that could be used to support 4G as well as 5G technologies in the 700 MHz, 2300 MHz and 3.4 to 3.8 GHz bands.[8]

Figure 1: Timeline showing mobile licence awards and technical variations to support next generation technology since 1985



2.10 Following developments in the step change to 5G technology and further, the technical studies from CEPT, more spectrum bands are becoming available that support these newer technologies. Therefore, we are now able to consider the introduction of technology neutral provisions and next generation technology parameters which Vodafone and Telefónica have requested in the 900 MHz, 1800 MHz, 2100 MHz and 2.6 GHz bands.

Legal background

2.11 Ofcom is responsible for authorising use of the radio spectrum. We permit the use of the radio spectrum either by granting wireless telegraphy licences under the Wireless Telegraphy Act 2006 (the "2006 Act") or by making regulations exempting the use of particular equipment from the requirement to hold such a licence. It is unlawful and an offence to install or use wireless telegraphy apparatus without holding a licence granted by Ofcom unless the use of such equipment is exempted. In Annex 5 we set out in more detail the relevant legal framework which we have taken into account in making the proposals set out in this document. This annex should be treated as part of this document.

[7] https://www.ofcom.org.uk/__data/assets/pdf_file/0023/63932/statement.pdf
[8] Ofcom award of 2.3 and 3.4 GHz Information Memorandum and Award of the 700 MHz and 3.6-3.8 GHz spectrum bands Information Memorandum

Impact assessment

2.12 Section 7 of the Communication Act 2003 (the "2003 Act") provides that where we are proposing to do anything for the purposes of, or in connection with, the carrying out of our functions, and it appears to us that the proposal is important, then we are required to carry out and publish an assessment of the likely impact of implementing the proposal, or a statement setting out our reasons for thinking that it is unnecessary to carry out such an assessment. Where we publish such an assessment, stakeholders must have an opportunity to make representations to us about the proposal to which the assessment relates.

2.13 We consider that our proposed changes to the licences are important for the purposes of section 7 of the 2003 Act. We have made this assessment in light of our statutory duties. On that basis, we are publishing for consultation our proposal to make changes to these licences and our assessment of the likely impact of doing so, to give the licensees and interested third parties an opportunity to make representations.

2.14 In preparing this document, we have considered the citizen and consumer interests relating to the licences. We have also considered the impact of our proposals on the licensees and on existing users in the adjacent spectrum bands. We have also considered whether our proposals would have any impacts on competition.

2.15 This document as a whole, including its annexes, comprises an impact assessment as defined in Section 7 of the 2003 Act. Ofcom is an evidence-based organisation and welcomes responses to this consultation. Any comments about our assessment of the impact of our proposals should be sent to us by the closing date for this consultation. We will consider all comments before deciding whether to implement our proposals. For further information about our approach to impact assessments, see the guidelines 'Better policy making: Ofcom's approach to impact assessments' on our website.[9]

Equality impact assessment

2.16 Section 149 of the Equality Act 2010 (the 2010 Act) imposes a duty on us, when carrying out our functions, to have due regard to the need to eliminate discrimination, harassment, victimisation and other prohibited conduct related to the following protected characteristics: age; disability; gender reassignment; marriage and civil partnership; pregnancy and maternity; race; religion or belief; sex and sexual orientation. The 2010 Act also requires us to have due regard to the need to advance equality of opportunity and foster good relations between persons who share specified protected characteristics and persons who do not.

2.17 Section 75 of the Northern Ireland Act 1998 (the 1998 Act) also imposes a duty on us, when carrying out our functions relating to Northern Ireland, to have due regard to the need to promote equality of opportunity and regard to the desirability of promoting good relations across a range of categories outlined in the 1998 Act. Ofcom's Revised Northern

[9] An overview and link to the guidelines can be found on our Policies and Guidelines webpage.

Ireland Equality Scheme[10] explains how we comply with our statutory duties under the 1998 Act.

2.18 To help us comply with our duties under the 2010 Act and the 1998 Act, we assess the impact of our proposals on persons sharing protected characteristics and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations.

2.19 We do not consider that our proposals have any equality implications under the 2010 Act or the 1998 Act.

EMF and health concerns

2.20 In October 2020, we published a statement setting out our decision to formally incorporate the relevant limits in the International Commission for Non-Ionising Radiation Protection (ICNIRP) guidelines on limiting exposure to electromagnetic fields (EMF) (the "ICNIRP Guidelines")[11] into our spectrum licences, following a public consultation process.[12]

2.21 This requirement applies to all 2006 Act licence classes which authorise equipment to transmit at powers above 10 Watts EIRP. We received a significant number of comments in response to our proposals in relation to health concerns which we addressed during that consultation process.[13] Whilst we have seen no evidence that spectrum users are operating radio equipment in breach of the ICNIRP general public limits, the licence condition we have imposed sets out a clear requirement on licensees to ensure services operate in a way which will not adversely affect peoples' health. It also puts Ofcom in a position where we can take appropriate enforcement action in the unlikely event the ICNIRP general public limits are breached.

2.22 Ofcom has been carrying out radio frequency EMF measurements near mobile phone base stations for many years.[14] These measurements have consistently shown these are well within the internationally agreed levels published in the ICNIRP Guidelines. In March 2021 we published the latest update to our summary of results from measurements taken near 5G base stations.[15] These results show that, at all locations where we have conducted measurements, the EMF levels are at small fractions of the maximum levels identified in the ICNIRP Guidelines. We continue to monitor the EMF levels and publish the results regularly.[16]

[10] Revised-NI-Equality-Scheme.pdf (ofcom.org.uk)
[11] ICNIRPemfgdl.pdf
[12] See our Statement on Measures to require compliance with international guidelines for limiting exposure to electromagnetic fields (EMF) (ofcom.org.uk) dated 5 October 2020 ("EMF Statement") and Update: Implementation of measures to require compliance with international guidelines for limiting exposure to electromagnetic fields (EMF) (ofcom.org.uk) dated 1 March 2021 ("EMF Update")
[13] See Section 3 of both our EMF Statement and our EMF Update
[14] Ofcom inherited a programme of EMF measurements started by its predecessor, the Radiocommunications Agency (one of the five regulators whose duties were subsumed by Ofcom when it was created).
[15] Electromagnetic Field (EMF) measurements near 5G mobile phone base stations Summary of results Summary of results - EMF measurements near 5G mobile phone base stations (ofcom.org.uk) updated 1 March 2021
[16] Mobile phone base station audit results Electromagnetic field measurements near mobile base stations - Ofcom

2.23 We expect that, as a result of the changes to Vodafone's and Telefónica's licences proposed in this document, the emission limits will remain well within the levels that we have set. Licensees will continue to not be allowed to exceed the internationally agreed exposure levels for the protection of the general public and there should therefore be no EMF implications for public health.

Structure of this document

2.24 The remainder of this document is set out as follows:

a) Section 3 sets out Ofcom's assessment framework for considering the licence variations requested by Vodafone and Telefónica

b) Section 4 provides an overview of the changes needed to update Vodafone's licences

c) Sections 5 – 7 set out the changes that we are proposing to make to each of the relevant licences

d) Section 8 summarises Ofcom's provisional decisions and sets out next steps

e) Annexes 1 – 3 provide information on how to respond to this consultation

f) Annex 4 sets out the consultation questions

g) Annex 5 sets out Ofcom's legal framework

h) Annex 6, which is published as a separate document, shows the changes that we are proposing to make to each licence using tracked changes.

3. Ofcom's assessment framework

3.1 In this section we explain our overall assessment framework for considering the licence variations requested by Vodafone and Telefónica,[17] which derive from our statutory duties.

3.2 The radio spectrum is a finite national resource of considerable economic and social value. In considering the variation of individual licences we take into account our duties and, in light of those duties, the factors that we take into account include:

a) securing optimal spectrum use;

b) promoting competition;

c) encouraging innovation and investment;

d) benefits for consumers and citizens; and

e) the impact on users of spectrum in the same and adjacent bands.

3.3 In reaching our provisional conclusion, we have balanced the advantages and disadvantages of updating the relevant licences, in light of the relevant factors and evidence, in order to reach an outcome that appropriately meets our relevant statutory duties.

3.4 We have considered both the likely impact on competition of making these changes and the likely impact on spectrum management, in particular the impact on existing licensed or exempted users of the adjacent spectrum bands.

Initial assessment

Securing optimal use of spectrum

3.5 In securing our principal duty to further the interests of citizens in relation to communications matters and consumers in relevant markets, we are required to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum.

3.6 Ofcom's general policy is to set technical restrictions that are the minimum necessary to provide adequate protection against undue interference. This is because optimal use of the radio spectrum is more likely to be secured if users decide, rather than Ofcom dictates, the way in which technology is used or a service is provided in a particular frequency band. Imposing the minimum necessary constraints will increase users' flexibility and freedom to respond to changing conditions and to make best use of the valuable spectrum resource.

3.7 This is reflected in our proposed approach to Telefónica's request (as supported by Vodafone) to make more efficient use of its 20 MHz spectrum allocation in the 2.6 GHz band. Due to restrictions placed in its licence to protect the adjacent user when it was originally awarded in 2012, Telefónica is currently only able to effectively use 15 MHz of that allocation. The proposed changes set out in this document will allow it to make more

[17] Annex 6 contains draft licence templates of the proposed changes

efficient use of this spectrum. This would improve spectrum efficiency and make greater use of this valuable resource.

3.8 The current technology specific provisions in licences prevent the licensees from being able to deploy the latest technologies and the benefits this brings. As we set out in our Mobile Networks and Spectrum Discussion document[18], the deployment of Active Antenna Systems (AAS) and higher order massive Multiple Input Multiple Output (MIMO)[19] can enable substantial capacity gains. These technology improvements will result in increased spectral efficiency over time and we propose to enable these improvements by removing the current technology-specific restrictions.

Promote competition

3.9 We have a principal duty to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition. We believe the UK market for mobile services is generally operating well with continuing innovation and relatively low prices compared to other markets internationally.[20]

3.10 As set out above (para 1.3), we are currently minded to make available similar changes to the ones requested by Vodafone to other licensees operating in the relevant spectrum bands, if they so request. Therefore, we do not consider that the changes that we are proposing to make to Vodafone's licence would have an adverse impact on competition between MNOs or any other licensees.

3.11 We also do not consider that the changes that we are proposing to make to Telefónica's licence would have an adverse impact on competition between MNOs or any other licensees. This is because the proposed changes do not give Telefónica access to any more spectrum than it has been assigned, rather they would allow it to make use of all of the spectrum it has been assigned in a more efficient manner. In addition, as set out above (para 1.1) both Telefónica and Vodafone agree the proposed arrangement, therefore we do not consider that these proposals raise competition issues.

3.12 Finally, we have considered whether the proposed changes would have an adverse competitive impact on other spectrum users, and have provisionally concluded that they would not. The proposed changes to technical conditions should not impact the spectrum quality of existing deployments in, or the bands adjacent to, the frequencies in the licences we are minded to vary.

Encouraging innovation and investment

3.13 We have also had regard to the economic and other benefits that may arise from the use of this spectrum, and the need to encourage the development of innovative services.

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[18] See paragraphs 5.3 to 5.12 https://www.ofcom.org.uk/__data/assets/pdf_file/0017/232082/mobile-spectrum-demand-discussion-paper.pdf

[19] MIMO or Multiple Input Multiple Output is an antenna technique in which multiple transmit and receive antenna elements are used to improve the capacity of a radio link.

[20] See paragraphs 1.8 – 1.10 Discussion paper: Ofcom's future approach to mobile markets

Vodafone and Telefónica have requested that we vary their licences on the basis that this would enable the deployment of advanced technologies such as 5G.

3.14 In addition to increasing capacity to meet demand for services delivered via existing mobile networks, there is the potential for all of this spectrum to be used for 5G services. Further deployment of 5G services has the potential to deliver benefits for UK consumers and businesses, including superfast broadband, greatly expanded capacity and innovative new services.

3.15 All of these bands have the properties and characteristics that make them particularly suitable for mobile broadband services and for deployment of the latest technologies. We consider it important that operators are able to make efficient use of the band so that they can meet consumer demand, particularly for increasing capacity for mobile broadband services, improve coverage, and enable the industry to take advantage of innovation opportunities.

3.16 The updated technical conditions that will support the deployment of 5G services are taken from a number of decisions of the Electronic Communications Committee (ECC).[21] In addition, our proposals to harmonise the technical conditions with those used by other European administrations would enable economies of scale. This is because manufacturers will be able to build the same equipment to operate in the UK as in other European countries. The changes that we are proposing to make in response to Vodafone's request may make it easier and potentially cheaper for operators to roll out 5G and other future technologies in all of the bands.

Benefit to citizens and consumers

3.17 Spectrum is a scarce and valuable resource. These licences are of direct public benefit because they ensure that citizens, consumers and businesses can all realise the greatest available value from use of the frequencies.

3.18 Consumers should benefit from the proposed changes, as they would enable licensees to provide higher quality enhanced mobile broadband services.

3.19 The move to more efficient technologies would enable deployment of 5G and other technologies. As we are currently minded to make similar changes available to other licensees operating in the relevant spectrum bands, if they so request, we would expect to see these benefits apply also to customers of other networks in the future.

Impact of proposed licence changes on other users of the radio spectrum

3.20 In the following sections of this document, we set out the technical conditions we propose to apply to each band. Based on these parameters, we have assessed the risk of interference to other spectrum users if these conditions were implemented. Our provisional view is that the proposed conditions would ensure appropriate protection from the risk of harmful interference.

[21] ECC is a committee of the CEPT

4. Overview of the changes needed to update Vodafone's licences

4.1 In this section, we explain the overarching changes we propose to Vodafone's licences, and those we would propose to apply to similar licences held by other MNOs if requested, in order to make them technology neutral, be 5G-ready and align them with more recent licences we awarded. In Sections 5, 6 and 7 of this document we set out the specific changes that we are proposing to make to each of Vodafone's relevant licences.

4.2 Most of the changes needed are technical changes, relating to the power and transmission parameters of the equipment authorised under the licences. Below we explain what these changes entail and explain how we calculated the proposed transmit powers for AAS equipment. We are also proposing a few minor administrative changes which we would apply to all of Vodafone's mobile licences, and these are explained in this section.

Required technical changes

4.3 In order to make Vodafone's mobile licences technology neutral and support the latest technologies we would need to make the following technical changes:

a) Move to a Block Edge Mask (BEM) approach to the technical parameters in the 900 MHz and 1800 MHz licences to make these licences technology neutral;

b) Introduce "active antennas systems" ("AAS") and the associated "total radiated power" ("TRP") transmission parameter (these terms are explained in the following paragraphs) in Vodafone's 1800 MHz, 2100 MHz and 2.6 GHz bands to permit use of the latest mobile technology, such as 5G; and

c) Allow the network to transmit in both the uplink and downlink frequencies in the 900 MHz, 1800 MHz and 2100 MHz bands, to allow the deployment of equipment such as repeaters.

4.4 Much of the analysis carried out to evaluate these proposed technical changes has been done within CEPT. We have taken account of this work to inform our proposals and the assessment of the risks on other users of the spectrum.

4.5 In Annex 6 we show the proposed technical changes to the licences in mark-up.

Move to Block Edge Masks for the 900 MHz and 1800 MHz licences

4.6 Block Edge Masks (BEMs) have been developed in CEPT as a new regulatory approach and replace the previous technical framework which has been based on references to ETSI standards of specific technologies. This new approach ensures that the development and deployment of new technologies (such as 5G) are not hindered by the delay in updating the technical framework. We have also adopted this technology neutral approach in our more recent licences, such as the 3.6 to 3.8 GHz licences that we auctioned in 2021.

4.7 BEMs define maximum permitted emission levels from a transmitter. They comply with the principle of technology neutrality, granting maximum freedom to licence holders to decide how to make best use of the spectrum, while providing protection for wireless systems in the adjacent frequencies and reducing the need for coordination between adjacent operators. BEMs are not intended to replace or relax limits set out in dedicated equipment standards.

4.8 A BEM is defined relative to the edge of a block of spectrum held by a licensee (see Figure 3). It consists, as a minimum, of three elements:

a) An in-block power limit, which defines the maximum power the operator can radiate within its assigned frequency block;

b) A baseline power limit, which defines the maximum power that can be emitted from the operator's equipment outside its assigned frequency block, protecting adjacent spectrum users from unwanted emissions; and

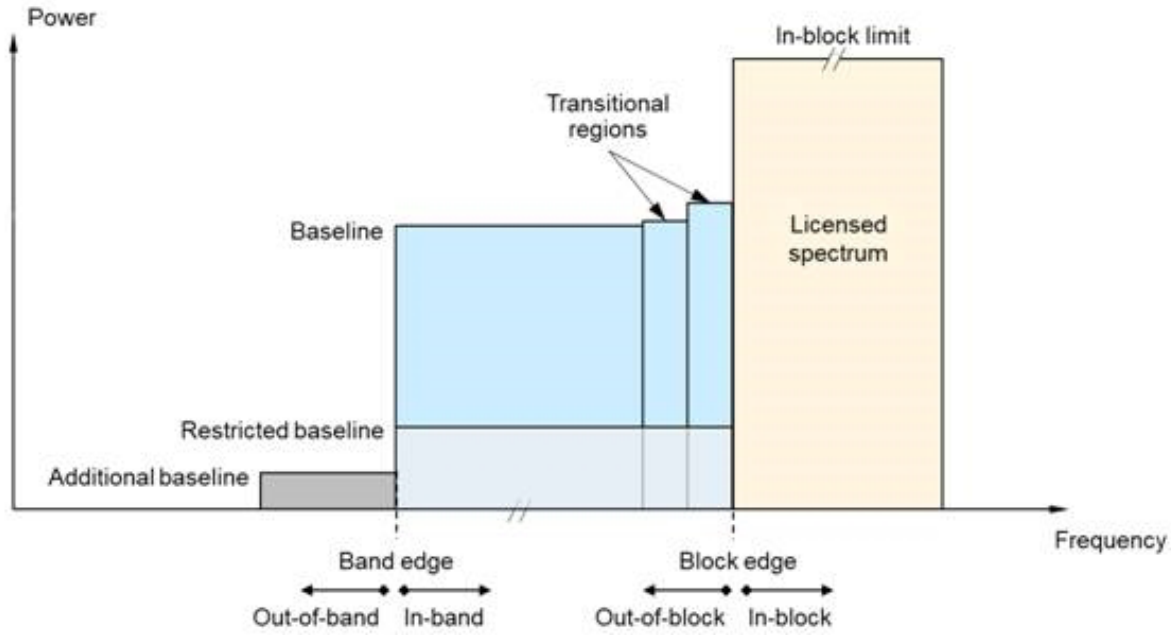
c) One or more transitional region power limits, which define the maximum power that can be emitted in the transition from the in-block power limit to the baseline power limit at different frequency offsets, also protecting adjacent spectrum users from unwanted emissions.

4.9 In some bands, the BEM may also consist of:

a) A restricted baseline power limit, which may, for example, allow for unsynchronised operation of a Base Station (BS) within a Time Division Duplex (TDD) band, while protecting the adjacent licensees.

b) An additional baseline power limit, which may define an out-of-band limit to ensure coexistence with adjacent band spectrum users where needed if it is different from out-of-block baseline limits.

Figure 2: Elements of Block Edge Mask

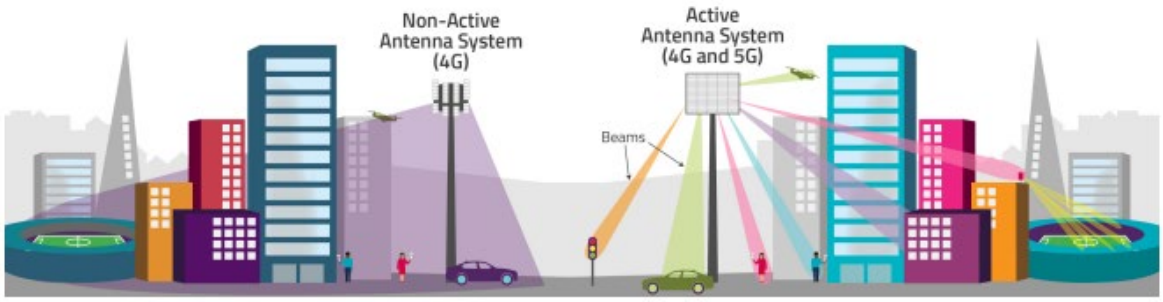


4.10 The BEM elements that we are proposing for each band are set out in the following sections.

Addition of Active Antenna System (AAS) and of Total Radiated Power (TRP) conditions for the 1800 MHz, 2100 MHz and 2.6 GHz licences

4.11 Updating the licences to be suitable for 5G, in most cases, requires changes to enable the use of AAS. The practical effect of AAS for consumers could be a higher quality of service in busy areas. This is because AAS enables use of massive multiple-input multiple-output (massive MIMO)[22] antennas, which can increase the capacity of the radio access network in those areas. This technology has the potential to significantly increase the spectral efficiency and network capacity through the use of beamforming (focusing radio transmissions in a specific direction), spatial multiplexing (re-using frequencies to send data to different users) and other techniques which take advantage of the location of people and their devices. (See Figure 4.)

Figure 3: AAS and Beamforming



4.12 The in-block and out-of-block limits for transmission powers contained in the licences for each of the 1800 MHz, 2100 MHz and 2.6 GHz bands do not consider the difference between AAS and non-AAS antennas and are currently all expressed as EIRP (effective isotropically radiated power). The updated technical conditions contained in the ECC/CEPT reports express two sets of power limits: as EIRP for non-AAS base stations and as TRP (total radiated power) for AAS base stations. We are proposing to add TRP limits for AAS and to specify that the limits which are currently written into the relevant licences will apply only to non-AAS base stations.

4.13 In the case of AAS, there is no straightforward mapping between TRP and EIRP because the relationship depends upon the number of radiating antenna elements, the geometry of the antenna array and the way that beams are formed by the antenna array. When enabling AAS, we must ensure that specifying emission limits as TRP does not cause harmful interference to other authorised users who are using the same or nearby frequencies.

4.14 The harmonised framework for each band was developed and has been updated by the CEPT. The ECC[23] which considers and develops policies on electronic communication activities in Europe, has published reports recommending the least restrictive technical

[22] Massive MIMO is a high-order MIMO technology typically using a large number of antenna elements at the base station and user terminal.
[23] The ECC is a committee of the CEPT.

conditions for each band. Recommendations are based upon analysis ensuring coexistence of services within the same band as well as coexistence in adjacent bands. Ofcom has played, and continues to play, a key role in the development of these reports, particularly regarding the relevant technical analysis.

4.15 We have reviewed the CEPT conclusions on appropriate TRP limits for adjacent service coexistence following introduction of AAS base stations in the 1800 MHz, 2100 MHz and 2.6 GHz bands. We refer to the relevant ECC report and decisions for each band, as illustrated in Table 2.

Table 2: Relevant reports and decisions for each band

Band	ECC Technical Report	ECC Decision
1800 MHz	ECC Report 297[24]	ECC Decision (06)13[25]
2100 MHz	ECC Report 298[26]	ECC Decision (06)01[27]
2.6 GHz	ECC Report 308[28]	ECC Decision (05)05[29]

4.16 We note that the recommended out-of-block TRP limits for AAS in the ECC reports for these bands is not expected to reduce compatibility with adjacent services. In the case of in-block emission limits for base stations, we have exercised our judgement to determine appropriate TRP limits.

4.17 The in-block EIRP limits in the current 1800 MHz, 2100 MHz and 2.6 GHz licences are given in Table 3. For AAS radio equipment in the 1800 MHz and 2100 MHz bands we propose a TRP per cell limit of 50 dBm /5 MHz. This is equivalent to 200 W in a 10 MHz channel. The 2.6 GHz band has a lower EIRP limit than the other two bands, and for this band we propose 46 dBm /5 MHz, noting that a lower limit may be commensurate with protection of radar services in the adjacent spectrum. The proposed TRP limits are summarised in Table 3.

[24] ECC Report 297, Analysis of the suitability and update of the regulatory technical conditions for 5G MFCN and AAS operation in the 900 MHz and 1800 MHz bands, approved 8 March 2019. https://docdb.cept.org/download/1387
[25] ECC Decision (06)13
[26] ECC Report 298, Analysis of the suitability and update of the regulatory technical conditions for 5G MFCN and AAS operation in the 1920-1980 MHz and 2110-2170 MHz band, approved 8 March 2019. https://docdb.cept.org/download/1388
[27] ECC Decision (06)01
[28] ECC Report 308, Analysis of the suitability and update of the regulatory technical conditions for 5G MFCN and AAS operation in the 2500-2690 MHz band, approved 6 March 2020. https://docdb.cept.org/download/1409
[29] ECC Decision (05)05

Table 3: Current in-block EIRP limits and the proposed TRP limits

Band	Current in-block EIRP limit	Proposed TRP per cell limit for AAS radio equipment
1800 MHz[(1)]	UMTS 65 dBm /carrier LTE 65 dBm / 5 MHz WiMAX 65 dBm / 5 MHz	50 dBm / 5 MHz
2100 MHz	65 dBm / 5 MHz	50 dBm / 5 MHz
2.6 GHz	61 dBm / 5 MHz	46 dBm / 5 MHz

[(1)] Inclusion of broadband terrestrial electronic communication services (ECS) systems only in this table, i.e. not including GSM or other narrowband systems.

4.18 In all cases, our proposed TRP limits for base stations are lower than the maximum value recommended in the relevant CEPT reports (as are our existing EIRP limits) and also high enough that it should not be a significant constraint on the ability of licensees to deploy AAS.

4.19 AAS antennas are currently impractical in the 900 MHz band and their use is not anticipated in the foreseeable future, so CEPT reports make no recommendations on TRP limits for this band.

Allow the use of downlink and uplink frequencies in the 900 MHz, 1800 MHz and 2100 MHz bands

4.20 For paired frequency bands, such as the 900 MHz and 1800 MHz bands, terminal devices (such as handsets) use the uplink frequency (mobile transmit) to send to the network and the downlink frequency (base transmit) to receive from the network.[30] Licences for paired mobile spectrum in the 900, 1800 and 2100 MHz frequency ranges authorises the network to use only the downlink frequencies. However, licences awarded by Ofcom since 2013 have authorised the network to use both the downlink and uplink frequencies. This allows operators to deploy technical configurations such as the use of repeaters, which are not 'terminal' devices and are not covered by regulations to make them exempt from licensing. The uplink frequencies were not included in the original 900 MHz, 1800 MHz and 2100 MHz licences because technology was less developed when these licences were granted and, consequently, the case for authorising the network to use the uplink was not considered at that time.

4.21 We consider that aligning Vodafone's 900 MHz, 1800 MHz and 2100 MHz licences with the licences granted by Ofcom since 2013, by permitting use of uplink frequencies in addition to downlink frequencies, could benefit the network performance and consequently the service available to end-users. Therefore, we are proposing to make this change by replacing the Radio Equipment definition and purpose at the start of the schedule of each relevant licence with text to reflect the permitted use of both the uplink and downlink frequencies. Annex 6 contains draft licence templates containing our proposed changes.

[30] The technical parameters for the 2100 MHz unpaired band is not subject to change through this consultation

Administrative licence changes

4.22 Vodafone requested that we make administrative changes to its licences to align the conditions and format to the licences we have awarded more recently. Having reviewed these terms and conditions, we consider that, other than the proposed technical changes, only a small number of areas need to be updated. In summary, we propose the following administrative changes:

a) Update the provisions relating to the information that MNOs are required to maintain regarding transmit power levels expressed in terms of TRP; and

b) Minor administrative amendments to remove references that are no longer required and to align some defined terms with the most recent mobile licences issued by Ofcom.

4.23 In our view, these administrative changes will help to create a more consistent licensing regime for the mobile sector.

Information requirements for the 900 MHz, 1800 MHz, 2100 MHz and 2.6 GHz licences

4.24 With the proposed enablement of AAS equipment and associated power limits set as TRP, we need to update the provisions in the licences concerning certain special conditions relating to the radio equipment. These provisions cover the records that the licensee must keep in relation to certain equipment. We are proposing to update these provisions to align them with the most recent mobile licences that Ofcom has issued. We are proposing the following changes:

i) Set the National Grid location information requirement to a resolution of 10 metres (currently this varies from 100 metres for the 900/1800 MHz licences to 1 metre for 2.6 GHz); and

ii) include provisions relating to non-AAS and AAS transmit power limits.

4.25 A draft of the proposed text that reflects these changes can be found in Annex 6 of this document.

4.26 The proposed changes are intended to standardise the record-keeping and information-provision requirements across all licences. This should enable a consistent approach across all licences and help minimise the administrative burden on licensees of having to maintain differing record-keeping regimes.

Minor administrative amendments

4.27 We are also proposing to make a number of minor amendments including the alignment of some definitions, removal of obsolete terms and corrections of any errors.

4.28 One of these proposed changes is to amend the definition of an Interface Requirement (IR) document. The current definition in some licences makes references to EU legislation under which these provisions were previously notified. As the UK is no longer a member of the EU, we are proposing to update this definition by referencing the Radio Equipment Regulations 2017, which is now the relevant UK legislation.

4.29 The changes that we are proposing to make are shown in mark-up in the draft licence templates in Annex 6 of this document.

5. Proposed changes to Vodafone's licence in the 900 MHz and the 1800 MHz bands including an interference assessment

Background

5.1 In response to a formal request for a licence variation received from Vodafone, we are proposing to vary Vodafone's licence no. 0249664, which authorises the use of the following frequencies: 880.1 to 885.1 MHz; 890.1 to 902.5 MHz; 925.1 to 930.1 MHz; 935.1 to 947.5 MHz; 1715.9 to 1721.7 MHz; and 1810.9 to 1816.7 MHz. In the rest of this section, we refer to this licence as '**Vodafone's 900 MHz and 1800 MHz Licence**'.

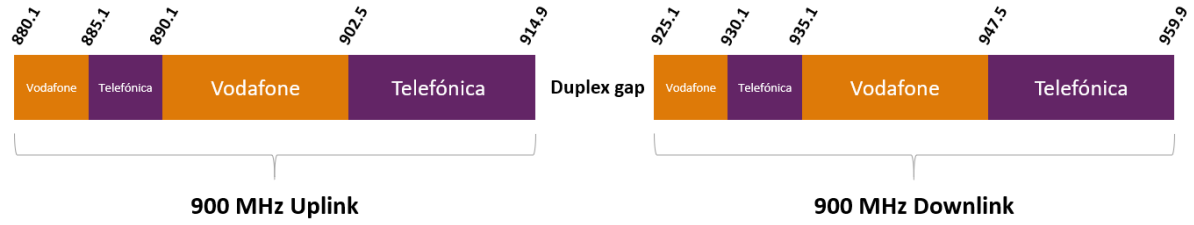
5.2 The current spectrum holdings by the MNOs in the 900 MHz and 1800 MHz bands are shown in Table 4 and Figure 5 below. As shown in Figure 5 below, Vodafone's holdings in the 900 MHz band are adjacent to Telefónica's holdings in the same band, while Vodafone's holdings in the 1800 MHz band are adjacent to both Telefónica's and H3G's holdings.

Table 4: Spectrum holdings in the 900 and 1800 MHz spectrum bands

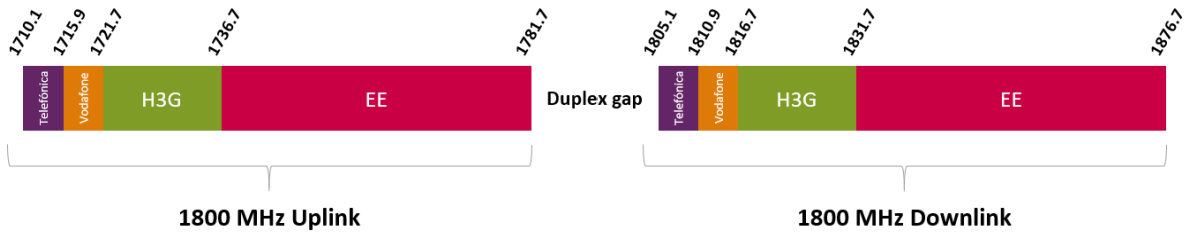
	EE	H3G	Telefónica	Vodafone
900 MHz	-	-	34.8 MHz	34.8 MHz
1800 MHz	90 MHz	30 MHz	11.6 MHz	11.6 MHz

Figure 4: Spectrum holdings in the 900 and 1800 MHz spectrum bands

900 MHz



1800 MHz



Proposed changes

5.3 The changes that we are proposing to make to Vodafone's 900 MHz and 1800 MHz Licence are shown in Annex 6 and summarised below. As set out in Section 4, the proposed changes are intended to align Vodafone' licence with the most recent mobile licences issued by Ofcom and ensure that its technical conditions are appropriate to authorise the deployment of new services including 5G.

Technical changes

5.4 We are proposing to update the technical conditions in Vodafone's 900 MHz and 1800 MHz Licence that authorise how the spectrum is used. These updates include:

a) Removing the technology specific requirements for UMTS, LTE and WiMAX, by aligning the technical conditions with ECC Decision (06)13. This would make the licences technology neutral with a specified BEM and conditions suitable for AAS, thereby allowing the use of 5G in these bands. This includes:

i) Defining EIRP limits (per antenna), for both inside and outside the Permitted Frequency Blocks, for non-AAS BS of wideband terrestrial ECS systems (i.e. channel bandwidth > 200 kHz).

ii) Defining EIRP limits (per antenna), for both inside and outside the Permitted Frequency Blocks, for non-AAS BS of narrowband terrestrial ECS systems (i.e. channel bandwidth = 200 kHz).

iii) Defining TRP limits (per cell), for both inside and outside the Permitted Frequency Blocks, for AAS BS of wideband terrestrial ECS systems (i.e. channel bandwidth > 200 kHz) in the 1800 MHz band.

b) Including the terminal station power limits in the licence (previously these were not included in the licences).

c) Updating the frequency carrier spacing requirements to align with the new technology neutral definitions.

d) Referencing a new technology neutral Interface Requirements document.

5.5 In the following paragraphs we explain how the new proposed technical conditions will affect Vodafone's Licence for the 900 MHz and 1800 MHz bands.

Technical studies

5.6 At the time of Vodafone's request, work was already underway in CEPT to develop harmonised least restrictive technical conditions (LRTCs) suitable for 5G and other technologies, in compliance with the principles of technology and service neutrality. Therefore, we considered it appropriate to wait until this wider work on developing technology neutral LRTCs while maintaining coexistence with other services had been completed before updating Vodafone's 900 MHz and 1800 MHz Licence in response to its

request. Over the intervening period relevant technical studies[31] have gone through the CEPT review and approval process.

5.7 ECC Report 297 assessed the suitability of the 900 MHz and 1800 MHz bands for 5G and AAS and proposed an update to the regulatory technical conditions to enable the deployment of 5G and AAS whilst maintaining compatibility with current systems deployed in the band and in the adjacent bands. These proposals were implemented in ECC Decision (06)13 updating the regulatory framework to support the introduction of 5G in the 900 MHz band, and 5G and AAS in the 1800 MHz band.

5.8 ECC developed CEPT Report 80 which analysed how to transpose the harmonised technical conditions of certain technologies (UMTS, LTE, WiMAX, 5G New Radio and NB-IoT) to a common set of technology neutral technical conditions. The proposals from CEPT Report 80 were implemented in ECC Decision (06)13, as amended on 4 March 2022.[32]

5.9 As the interference assessment and technical harmonised conditions have now been developed, we believe that it is appropriate to update Vodafone's 900 MHz and 1800 MHz Licence in response to its request.

Detail of the proposed technical licence changes

5.10 Currently, Vodafone's 900 MHz and 1800 MHz Licence specifies the technologies that can be used. These are GSM (2G), UMTS (3G) and WiMAX and LTE (4G). As requested by Vodafone and in accordance with ECC Decision (06)13, we are proposing to make Vodafone's its 900 MHz and 1800 MHz Licence technology neutral. The result of this will be a number of changes to the technical schedules of the licence.

Introduction of technology neutral BEM

5.11 The changes in ECC Decision (06)13 now define technology neutral technical conditions as two block edge masks which support the deployment of 5G New Radio services, as well as the deployment of LTE (4G), UMTS (3G), WiMAX and NB-IoT in the 900 MHz and 1800 MHz bands. We are therefore proposing to introduce new baseline and block-specific requirements.

5.12 We propose that the baseline and block-specific requirements for base stations should align with those given in ECC Decision (06)13, as amended on 4 March 2022. This will replace the technology specific emission requirements. The proposed limits are set out in Table 5.

[31] CEPT Report 80, published 2 July 2021 https://docdb.cept.org/download/3466

[32] The proposals from CEPT Report 80 were implemented also in Commission Implementing Decision (EU) 2022/173, published 7 February 2022 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022D0173

Table 5: Baseline and out of block specific requirements for 900 MHz and 1800 MHz

Frequency Range	Non-AAS mean EIRP limit per antenna	AAS mean TRP limit per cell (1800 MHz only)
Baseline		
915 – 970 MHz (900 MHz) 1795 – 1890 MHz (1800 MHz)	3 dBm / MHz	−6 dBm / MHz
Out of block-specific requirements		
-10 to -5 MHz from lower block edge	12 dBm / 5 MHz	3 dBm / 5 MHz
-5 to -1 MHz from lower block edge	5 dBm / MHz	−4 dBm / MHz
-1 to -0.2 MHz from lower block edge	13.8 dBm / 0.8 MHz	4.7 dBm / 0.8 MHz
-0.2 to 0 MHz from lower block edge	32.4 dBm / 0.2 MHz	17.4 dBm / 0.2 MHz
0 to +0.2 MHz from lower block edge	32.4 dBm / 0.2 MHz	17.4 dBm / 0.2 MHz
+0.2 to +1 MHz from lower block edge	13.8 dBm / 0.8 MHz	4.7 dBm / 0.8 MHz
+1 to +5 MHz from upper block edge	5 dBm / MHz	−4 dBm / MHz
+5 to +10 MHz from upper block edge	12 dBm / 5 MHz	3 dBm / 5 MHz

5.13 GSM is not covered by these block edge masks and is maintained through reference to the ETSI standards. We are proposing to adopt these changes in the technical schedules of the licences. Therefore, the parameters for GSM would remain unchanged.

5.14 Due to these changes, we are proposing to remove references to the existing UMTS and WIMAX/LTE specific Interface Requirement documents and replace them with a new technology neutral version, IR 2109, [33] that will mirror the power limits set out in Table 6 below.

Transmit power limits in the Permitted Frequency Blocks

5.15 ECC Decision (06)13 does not define a mandatory maximum power in the Permitted Frequency Blocks, but gives administrations flexibility to define a limit themselves. As Vodafone's 900 MHz and 1800 MHz Licence has a limit for each technology, we are also proposing a technology neutral limit to replace these technology-specific limits. Our approach to this is set out in Section 4 of this document.

5.16 Vodafone's 900 MHz and 1800 MHz Licence currently permits a maximum in-block power of 65 dBm / carrier EIRP for UMTS and 65 dBm / 5 MHz EIRP for LTE and WiMAX in the downlink frequencies. We propose to replace this with a technology neutral maximum in-block power limit of 65 dBm / 5 MHz for wideband terrestrial ECS systems, and clarify that this EIRP limit is per antenna, and applies only to non-AAS base stations.

[33] https://www.ofcom.org.uk/__data/assets/pdf_file/0030/237828/ir2109.pdf

5.17 Vodafone's 900 MHz and 1800 MHz Licence does not currently define a maximum in-block power limit of any narrowband terrestrial systems in the downlink frequencies (other than GSM). We propose to define a technology neutral maximum in-block power limit of 62 dBm/200 kHz per antenna for narrowband terrestrial ECS systems, which aligns with the current limit defined for GSM.

5.18 ECC Decision (06)13 introduced parameters designed to allow the use of AAS in the 1800 MHz band. In Section 4 we set out our method for setting the maximum in-block power limit for AAS base stations. We proposed that this limit should be 50 dBm / 5 MHz TRP per cell. It would apply only to the 1800 MHz band and only for wideband terrestrial ECS systems.

5.19 Finally, as we set out in Section 4, Vodafone's 900 MHz and 1800 MHz Licence only covers base station downlink frequencies and not the uplink frequencies. This does not allow the mobile networks to take advantage of some potential network configurations, such as the use of repeaters. Therefore, we propose to include the terminal station power limits in the licences (previously these were only in the interface requirement documents IR 2014).[34]

5.20 Aligning with ECC Decision (06)13, we propose that the defined terminal station power limit now include the possible tolerance of up to +2 dB, which takes account of operation under extreme environmental conditions and production spread, but not test tolerance. As such, we are proposing that a value of 25 dBm will appear in the licences. Although this value differs from the 23 dBm set out in IR 2014, this is because the power limit in IR 2014 does not include this +2 dB tolerance.

Table 6: Maximum permissible transmit power in downlink frequencies

Radio Equipment	Maximum mean power
GSM base station	62 dBm EIRP per carrier
non-AAS base station – narrowband terrestrial ECS	62 dBm / 200 kHz EIRP per antenna
non-AAS base station – broadband terrestrial ECS	65 dBm / 5 MHz EIRP per antenna
AAS base station – broadband terrestrial ECS (1800 MHz only)	50 dBm / 5 MHz TRP per cell

[34] Ofcom Interface Requirement 2014, published Ofcom

Table 7: Maximum permissible transmit power in uplink frequencies

Radio Equipment	Maximum mean power 900 MHz	Maximum mean power 1800 MHz
GSM terminal station	33 dBm TRP	30 dBm TRP
Terrestrial ECS mobile or nomadic terminal station[b]*[c]	25 dBm TRP	25 dBm TRP
Terrestrial ECS fixed or installed terminal station[b]*[c]	25 dBm EIRP	25 dBm EIRP

[b] The maximum mean power relates to the EIRP or TRP of a specific piece of Radio Equipment irrespective to the number of transmit antennas.

**[c] The maximum mean power relates to the EIRP or TRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas. It is recognised that a possible tolerance of up to + 2 dB is included in this value, to take account of operation under extreme environmental conditions and production spread. This value does not include test tolerance.*

Frequency separation

5.21 ECC Decision (06)13 also defines the need for a 200 kHz frequency separation between some of the systems, the implementation of which should be decided at a national level. We are proposing that the implementation of this frequency separation requirement closely aligns with the existing requirement in Vodafone's 900 MHz and 1800 MHz Licence which, in the absence of bilateral or multilateral agreements, requires the channel edge of any UMTS, LTE or WiMAX to be 200 kHz or more inside the edge of the permitted frequency block where a neighbouring licensee has deployed a GSM carrier or carriers (including Global System Mobile Communications for Railways (GSM-R), in the case of the 900 MHz band) in the immediately adjacent spectrum.

5.22 We are minded to ensure alignment with this requirement by applying it to all wideband terrestrial ECS systems. We are also proposing that for the newly defined narrowband terrestrial ECS systems, in the absence of bilateral or multilateral agreements, the channel edge of any narrowband terrestrial ECS system carriers must be 200 kHz or more inside the edge of the permitted frequency block.

Carrier spacing requirements

5.23 The only technical change in the frequency carrier spacing proposal explained above (para 5.22) is the addition of a requirement on narrowband terrestrial ECS systems, which does not currently appear in Vodafone's Licences. The remaining changes are simply a shift towards technology neutral language, and have no impact on the current requirements that apply to GSM, UMTS, LTE or WiMAX.

5.24 In light of the new technology neutral approach, and removal of the references to UMTS, LTE and WiMAX technologies, we also propose to make updates to the Radio Frequency Carrier Spacing requirement set out in Vodafone's 900 MHz and 1800 MHz Licence. The proposed updates will ensure that in absence of relevant agreements that have been notified to Ofcom specifying alternative arrangements, the licensee should operate in

accordance with the terms set out in paragraph 6 of the licence schedule. Details can be found in the draft licence template set out in Annex 6.

Impact on other spectrum users

5.25 When considering the impact on other users we considered the work already carried out by CEPT.

5.26 We have reviewed the conclusions for adjacent service coexistence with AAS base stations in the 1800 MHz band, from ECC Report 297, to confirm their validity for the UK context of licence variation to include AAS. We consider that the findings remain valid, and that the introduction of AAS will not worsen the compatibility situation for those services studied.

5.27 We have also reviewed the conclusions for adjacent service coexistence with the development of technology neutral LRTCs for non-AAS and AAS BSs in the 900 MHz and 1800 MHz bands, from CEPT Report 80. As the BEMs for non-AAS and AAS BSs were derived from BEMs of existing technologies already permitted in the bands[35], the compatibility situation is unchanged by the move to using technology neutral BEMs. After reviewing the previous technical work undertaken, we have confirmed that the adjacent service coexistence conclusions in CEPT Report 80 remain valid for the UK context, and the use of technology neutral LRTCs will not worsen the compatibility situation for those services studied.

5.28 The GSM-R network used by Network Rail (NR) for the operation of its communications system, uses spectrum adjacent to the 900 MHz band. There is an Ofcom Notice of Co-ordination Procedure[36] (the Notice) which sets out a coordination procedure which the 900 MHz operators must follow when deploying new 3G or 4G base stations in the 900 MHz band. Our proposed technical conditions for 900 MHz non-AAS antennas on a technology neutral basis would not change the risk of interference from any technology neutral wideband transmission in the 900 MHz band, although we recognise that the requirements of the Notice only currently apply to 3G and 4G base stations.

5.29 We understand that NR introduced a programme to upgrade their GSM-R radios in the train cabs to reduce the interference impact from wideband signals in the adjacent 900 MHz band. We also understand that Vodafone and Telefónica have been cooperating closely with Network Rail in the intervening period in order to manage any coexistence issues on a case-by-case basis. We will consider with the relevant parties whether any amendments to the Notice are required to include the provision for new technology neutral sites.

[35] A single BEM for non-AAS BS was derived based on the MSR non-AAS BS BEM given in ETSI TS 137 104 (version 15.10.0), Table 6.6.2.2-1 and 6.6.2.2-2. A single BEM for AAS BS was derived based on the MSR AAS BS BEM given in ETSI TS 137 105 (version 15.8.0), Table 9.7.5.2.3-1 and 9.7.5.2.3-2.

[36] Notice of Co-ordination Procedure required for 3G and 4G deployment under the Public Wireless Network Licences covering the 900 MHz band Statement (ofcom.org.uk). This was updated in July 2013 to add the requirements to 4G base stations in addition to the requirements on 3G ones, when the 900 MHz licences were varied to add 4G technology.

Administrative changes

5.30 We are also proposing to make the administrative changes set out in Section 4 and shown in mark-up in Annex 6. These include changes to update the provisions relating to the information that the licensee is required to maintain regarding transmit power levels in Total Radiated Power (TRP) and changes to update some definitions.

Our provisional conclusions

5.31 We are minded to vary Vodafone's 900 MHz and 1800 MHz Licence as set out above and shown in Annex 6.

5.32 Subject to this consultation, we also propose to make substantially similar licence changes available to other MNOs with mobile licences in the 900 MHz and 1800 MHz bands upon request.

Question 1a: Do you have any comments on our proposal to agree to Vodafone's request for changes to its licences in the 900 MHz and 1800 MHz bands to enable 5G?

Question 1b: Do you have any comments on our proposal to make substantially similar licence changes available to the other MNOs with licences in the 900 MHz and 1800 MHz bands?

6. Proposed changes to Vodafone's licence in the 2100 MHz band including an interference assessment

Background

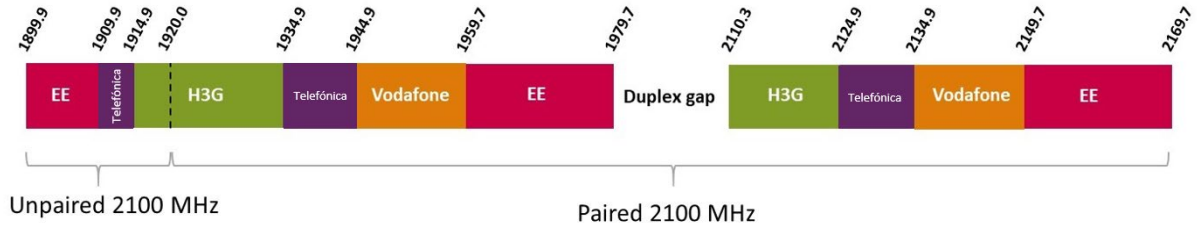
6.1 In response to a formal request for a licence variation received from Vodafone, we are proposing to vary Vodafone's licence no. 0207131, which authorises the use of the following frequencies: 1944.9 – 1959.7 MHz and 2134.9 – 2149.7 MHz. In the rest of this section, we refer to this licence as '**Vodafone's 2100 MHz Licence**'.

6.2 The current spectrum holdings in the 2100 MHz band are shown in Table 8 and Figure 6 below. While the illustrations include MNOs' holdings of both paired and unpaired spectrum, Vodafone only holds paired spectrum in the band. As shown in Figure 6 below, Vodafone's holdings in the 2100 MHz band are adjacent to Telefónica's and EE's holdings in the same band.

Table 8: Spectrum holdings in the 2100 MHz spectrum

2100 MHz band	EE	H3G	**Telefónica**	Vodafone
Paired spectrum	40 MHz	29.5 MHz	20 MHz	29.6 MHz
Unpaired spectrum[37]	10 MHz	5.1 MHz	5 MHz	-

Figure 5: Spectrum holdings in the 2100 MHz spectrum



Proposed changes

6.3 The changes we are proposing to Vodafone's Licence are shown in Annex 6 and summarised below. As set out in Section 4, the proposed changes are intended to align Vodafone's Licence with the most recent mobile licences issued by Ofcom and ensure that its technical conditions are appropriate to authorise the deployment of new services including 5G.

[37] 1900 MHz band (unpaired) is subject to an ongoing review and we will not be varying the schedule as part of this consultation.

Technical licence changes

6.4 We are proposing to update the following technical conditions in Vodafone's Licence:

a) Removing ambiguity in the definition of the EIRP limits, by clarifying that the EIRP limits are defined per antenna and defining that they will apply for non-AAS BS only. This ensures consistency across the 1800 MHz, 2100 MHz and 2.6 GHz bands.

b) Defining TRP limits (per cell), for both inside and outside the Permitted Frequency Blocks for AAS BS.

c) Including the terminal station power limits in the licence (previously these were not included in the licences).

6.5 The proposed changes reflect our analysis of the updated technical conditions and power limits contained in the ECC Decision (06)01. In the following paragraphs, we explain how we have taken account of the relevant technical studies, as well as explaining how the new proposed technical conditions will affect Vodafone's Licence.

Technical studies

6.6 In March 2019, the ECC Decision 06(01)[38] on harmonised technical conditions of use of the 1920 to 1980 MHz and 2110 to 2170 MHz band ("1900/2100 MHz") was updated following approval of ECC Report 298[39]. The majority of the technical conditions for the 2100 MHz licences were set out in ECC Decision 06(01) detailing the technical parameters for harmonised utilisation of spectrum in the 1900/2100 MHz band for mobile networks to include 5G and AAS.

6.7 The aim of ECC Decision (06)01 was to ensure efficient and effective use of these frequencies within the CEPT and included the relevant least restrictive technical conditions covering the downlink FDD frequency band (i.e. 2110 to 2170 MHz), complemented by a set of least restrictive technical conditions for AAS.

6.8 ECC Report 298 assessed the suitability for 5G and AAS of the existing least restrictive technical conditions in the 1900/2100 MHz band implemented in ECC Decision (06)01. It updated the regulatory framework to support the introduction of 5G and AAS in the 1900/2100 MHz band.

6.9 On 6 May 2020, the EU made the Commission Implementing Decision (EU) 2020/667 which updated the harmonised technical conditions for the 2100 MHz band to make it suitable for next-generation (5G) terrestrial wireless systems.[40]

[38] ECC Decision (06)01 amended 2019
[39] ECC Report 298 approved 8 March 2019
[40] Decision 2020/667 continues to be part of UK law, following Brexit, by virtue of section 3 of the EU Withdrawal Act 2018. See: https://www.legislation.gov.uk/eudn/2020/667/introduction

Detail of the proposed technical licence changes

6.10 Vodafone's Licence permits a maximum power in the Permitted Frequency Blocks of 65 dBm / 5 MHz EIRP for the downlink frequencies. The proposed variation clarifies that this EIRP limit is per antenna, and this limit applies only to non-AAS base stations.

6.11 Similarly, the proposed update clarifies that the EIRP limits for frequencies outside of the Permitted Frequency Blocks (the baseline and block specific requirements) are defined per antenna and apply only to non-AAS base stations.

6.12 We propose that, for AAS base stations, the maximum power in the Permitted Frequency Blocks should be 50 dBm / 5 MHz TRP per cell.

6.13 We propose that, for AAS base stations, the TRP limits for frequencies outside the Permitted Frequency Blocks (the baseline and block specific requirements) should align with those given in ECC Decision (06)01, as amended on 8 March 2019.

6.14 These power limits, when applied together with the harmonised spectrum scheme defined in ECC Decision (06)01, ensure coexistence between networks operating in the 2100 MHz band, and other applications operating in adjacent bands.

6.15 The proposed power limits for both non-AAS and AAS are set out in Table 9 and Table 10 below:

a) the power transmitted in any direction in the Permitted Frequency Blocks (in-block) shall not exceed the limits set out in Table 9; and

b) for transmissions on the downlink frequencies, the power transmitted outside the Permitted Frequency Blocks shall not exceed the limits set out in Table 10.

Table 9: Maximum permissible power within the Permitted Frequency Blocks

Radio Equipment	Maximum mean power
non-AAS base station[a]	65 dBm / 5 MHz EIRP per antenna
AAS base station[a]	50 dBm / 5 MHz TRP per cell
Mobile or nomadic terminal station[b]	24 dBm TRP
Fixed or installed terminal station[b]	24 dBm EIRP

[a] For femtocell base stations, power control must be applied to minimise interference to adjacent channels.

[b] The maximum mean power relates to the EIRP or TRP of a specific piece of Radio Equipment irrespective of the number of transmit antennas.

Table 10: Maximum transmit power outside the Permitted Frequency Blocks

Frequency range	Non-AAS mean EIRP limit per antenna[1]	AAS mean TRP limit per cell[2]
Frequencies spaced more than 10 MHz from the lower or upper block edge	9 dBm / 5 MHz	1 dBm / 5 MHz
-10 to -5 MHz from lower block edge	11.0 dBm / 5 MHz	3 dBm / 5 MHz
-5 to 0 MHz from lower block edge	16.3 dBm / 5 MHz	8 dBm / 5 MHz
0 to +5 MHz from upper block edge	16.3 dBm / 5 MHz	8 dBm / 5 MHz
+5 to +10 MHz from upper block edge	11.0 dBm / 5 MHz	3 dBm / 5 MHz

[1] The non-AES BEM is defined per antenna and applicable to base station configuration with up to four antennas per sector

[2] In a multi-sector base station, the AAS radiated power limit applies to each one of the individual sectors.

Impact on other spectrum users

6.16 We have reviewed the conclusions for adjacent service coexistence with AAS Base Stations in the 2100 MHz band, from ECC Report 298, to confirm their validity for the UK context of licence variation to include AAS. We consider that the findings remain valid, and the introduction of AAS will not worsen the compatibility situation for those services studied.

6.17 ECC Report 298 concludes that for Earth Exploration and Space Services (EESS) Earth Stations (ES) above 2200 MHz, where coordination zones were needed to protect the EESS ES from non-AAS BS, a coordination zone of a similar magnitude will be needed to protect the EESS ES from AAS BS. In the UK, there is no requirement to coordinate non-AAS BS with EESS ES. Additionally, the spurious domain for the BS in 2110-2170 MHz is above 2180 MHz and as such the interference (due to unwanted emissions) scenario is unchanged by the introduction of AAS. We are therefore proposing that no coordination requirement is needed for AAS BS.

6.18 ECC Report 298 does not assess the compatibility of PMSE below 2110 MHz with the implementation of AAS in the 2100 MHz band, and as such Ofcom has made its own assessment, which is set out below.

6.19 When considering the potential change in impact caused by AAS implementation in 2110-2170 MHz on PMSE below 2110 MHz, it is helpful to distinguish between:

a) the first adjacent channel (centred on 2105 MHz) which is immediately adjacent to the MNO licence boundary; and,

b) the second and further adjacent channels (centred on 2095 MHz and below) which have a frequency separation of at least 10 MHz from the MNO licence band edge.

6.20 As highlighted in our 2010 consultation,[41] PMSE channel filters are widely used in this band to protect the second and further adjacent channels from interference (due to receiver selectivity). Additionally, the spurious domain for the BS in 2110 to 2170 MHz is below 2100 MHz and as such the interference (due to unwanted emissions) scenario is unchanged by the introduction of AAS.

6.21 As highlighted in our 2010 consultation on a BS power increase in the 2100 MHz licences, we understand that the wireless camera community does not use the first adjacent channel to avoid interference from mobile base stations, and therefore we are of the view that the implementation of AAS in the 2100 MHz band is likely to have little or no impact on the PMSE community in practice.

Administrative licence changes

6.22 We are also proposing to make the administrative changes set out in Section 4 and shown in mark-up in Annex 6. These include changes to update the provisions relating to the information that MNOs are required to maintain regarding transmit power levels in Total Radiated Power (TRP) and changes to update some definitions.

Our provisional conclusions

6.23 We are minded to vary Vodafone's 2100 MHz Licence as set out above and shown in Annex 6.

6.24 Subject to this consultation, we also propose to make substantially similar licence changes available to other MNOs with licences in the 2100 MHz band upon request.

> Question 2a: Do you have any comments on our proposal to agree to Vodafone's request for changes to its licence in the 2100 MHz band to enable 5G?
>
> Question 2b: Do you have any comments on our proposal to make substantially similar licence changes available to the other MNOs with licences in the 2100 MHz band?

[41] Consultation: Application for a variation to 3G licence (and consequent proposal to vary draft 2GHz MSS/CGC Base station licence) - Ofcom

7. Proposed changes to Vodafone's and Telefónica's licences in the 2.6 GHz band

Background

7.1 We are proposing to vary:

a) Vodafone's licence no. 0943538, which authorises the use of 2500 to 2520 MHz, 2570 to 2595 MHz and 2620 to 2640 MHz in the 2.6 GHz band (in addition to 842 to 852 MHz and 801 to 811 MHz in the 800 MHz band); and

b) Telefónica's licence no. 1238565, which authorises the use of 2595 to 2620 MHz.

7.2 In the rest of this section, we refer to these licences as '**Vodafone's 2.6 GHz Licence**' and '**Telefónica's 2.6 GHz Licence**'.

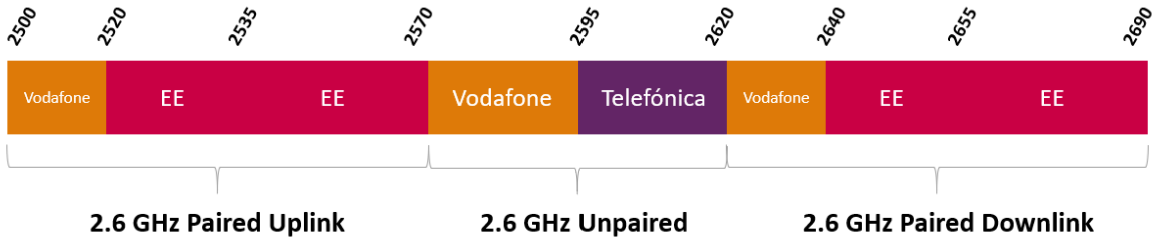
7.3 The current spectrum holdings held by licensees in the 2.6 GHz band are shown in Table 11 and Figure 7 below. As shown in Figure 7 below, Vodafone's holdings in the 2.6 GHz band are adjacent to Telefónica's and EE's holdings in the same band, while Telefónica's holdings are adjacent to Vodafone's holdings.

7.4 The 2.6 GHz licences were awarded in 2013 for the incoming new 4G technology. They consist of paired and unpaired spectrum.

Table 11: Spectrum holdings in the 2.6 GHz band

2600 MHz band	EE	H3G	**Telefónica**	Vodafone
Paired spectrum	100 MHz	-	-	40 MHz
Unpaired spectrum	-	-	25 MHz	25 MHz

Figure 6: Amount of spectrum holdings in the 2.6 GHz band



7.5 As set out in Section 2 of this document, we are proposing changes to the licences in response to the following formal requests which we have received:

a) a formal request from Vodafone to vary its licences to facilitate 5G deployment, including for this spectrum band; and

b) a formal request from Telefónica to vary its 2.6 GHz (unpaired) licence to relax a restriction to the 5 MHz restricted block, 2595 MHz to 2600 MHz, adjacent to the unpaired spectrum block held by Vodafone. Vodafone has confirmed that it is

supportive of this change, and has agreed to coordination between themselves and Telefónica to enable this.

Proposed changes

7.6 The changes we are proposing to Vodafone's Licence and Telefónica's Licence are shown in Annex 6 and summarised below.

Technical licence changes to update Vodafone's Licence

7.7 We are proposing to update the technical conditions in Vodafone's Licence. These updates include:

a) Removing ambiguity in the definition of the EIRP limits, by clarifying that the EIRP limits are defined per antenna and defining that they will apply for non-AAS BS only. This ensures consistency across the 1800 MHz, 2100 MHz and 2.6 GHz bands.

b) Simplify the requirements for transition regions for paired downlink and unpaired unrestricted frequencies in line with the latest ECC Decision.

c) Defining TRP limits (per cell), for both inside and outside the Permitted Frequency Blocks for AAS BS.

7.8 The proposed changes reflect our analysis of the updated technical conditions and power limits contained in the ECC Decision (05)05. In the following paragraphs, we explain how we have taken account of the relevant technical studies, as well as explaining how the new proposed technical conditions will affect Vodafone's Licence.

Technical studies

7.9 Following a European Commission mandate to CEPT in July 2018 to review the current technical conditions in European Commission Decision 2008/477/EC[42] (the "2008 Commission Decision) to make them suitable for the next-generation technologies; CEPT published CEPT Report 72 in July 2019.[43] At the same time, CEPT also updated ECC Decision (05)05[44] which it published in July 2019.

7.10 Further work was undertaken to look at the technical parameters needed to permit the use of AAS technologies. CEPT published ECC Report 308[45] in March 2020 and this led to an update of ECC Decision (05)05. Subsequently, the European Commission made Commission

[42] Commission Decision of 13 June 2008 on the harmonisation of the 2500-2600 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community (2008/477/EC) as amended by Commission Implementing Decision (EU) 2020/636, 8 May 2020. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008D0477-20200512&qid=1648832665253

[43] CEPT Report 72, Report from CEPT to the European Commission in response to the Mandate, approved 5 July 2019 https://docdb.cept.org/download/06b2620f-202e/CEPTRep072.pdf

[44] ECC Decision (05)05, Harmonised utilization of spectrum for Mobile/Fixed Communications Networks (MFCN) operating within the band 2500-2690 MHz, approved 18 March 2005, corrected 4 March 2022. https://docdb.cept.org/download/3716

[45] ECC Report 308, Analysis of the suitability and update of the regulatory technical conditions for 5G MFCN and AAS operation in the 2500-2690 MHz band, approved 6 March 2020 https://docdb.cept.org/download/1409

Implementation Decision (EU) 2020/636 of 8 May 2020[46] (the "2020 Commission Decision") which replaced the harmonisation parameters set out in the 2008 Commission Decision.[47]

Detail of the proposed technical licence changes

7.11 The licences for spectrum use in the 2.6 GHz band permit a maximum power in the Permitted Frequency Blocks of 61 dBm / 5 MHz EIRP for the downlink frequencies in paired spectrum and 61 dBm / 5 MHz EIRP for unrestricted blocks and 25 dBm / 5 MHz for restricted blocks in the unpaired spectrum. The proposed variation clarifies that this EIRP limit in both paired or unpaired spectrum is per antenna, and this limit applies only to non-AAS base stations.

7.12 Similarly, the proposed update clarifies that the EIRP limits for frequencies outside of the Permitted Frequency Blocks in paired or unpaired spectrum (the baseline and block specific requirements) are defined per antenna and apply only to non-AAS base stations.

7.13 We propose that, for AAS base stations, the maximum power in the Permitted Frequency Blocks for paired spectrum downlink frequencies or unpaired unrestricted blocks should be 46 dBm / 5 MHz TRP per cell. For restricted blocks in unpaired spectrum, we propose that the limit should be 22 dBm / 5 MHz TRP per cell.

7.14 We propose that, for AAS base stations, the TRP limits for frequencies outside the Permitted Frequency Blocks (the baseline and block specific requirements) should align with those set out in ECC Decision (05)05.

7.15 The maximum mean TRP requirements per cell for AAS Radio Equipment in restricted blocks of unpaired spectrum are not specified in the 2020 Commission Decision. We are proposing that the alternative block-specific EIRP requirements for downlink transmissions on restricted frequencies in unpaired spectrum are also subject to the "*Notice of coordination procedure for the licences covering the 2.6 GHz band – Deployment of mobile electronic communication networks in unpaired restricted blocks and in spectrum adjacent to unpaired restricted blocks*" notified by Ofcom to the Licensee. These requirements apply to base stations with outdoor antennas meeting a specified antenna height limit of 12 metres above ground level and to base stations with indoor antennas.

7.16 We propose to align the transitional region power limits for non-AAS and AAS base stations with the updated ECC Decision (05)05 which has simplified these transitional region power limits. In the 5 MHz adjacent to the Permitted Frequency Block, we now propose a single transitional limit instead of three transitional limits. If non-AAS emissions in paired spectrum downlink frequencies or from unrestricted blocks in unpaired spectrum are compliant with the current three transitional limits, they will comply with the proposed limit of 16 dBm / 5 MHz maximum mean EIRP per antenna for non-AAS Radio Equipment.

7.17 The transitional limits for AAS base stations in paired spectrum downlink frequencies or from unrestricted blocks in unpaired spectrum are proposed to be 16 dBm / 5 MHz as the

[46] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020D0636&from=en
[47] Decision 2020/636 continues to be part of UK law, following Brexit, by virtue of section 3 of the EU Withdrawal Act 2018. See: https://www.legislation.gov.uk/eudn/2020/636/contents

maximum mean TRP per cell for AAS Radio Equipment, aligned with those specified in the 2020 Commission Decision.

7.18 Whilst ECC Decision (05)05 allows for an additional baseline limit above 2690 MHz to be applied for AAS base stations using paired spectrum to help reduce the necessary coordination zone for the protection of radio astronomy services in the adjacent frequency band 2690 MHz to 2700 MHz, there is no such provision for AAS base stations in unpaired spectrum. We understand that there is little current or planned observation in this band and that it is not a priority for UK radio astronomy use. We are proposing not to include this additional baseline limit.

7.19 However, the current licences include emission limits of -45 dBm / 5MHz EIRP up to 3100 MHz for the protection of radars operating in the 2.7 GHz to 3.1 GHz band. We have accordingly included TRP limits for AAS base stations of -52 dBm / 5 MHz per cell for 2700 to 3100 MHz.

Impact on spectrum users

7.20 We have reviewed the conclusions for adjacent service coexistence with AAS Base Stations in the 2.6 GHz band, from ECC Report 308, to confirm their validity for the UK context of licence variation to include AAS. We consider that the findings remain valid, and that the introduction of AAS will not worsen the compatibility situation for those services studied.

7.21 The UK requirement for licensees to coordinate their 2.6 GHz deployments with aeronautical radionavigation radar in the 2.7 GHz band remains for all Base Stations (non-AAS and AAS), as described below.

Co-ordination with radionavigation radar in the 2.7 GHz band

7.22 Radars operating in the 2.7 GHz band have some sensitivity to emissions from the 2.6 GHz band. This was accounted for in the award of the 2.6 GHz band in 2013 by the introduction of a notice of coordination under spectrum access licences for the 2.6 GHz band.[48]

7.23 This notice requires licences when planning their 2.6 GHz deployments to check whether the protection thresholds at a number of radar locations would be exceeded as a result of any proposed 2.6 GHz deployment. These thresholds apply to the communications signal and the out-of-band noise at relevant Protected Radar locations.[49] Planned deployments can only proceed if these calculations show that the relevant thresholds will not be exceeded as a result of the planned (or modified) deployment or if agreement is reached with the operator of the relevant radars.

7.24 This notice of coordination applies whether the 2.6 GHz emissions are from 2.6 GHz non-AAS or AAS radio equipment. In the case of AAS base stations, the licensee must ensure

[48] Notice of coordination procedure required under spectrum access licences for the 2.6 GHz band: Coordination with aeronautical radionavigation radar in the 2.7 GHz band, 1 March 2013. https://www.ofcom.org.uk/__data/assets/pdf_file/0026/56951/final_radar_coordination.pdf

[49] "Protected Radar" means the list of military and civil radars on the Protected Radar List: https://www.ofcom.org.uk/__data/assets/pdf_file/0020/44921/protected_radar.pdf

that the worst-case antenna gain is considered when determining the EIRP relevant for the calculation.

Technical licence changes to permit Telefónica to use an unrestricted 20 MHz carrier

7.25 When the 2.6 GHz spectrum was awarded in 2013, compatibility between networks using unpaired and adjacent paired spectrum was achieved by restricting the technical conditions applicable in the 5 MHz blocks at 2570 to 2575 MHz and 2615 to 2620 MHz. At that time, it was assumed that if two or more licensees were operating in the unpaired sub-band their transmissions would not necessarily be synchronised when operating in the same geographic area. To ensure compatibility between unrestricted TDD block allocations licensed to two operators, a centrally-located 5 MHz restricted block was positioned at 2595 to 2600 MHz, which forms a part of the allocation held by Telefónica. This means that only 15 MHz of Telefónica's unpaired block is fully usable without a power restriction.

Detail of the proposed technical licence changes

7.26 Permitting Telefónica to use an unrestricted 20 MHz carrier compared to the currently available 15 MHz would require the following technical changes:

a) The restricted frequencies at 2595 to 2600 MHz become unrestricted frequencies. For downlink transmissions, this would allow a maximum EIRP of 61 dBm / 5 MHz per antenna for non-AAS base stations or a maximum TRP of 46 dBm / 5 MHz per cell for AAS Radio Equipment.

b) For unrestricted blocks the adoption of a new baseline requirement across the whole of the 2570 to 2620 MHz sub-band with an EIRP of 4 dBm /5 MHz per antenna for non-AAS base stations and a TRP of 5dBm / 5 MHz per cell for AAS base stations. This is supported by ECC Decision (05)05.

c) Licensees of the unrestricted frequencies in this sub-band to cooperate and adopt a common transmission frame structure.

7.27 The use of restricted frequencies between two adjacent allocations to different licensees using unpaired spectrum is unnecessary if networks operating in the same geographic area use a common frame structure, i.e. if all base stations transmit at the same time as each other, and receive at the same time as each other. In such a situation the cells use a synchronised transmission frame structure, meaning that switching between uplink and downlink transmissions are aligned in time, using a common reference clock such as satellite-based Global Positioning System (GPS).

7.28 In this case the restricted frequencies can be converted to unrestricted frequencies. It also allows the baseline limit across the 2.6 GHz unpaired spectrum to be relaxed to +4 dBm / MHz, as indicated in ECC Decision (05)05. Since the 2.6 GHz spectrum was awarded, the use of frame structure synchronisation has become more common, with many operators choosing to fully synchronise.

7.29 We propose to allow the use of bilateral or multilateral agreements between the holders of Spectrum Access licences in the 2570 to 2620 MHz sub-band (currently, Vodafone and Telefónica) on the frame structure. However, in the absence of any agreements, we propose to mandate a backstop frame structure referred to as Frame Structure A, which is also specified in our 2.3 GHz, 3.4 GHz, 3.5 GHz, 3.6 GHz and 3.6 to 3.8 GHz Spectrum Access licences. It is a fully-synchronised frame structure with a 10 msec frame and a 3:1 downlink/uplink ratio. This definition of frame structure is sufficient to enable 4G and 5G as there are 4G and 5G frame structures that are compatible with this definition.

7.30 We also propose to follow the same approach for indoor small cells as we do in our other unpaired licences. These cells will not be required to synchronise, except in the case of indoor non-domestic small cells where another licensee demonstrates that they are suffering harmful interference as a result of the lack of synchronisation. Small cells are defined with an EIRP of up to 24 dBm per 20 MHz.

Impact on other spectrum users

7.31 We have reviewed the conclusions for adjacent service coexistence with AAS Base Stations in the 2.6 GHz band, from ECC Report 308, to confirm their validity for the UK context of licence variation to include AAS. We consider that the findings remain valid, and the introduction of AAS will not worsen the compatibility situation for those services studied.

7.32 The UK requirement for licensees to coordinate their 2.6 GHz deployments with aeronautical radionavigation radar in the 2.7 GHz band remains for AAS Base Stations, as described in paragraphs 7.21 to 7.23.

7.33 We do not consider that adoption of the new baseline requirements for unrestricted TDD blocks or the requirements to adopt a common transmission frame structure will have a wider impact beyond the two licensees of the 2570 to 2620 MHz sub-band.

Administrative licence changes

7.34 We are also proposing to make the administrative changes set out in Section 4 and shown in mark-up in Annex 6. These include changes to update the provisions relating to the information that the licensee is required to maintain regarding transmit power levels in Total Radiated Power (TRP) and changes to update some definitions.

Our provisional conclusions

7.35 We are minded to vary Vodafone's Licence and Telefónica's Licence as set out above and shown in Annex 6.

7.36 Subject to this consultation, we also propose to make substantially similar licence changes available to other MNOs with paired spectrum licences in the 2.6 GHz band upon request

Question 3a: Do you have any comments on our proposal to agree to Vodafone's request for changes to its licence in the 2.6 GHz band to enable 5G?

Question 3b: Do you have any comments on our proposal to make substantially similar licence changes available to the other MNOs with paired spectrum licences in the 2.6 GHz band?

Question 4: Do you have any comments on our proposal to vary Telefónica's and Vodafone's licences in the 2570 MHz to 2620 MHz sub-band to relax restrictions in relation to the 5 MHz restricted block?

8. Provisional decision

8.1 We have considered the licence variations requested by Vodafone's and Telefónica's in light of our relevant licensing functions and statutory duties. Our provisional decision, which is subject to responses to this consultation, is that it is appropriate to update the conditions contained in the relevant licences which are currently held by Vodafone and Telefónica, as proposed in this document.

8.2 Overall, we believe that consumers are likely to benefit from the proposed licence variations because these changes will enable licensees to provide innovative mobile services and to make a more efficient use of spectrum. Consumers may also benefit from these services providing faster download speeds and improved coverage.

8.3 In our view, our proposed changes to the licences are:

- **objectively justified** in that they would enable optimal use of spectrum and encourage investment and innovation in the services that can be deployed in various bands;
- **not unduly discriminatory** against particular persons or against a particular description of persons, in that we are proposing to make substantially similar licence changes available to other licence holders upon request;
- **proportionate** to what they are intended to achieve, in that we are updating several conditions to make them less restrictive to take account of changes in market conditions since the licences were issued; and
- **transparent in relation to what they are intended to achieve**, in that the proposals, and our underlying objectives and reasoning, are described and explained in this consultation document.

8.4 We consider that our proposed changes would further the performance of our general duties in section 3 of the Communications Act 2003 (the '2003 Act'). This is because, as set out above, citizens and consumers will likely benefit from higher quality enhanced mobile broadband services and optimal use of spectrum.

8.5 As set out in Section 3 of this document, in considering the variation requested by Vodafone and Telefónica we take into account our duties and, in light of those duties, the factors that we have taken into account include: securing optimal spectrum use; promoting competition; encouraging innovation and investment; benefits for consumers and citizens; and the impact on spectrum users in the same and adjacent bands.

8.6 The proposed changes to Vodafone's and Telefónica's licences are shown in a draft marked-up version in Annex 6 of this document.

8.7 As noted above, we are proposing that these changes would be also available to other licensees should they request them. For those licensees the changes set out in this document are for illustrative purposes and show what the updated technical provisions would look like. Final versions of the licences issued to other individual licensees may differ due to specific provisions that may only apply to certain licensees in the band.

8.8 Our approach for these licence variations would be to consult individually with licensees on the precise implementation of the updated technical parameters. We anticipate that any

proposed updates would be substantially similar to what we have proposed in this document.

Views sought

8.9 We are giving stakeholders until **5pm on 1 July 2022** to provide comments. For the full list of questions, see Annex 6 of this document.

Next Steps

8.10 After considering responses to this consultation, we will publish a final decision and issue revised licences to Vodafone and Telefónica if we decide to proceed with the proposed variations.

8.11 If any other MNOs would like similar changes made to their licences, they should contact us and make a formal request to vary their licences accordingly.

8.12 We would also like to make the licensees aware of the ECC Recommendation (21)02 that was approved in November 2021[50]. It looked at the conditions to ensure that military radiolocation systems operating below the 3.4 GHz band were protected from indoor non-AAS small cells operating in the 3.4 to 3.8 GHz band.

8.13 The recommendation proposed a specific additional baseline limit for these small cells below 3.4 GHz. This was a relaxed limit, as the existing baseline limits were derived from the use of outdoor cells and did not consider additional losses such as building entry/exit loss. Varying the licences to incorporate this new provision would require a minor administrative change to update licences in the 3.4 to 3.8 GHz band. If any licensees are interested in making these changes to their licences, they should contact us and make a formal request to do so.

[50] https://docdb.cept.org/download/3533

A1. Responding to this consultation

How to respond

A1.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 1 July 2022.

A1.2 You can download a response form from https://www.ofcom.org.uk/consultations-and-statements/category-2/vodafone-and-telefonica-request-to-update-technical-conditions-of-mobile-licences. You can return this by email or post to the address provided in the response form.

A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to Variationrequest@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet. This email address is for this consultation only, and will not be valid after 1 July 2022.

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:

Ruth John
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:

- Send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files. Or
- Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.

A1.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)

A1.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.

A1.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A1.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 4. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

A1.10 If you want to discuss the issues and questions raised in this consultation, please contact Paul Chapman by email to paul.chapman@ofcom.org.uk.

Confidentiality

A1.11 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on the Ofcom website as soon as we receive them.

A1.12 If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.

A1.13 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.14 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

A1.15 Following this consultation period, Ofcom plans to publish a statement by September 2022.

A1.16 If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

A1.17 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 2.

A1.18 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.

A1.19 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Email: corporationsecretary@ofcom.org.uk

A2. Ofcom's consultation principles

Ofcom has seven principles that it follows for every public written consultation:

Before the consultation

A2.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A2.3 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.

A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A2.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A2.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

A2.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A3. Consultation coversheet

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing ☐

Name/contact details/job title ☐

Whole response ☐

Organisation ☐

Part of the response ☐

If there is no separate annex, which parts? _____

_____

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name Signed (if hard copy)

A4. Consultation questions

A4.1 Ofcom invites third parties to respond to the questions set out below. Please provide Ofcom with available supporting evidence where possible.

Question 1a: Do you have any comments on our proposal to agree to Vodafone's request for changes to its licences in the 900 MHz and 1800 MHz bands to enable 5G?

Question 1b: Do you have any comments on our proposal to make substantially similar licence changes available to the other MNOs with licences in the 900 MHz and 1800 MHz bands?

Question 2a: Do you have any comments on our proposal to agree to Vodafone's request for changes to its licence in the 2100 MHz band to enable 5G?

Question 2b: Do you have any comments on our proposal to make substantially similar licence changes available to the other MNOs with licences in the 2100 MHz band?

Question 3a: Do you have any comments on our proposal to agree to Vodafone's request for changes to its licence in the 2.6 GHz band to enable 5G?

Question 3b: Do you have any comments on our proposal to make substantially similar licence changes available to the other MNOs with paired spectrum licences in the 2.6 GHz band?

Question 4: Do you have any comments on our proposal to vary Telefónica's and Vodafone's licences in the 2570 MHz to 2620 MHz sub-band to relax restrictions in relation to the 5 MHz restricted block?

A5. Legal framework

A5.1 This section provides an overview of the main legislative provisions relevant to wireless telegraphy licensing and the proposed variations. It is not a full statement of all the legal provisions which may be relevant to Ofcom's functions and to wireless telegraphy licensing.

A5.2 The applicable legal framework derives from our duties and powers under both the Communications Act 2003 (the '2003 Act') and the Wireless Telegraphy Act 2006 (the '2006 Act').

Licence variation

Ofcom's powers to vary a spectrum licence

A5.3 Our powers to carry out our spectrum functions are set out in the 2006 Act. Such powers include, under sections 9 and 10, the general power to revoke or vary any wireless telegraphy licences. Schedule 1 of the 2006 Act sets out a process for the variation of wireless telegraphy licences.

A5.4 We have a duty set out in section 9(7) of the 2006 Act to ensure that wireless telegraphy licence conditions are objectively justified in relation to networks and services to which they relate, non-discriminatory, proportionate and transparent.

A5.5 We have a broad discretion under paragraph 6 of Schedule 1 of the 2006 Act to vary licences, subject to certain limitations:

- pursuant to paragraph 6A of Schedule 1 of the 2006 Act, any variation of a wireless telegraphy licence must be objectively justifiable;
- UK obligations under international agreements where use of spectrum has been harmonised;
- section 5 of the 2003 Act and section 5 of the 2006 Act enable the Secretary of State to give us directions in respect of the carrying out of our spectrum functions;
- we must act in accordance with our statutory duties, including our duty to secure optimal use of the spectrum and our duties under section 3 of the 2006 Act; and
- general legal principles, which include the duties to act reasonably and rationally when making decisions and to take account of any legitimate expectations.

The licence variation process

A5.6 Paragraph 7 of Schedule 1 of the 2006 Act sets out a process for the variation of wireless telegraphy licences.

A5.7 Where we propose to vary a wireless telegraphy licence, we must:

- give the licensee a notice which sets out the reasons for the proposed variation and specifies the period within which the licensee may make representations about the proposal.

A5.8 We must then within 1 month of the end of that period:

- decide whether or not to vary the licence in accordance with our proposal or with modifications; and
- notify the licensee of our decision and the reasons for it.

A5.9 However, this process does not apply to a proposed licence variation that is made at the request or with the consent of the licensee.

Ofcom's duties when carrying out spectrum functions

A5.10 In carrying out our spectrum functions we have a duty under section 3 of the 2006 Act to have regard, in particular, to:

- the extent to which the spectrum is available for use, or further use, for wireless telegraphy;
- the demand for use of that spectrum for wireless telegraphy; and
- the demand that is likely to arise in future for such use.

A5.11 We also have a duty to have regard, in particular, to the desirability of promoting:

- the efficient management and use of the spectrum for wireless telegraphy;
- the economic and other benefits that may arise from the use of wireless telegraphy;
- the development of innovative services; and
- competition in the provision of electronic communications services.

Ofcom's general duties

A5.12 Our principal duty under section 3(1) of the 2003 Act, when carrying out our functions, is:

- to further the interests of citizens in relation to communications matters; and
- to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A5.13 In doing so, we are also required by section 3(2) to secure (among other things):

- the optimal use of spectrum, and
- the availability throughout the United Kingdom of a wide range of electronic communications services.

A5.14 Section 3(4) also requires us to have regard to the following matters (amongst others):

- the desirability of promoting competition in relevant markets;
- the desirability of encouraging investment and innovation in relevant markets;
- the different needs and interests, so far as the use of the electro-magnetic spectrum for wireless telegraphy is concerned, of all persons who may wish to make use of it; and

- the different interests of persons in the different parts of the United Kingdom, of the different ethnic communities within the United Kingdom and of persons living in rural and in urban areas.

A5.15 Section 4 of the 2003 Act requires us, when carrying out our spectrum management functions, to act in accordance with additional requirements, including:

- the requirement to promote competition; and
- the requirement to promote the interests of all members of the public in the UK.

A5.16 Where it appears to us that any of our duties in section 3 of the 2006 Act conflict with one or more of our general duties under sections 3 to 6 of the 2003 Act, we must give priority be our duties under the 2003 Act.

A6. Draft licence variations

A6.1 In order to manage the different licence changes that are proposed under this consultation, we have placed the draft licences in a separate document entitled 'Annex 6: Draft licence variation templates' which is attached to this consultation and can be found on our website.