



Variation of 900 MHz, 1800  
MHz and 2100 MHz Mobile  
Licences  
A consultation

Consultation

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# Contents

Section		Page
1	Executive Summary	1
2	Introduction	2
3	Liberalisation of Technical Conditions in 900 MHz, 1800 MHz and 2100 MHz licences for 4G technologies	11
4	Increase in the 900 MHz maximum permitted base station transmit power for UMTS and 4G technology	18
5	Other proposed changes to the 900 MHz, 1800 MHz and 2100 MHz licences	21
6	Next Steps	23
<b>Annex</b>		<b>Page</b>
1	Responding to this consultation	24
2	Ofcom's consultation principles	26
3	Consultation response cover sheet	27
4	Template 900 MHz / 1800 MHz licence	29
5	Template 2100 MHz licence	40
6	Assessment of a 3 dB power increase for 900 MHz base transmit frequencies	61
7	Consultation Questions	81

## Section 1

# Executive Summary

1.1 Ofcom has received the following requests for variation of mobile cellular licences:

- Vodafone and H3G have requested that we remove the regulatory constraint on the use of LTE (4G) technology in their spectrum licences (900 MHz, 1800 MHz and 2100 MHz in the case of Vodafone and 2100 MHz in the case of H3G); and
- Telefónica and Vodafone have also requested that we vary their 900 MHz Public Wireless Network licences so as to increase the maximum permitted base station transmit power by 3 decibels (3dB) for 3G use.

1.2 Having considered these requests, we propose in this consultation:

- to liberalise all mobile licences in the 900 MHz, 1800 MHz and 2100 MHz bands to permit the deployment of 4G services (where such licenses have not already been liberalised). This will align the permitted technologies across all mobile spectrum licences, including the existing licences at 900 MHz, 1800 MHz and 2100 MHz and the licences to be awarded by auction in the 800 MHz and 2.6 GHz bands. This will meet a long standing objective to liberalise all mobile licences so that there are no regulatory barriers to the deployment of the latest available mobile technology; and
- to increase the maximum permitted base station transmit power in the 900 MHz frequency band for UMTS (3G) technology, as requested by Telefónica and Vodafone who hold licences in this spectrum band.

1.3 Subject to responses to this consultation, we propose to implement these proposals by varying the 900 MHz, 1800 MHz and 2100 MHz licences in those cases where licence variation requests have been received, and seek licensee consent to the equivalent variations where the licensees have not yet made such a request.

1.4 We have also reviewed the format and administrative terms of the mobile cellular licences in the 900 MHz, 1800 MHz and 2100 MHz bands against the licences to be awarded in respect of 800 MHz and 2.6 GHz spectrum. Having done so, we propose to amend the 900 MHz, 1800 MHz and 2100 MHz licences to ensure a consistent approach across the mobile sector. This last proposal is largely for clarification purposes and is not expected to have any material effect on the licence terms and conditions of current licences. Again, subject to responses to this consultation, we propose to implement this proposal by seeking consent from the licensees.

## Section 2

# Introduction

- 2.1 This section sets out the relevant factual background, the applicable legal framework and the analytical framework we have applied in reaching the proposals set out in this document.
- 2.2 Section 3 considers the impact on competition and spectrum management if we liberalise all mobile licences in the 900 MHz, 1800 MHz and 2100 MHz bands to permit the deployment of LTE and WiMAX services (where such licenses have not already been liberalised).
- 2.3 Section 4 considers the impact on competition and spectrum management of increasing the maximum permitted base station transmit power in the 900 MHz frequency band for UMTS (3G) technology.
- 2.4 Section 5 outlines our proposals to amend the format and administrative terms of the 900 MHz, 1800 MHz and 2100 MHz licences to ensure a consistent approach across the mobile sector.
- 2.5 This document should be read together with the annexes. This document, together with those annexes, as a whole comprises an impact assessment.

## Factual background

### Current mobile spectrum holdings and technologies

- 2.6 There are over 80 million subscriptions to mobile services in the UK<sup>1</sup>. The voice and data services these consumers currently enjoy rely on the use of three frequency bands, namely 900 MHz, 1800 MHz and 2100 MHz.
- 2.7 Mobile operators' existing spectrum holdings differ – see Figure 1 below.

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<sup>1</sup> Ofcom's Communications Market Report.

**Figure 1: Mobile operators' existing paired spectrum holdings**

	EE	Vodafone	Telefónica	H3G
900 MHz	None	2x17.4 MHz	2x17.4 MHz	None
Liberalised 1800 MHz	2x45 MHz*	None	None	2x15 MHz*
Unliberalised 1800 MHz	None	2x5.8 MHz	2x5.8 MHz	None
2100 MHz	2x20 MHz	2x15 MHz	2x10 MHz	2x15 MHz
Share of paired spectrum	39%	23%	20%	18%

\* Reflects the 2x15 MHz of 1800 MHz spectrum that EE is divesting to H3G

- 2.8 Only EE currently has spectrum suitable for 4G mobile services, although it has divested a total of 2x15 MHz of liberalised 1800 MHz spectrum to H3G.<sup>2</sup>
- 2.9 There are differences in both the technologies that are authorised for use in these bands, and in the equipment that is available on the market for use in these bands. These differences change over time as new technologies emerge and MNOs and consumers exercise choice in deciding what equipment and services to purchase. Table 1 provides an overview of the current situation. Current technologies are 2G/GSM, suitable for voice and low speed data services, 3G/UMTS/HSPA<sup>3</sup> ("3G") suitable for voice and the higher speed data services currently available and 4G/LTE/WiMAX ("4G"), which is most suitable for high speed data services.

<sup>2</sup> In the course of the merger that led to the creation of EE, the merging parties committed to divest 2x10 MHz of 1800 MHz spectrum by 30 September 2013 and a further 2x5 MHz by 30 September 2015. EE has traded this spectrum to H3G and the rights will transfer to H3G from these dates.

<sup>3</sup> 3G is a family of mobile technologies that deliver voice and data services. UMTS is the original version of 3G. HSPA is its current, most advanced version.

**Table 1: Technologies authorised and available today in UK mobile bands**

	900MHz band	1800MHz band	2100 MHz band
<b>Technologies authorised for use in UK</b>	2G/GSM 3G/UMTS/HSPA	2G/GSM 3G/UMTS/HSPA LTE and WiMAX <sup>4</sup>	3G/UMTS/HSPA
<b>Technologies for which equipment is currently available on the market</b>	2G/GSM 3G/UMTS/HSPA LTE	2G/GSM LTE	3G/UMTS/HSPA LTE

- 2.10 As demonstrated above, each of EE, Telefónica, Vodafone and H3G holds 2100 MHz spectrum that is suitable for the provision of higher speed data services using 3G. Three of these operators (EE, Telefónica and Vodafone) also hold spectrum at 900 MHz and 1800 MHz which is authorised for use of 3G technologies, but 3G equipment is only currently available to support such use in the 900 MHz band and not the 1800 MHz band, and there is no clear prospect of this changing in the near term. As such, only Telefónica and Vodafone hold spectrum (the 900 MHz spectrum) in addition to the 2.1GHz spectrum that is suitable for providing 3G services now. Further, the 1800 MHz spectrum held by EE is also authorised for LTE and WiMAX technologies and EE has already launched 4G services in a number of cities using this spectrum. EE has subsequently traded a part of this liberalised 1800 MHz spectrum to H3G (with the first tranche of divested spectrum access rights in this traded licence coming into effect from 1 October 2013).
- 2.11 The MNOs' holdings also include further spectrum at 2100 MHz, referred to as unpaired spectrum, to which they have been holding rights since 2000. However, this spectrum is not in use for provision of commercial services.
- 2.12 Ofcom is currently in the process of awarding at auction wireless telegraphy licences authorising the use of 2x30 MHz of paired spectrum suitable for mobile services in the 800 MHz band and a further 2x70 MHz of paired spectrum in the 2.6 GHz band, also a further 50 MHz of unpaired spectrum in the 2.6 GHz band (the "Combined Award").<sup>5</sup> These bands are suitable for the deployment of LTE. We anticipate that the 800 MHz band will be cleared, and hence available for use nationally, by June 2013 (some restrictions may remain in the Highlands and Islands regions, although these are unlikely to affect the delivery of 4G services in Edinburgh and Glasgow).<sup>6</sup> Similarly, we anticipate that the 2.6 GHz spectrum is likely to be available for use in the London area by the end of Q2 2013 and nationally by the end of Q1 2014. A very large amount of spectrum suitable for 4G services will thus be available in the near future.

<sup>4</sup> The 1800MHz licences held by Vodafone and Telefonica are not currently authorised for LTE and WiMAX.

<sup>5</sup> *Assessment of future mobile competition and award of 800 MHz and 2.6 GHz*, 24 July 2012 (the "Award Statement"). Available at: <http://stakeholders.ofcom.org.uk/consultations/award-800mhz-2.6ghz/statement/>

<sup>6</sup> [Updated 800 MHz and 2.6 GHz spectrum award Information Memorandum](#) 12 November 2012

## Licence variation requests

2.13 Ofcom has received the following requests to vary the licences relating to the frequencies set out above:

- Vodafone and H3G have requested that we remove the regulatory constraint on the use of LTE (4G) technology in their spectrum licences (900 MHz, 1800 MHz and 2100 MHz in the case of Vodafone and 2100 MHz in the case of H3G) (the “4G licence variation requests”). Our consideration of these requests is set out in section 3.
- Telefónica and Vodafone have also requested that we vary their 900 MHz Public Wireless Network licences so as to increase the maximum permitted base station transmit power by 3 decibels (3dB) for 3G use (the “power increase licence variation requests”). Our consideration of these requests is set out in section 4.

2.14 We are also taking this opportunity, as set out in section 5, to consult on a number of other changes of an administrative nature that we propose to make in order to align licence mobile licence terms, including with the licences to be awarded in respect of 800 MHz and 2.6 GHz spectrum.

2.15 For the reasons set out in this document, we are proposing to make the above variations. The changes that that would give effect to these proposed changes are shown, by way of example, by reference to Vodafone’s licences at Annex 4 (900/1800 MHz) and Annex 5 (2100 MHz). Variations to the other 900 MHz, 1800 MHz and 2100 MHz licences would be in equivalent terms.

## Legal Framework

2.16 The applicable legal framework derives from our duties under both European and domestic legislation, specifically from:

- the Common Regulatory Framework<sup>7</sup> for electronic communications networks and services, in particular, the Framework Directive and the Authorisation Directive – together with a number of Decisions that apply to these specific spectrum bands; and
- the Communications Act 2003 (the “2003 Act”) and the Wireless Telegraphy Act 2006 (the “2006 Act”) which transpose the provisions of those directives into national law.

## European Law

2.17 There are a number of European Directives and Decisions that relate specifically to these frequency bands.

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<sup>7</sup> The Common Regulatory Framework comprises the Framework Directive (Directive 2002/21/EC), the Authorisation Directive (Directive 2002/20/EC), the Access Directive (Directive 2002/19/EC), the Universal Service Directive (Directive 2002/22/EC) and the Directive on privacy and electronic communications (Directive 2002/58/EC), as amended by the Better Regulation Directive (Directive 2009/140/EC).



- 2.18 Council Directive 87/372/EEC<sup>8</sup> (the “GSM Directive”) reserved the frequency bands 880-915 MHz and 925-960 MHz for the introduction of public pan-European cellular communications using GSM (2G) technology.
- 2.19 This was amended by Directive 2009/114/EC<sup>9</sup> to include GSM (2G), UMTS (3G) “as well as for other terrestrial systems capable of providing electronic communications services that can coexist with GSM systems.”
- 2.20 The European Commission’s Radio Spectrum Committee (“RSC”) Decision 2009/766/EC<sup>10</sup> (the “3G RSC Decision”), as amended by Decision 2011/251/EU<sup>11</sup> (the “LTE RSC Decision”), requires us to designate and make available the 900 MHz and 1800 MHz spectrum bands<sup>12</sup> for LTE and WiMAX by 31 December 2011.
- 2.21 Further, on 15 February 2012, the European Parliament and the Council adopted a Decision implementing the first Radio Spectrum Policy Programme<sup>13</sup> (the “RSPP Decision”). In particular, Article 6(2) provides:
- “In order to promote wider availability of wireless broadband services for the benefit of citizens and consumers in the Union, Member States shall make the bands covered by Decisions 2008/411/EC (3,4-3,8 GHz), 2008/477/EC (2,5-2,69 GHz), and 2009/766/EC (900-1 800 MHz) available under terms and conditions described in those decisions. Subject to market demand, Member States shall carry out the authorisation process by 31 December 2012 without prejudice to the existing deployment of services, and under conditions that allow consumers easy access to wireless broadband services.”*
- 2.22 On 5 November 2012 the European Commission made Commission RSC Decision 2012/688/EU<sup>14</sup> which requires Member States to designate and make available the 2100 MHz band<sup>15</sup> under conditions that enable the use of 4G technology by no later than June 2014, or earlier if issuing/amending rights in these bands. These technical conditions are defined by a block edge mask approach.
- 2.23 The Competition Appeal Tribunal’s judgment in *Telefónica O2 Limited v Office of Communications*<sup>16</sup> finds that the obligation to “designate and make available” requires us to ensure that any legal impediment to the relevant bands being authorised for use with LTE and WiMAX technology is removed. No such legal impediments exist in the UK, and so this requirement has been met in respect of each of the 900 MHz, 1800 MHz and 2100 MHz bands.

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<sup>8</sup> [Council Directive 87/372/EEC of 25 June 1987 on the frequency bands to be reserved for the coordinated introduction of public pan-European cellular digital land-based mobile communications in the Community](#)

<sup>9</sup> [Directive 2009/114/EC of the European Parliament and of the Council](#).

<sup>10</sup> Commission Decision of 16 October 2009 on the harmonisation of the 900 MHz and 1800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community.

<sup>11</sup> Commission Implementing Decision of 18 April 2011 amending Decision 2009/766/EC on the harmonisation of the 900 MHz and 1800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community.

<sup>12</sup> 900 MHz band: 800-915 MHz paired with 925-960 MHz. 1800 MHz band: 1710-1785 MHz paired with 1805-1880 MHz.

<sup>13</sup> Decision No 243/2012/EU of the European Parliament and of the Council of 14 March 2012 establishing a multiannual radio spectrum policy programme <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:081:0007:0017:EN:PDF>

<sup>14</sup> <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:307:0084:0088:EN:PDF>

<sup>15</sup> 2100 MHz band: 1921-1980 MHz paired with 2110-2170 MHz.

<sup>16</sup> [2010] CAT 25, Case Number: 1154/3/3/10.

- 2.24 The authorisation of particular undertakings to use the 900 MHz, 1800 MHz and 2100 MHz spectrum for LTE and WiMAX can only take place after implementation of the necessary authorisations and/or licence amendments in accordance with the applicable national legislation and the Authorisation Directive.
- 2.25 Article 14 of the Authorisation Directive requires that rights of use (in this case a wireless telegraphy licence) “*may only be amended in objectively justified cases and in a proportionate manner, taking into consideration, where appropriate, the specific conditions applicable to transferable rights of use for radio frequencies*”.
- 2.26 More generally, in carrying out our regulatory tasks, including considering the case for amending rights of use, we are required to take all reasonable measures which are aimed at achieving the objectives set out in Article 8 of the Framework Directive. Article 8 requires national regulatory authorities:
- to promote competition in the provision of *electronic communications* networks and services by, amongst other things by ensuring that there is no distortion or restriction of competition in the electronic communications sector and by encouraging efficient use and ensuring the effective management of radio frequencies; and
  - contribute to the development of the internal market by, amongst other things, removing obstacles to the provision of electronic communications networks and services at a European level and encouraging the interoperability of pan-European services.

## **The 2003 Act and the 2006 Act**

### Duties

- 2.27 The requirements of Article 8 of the Framework Directive are given effect to by our duties under the 2003 Act (in particular section 3 and 4) and the 2006 Act (in particular section 3).
- 2.28 Our principal duty under the 2003 Act is to further the interests of citizens in communications matters, and the interests of consumers in relevant markets, where appropriate by promoting competition.
- 2.29 By virtue of our principal duty, we are required to secure (amongst other things) the optimal use for wireless telegraphy of the electro-magnetic spectrum, and the wide availability throughout the UK of a wide range of electronic communications services.
- 2.30 In performing those duties, we are also required to have regard to various matters where they appear to us to be relevant in the circumstances, including the desirability of promoting competition in relevant markets, the desirability of encouraging investment and innovation in relevant markets, and the desirability of encouraging the availability and use of high speed data transfer services throughout the UK.
- 2.31 In furthering the interests of consumers we must have regard in particular to the interests of those consumers in respect of choice, price, quality of service and value for money.
- 2.32 In performing our principal duty we must have regard in all cases to the principles under which regulatory activities must be transparent, proportionate, consistent and targeted only at cases in which action is needed.

- 2.33 The 2006 Act requires us, amongst other things, to have regard to the desirability of promoting the efficient management and use of the part of the electromagnetic spectrum available for wireless telegraphy. It also requires us to ensure that wireless telegraphy licence conditions are objectively justified in relation to the networks and services to which they relate, non-discriminatory, proportionate and transparent.

### Powers

- 2.34 Section 9 of the 2006 Act gives Ofcom the power to grant wireless telegraphy licences subject to such terms as Ofcom thinks fit.
- 2.35 Schedule 1(6) of the 2006 Act gives Ofcom a general discretion to vary wireless telegraphy licences and sets out the process that Ofcom must follow.
- 2.36 Ofcom has a broad discretion under Schedule 1(6) of the 2006 Act to agree to vary licences but there are some limitations on that discretion. These include the following:
- UK obligations under EU law or international agreements where use of spectrum has been harmonised: Ofcom will not agree to remove restrictions from licences or other changes that would conflict with the UK's obligations under international law;
  - Ofcom must comply with any direction from the Secretary of State under section 5 of the 2003 Act or section 5 of the 2006 Act;
  - Ofcom must act in accordance with its statutory duties, including the duty to ensure optimal use of the spectrum;
  - General legal principles, which include the duties to act reasonably and rationally when making decisions and to take account of any legitimate expectations;
  - Any restrictions on variation contained in the relevant licences themselves, subject Schedule 1(8)(5) of the 2006 Act.

### **Process for considering a licence variation request**

- 2.37 In terms of process, Article 14 of the Authorisation Directive requires that Member States must ensure that, except where proposed amendments are minor and have been agreed with the licensee:
- notice of the proposed change is given in an appropriate manner; and
  - interested parties, including users and consumers, are allowed a sufficient period of time to express their views on the proposed amendments (such time to be no less than four weeks except in exceptional cases).
- 2.38 Section 7 of 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.

- 2.39 The 2006 Act sets out in Schedule 1 a process for the variation of wireless telegraphy licences. In the case where a variation is proposed by the licensee, we are under no obligation (under the 2006 Act) to consult on the proposal.
- 2.40 The variation of licences in the 900 MHz, 1800 MHz and 2100 MHz bands to allow LTE use of the relevant frequencies is not likely to be considered to be a minor variation by interested third parties. This is also likely to be the case for increasing the maximum permitted base station transmit power in the 900 MHz frequency band for 3G technology. On that basis we are publishing for consultation our proposal to vary these licences to give interested third parties an opportunity to make representations, and our assessment of the likely impact of doing so. At the same time we are consulting on our proposals to make certain administrative changes to the 900 MHz, 1800 MHz and 2100 MHz licences.

## Framework for analysis of licence variation requests

- 2.41 We consider each of the 4G licence variation requests and the power increase licence variation requests respectively in sections 3 and 4 below. In each case we have applied the same analytical framework which reflects our relevant regulatory objectives and our statutory duties, as set out above. Of particular relevance to our assessment are our principal duty, which 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, and our duty to promote optimal use of spectrum.
- 2.42 Following on from this, in proposing whether to grant the 4G licence variation requests and the power increase licence variation requests, we have considered in relation to each of these both the likely impact on competition of granting those variations and the likely impact on spectrum management, specifically the impact of the licence variation on existing licensed users of adjacent spectrum.

## Impact on competition

- 2.43 In deciding whether to vary the relevant licences as requested, we have considered the extent to which varying those licences would:
- be to the benefit of consumers because it would further their interests by, for example, encouraging innovation, investment, and the availability and use of mobile services throughout the UK; and result in better choice, price, quality of service and value for money; and/or
  - give rise to a material risk of a distortion of competition to the detriment of consumers such that any benefits to consumers resulting from varying those licences without delay would be outweighed by the detriment to consumers resulting from such a distortion of competition.
- 2.44 Any decisions we make in this regard involve the application of regulatory judgement. In reaching our conclusions, we have had to balance the advantages and disadvantages of different options and likely effects, in light of the relevant factors and evidence, in order to reach an outcome that most appropriately meets our relevant regulatory objectives and statutory duties.

## **Impact on spectrum management**

- 2.45 Ofcom's general policy is to set technical restrictions that are the minimum necessary to provide adequate protection against harmful 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. Following on from this, we have considered in each case whether varying the relevant licences would be consistent with the minimum necessary to provide adequate protection against harmful interference.

### Section 3

## Liberalisation of Technical Conditions in 900 MHz, 1800 MHz and 2100 MHz licences for 4G technologies

- 3.1 As explained in section 2 above, the 900 MHz and 1800 MHz licences permit the use of 2G (GSM) and 3G technologies, the licences having been varied in January 2011 to permit the use of 3G. More recently, the EE 1800 MHz licences have been varied so that, from September 2012, they permit the use of 4G technologies. Meanwhile, the current 2100 MHz licences permit the use of 3G technologies only, reflecting the technical conditions in the licences auctioned in 2000.
- 3.2 The proposals on which we are now consulting would have the effect of bringing these licences to a position where all 900 MHz, 1800 MHz and 2100 MHz licences could permit the deployment of 4G services as well by:
- varying the 900 MHz and 1800 MHz licence of Vodafone (and of Telefónica should they request, or consent to, such a change) to add LTE and WiMAX to the list of permitted technologies in their 900 MHz and 1800 MHz licences; and
  - varying the 2100 MHz licences of H3G and Vodafone (and those of Telefónica and EE should they request, or consent to, such a change) so that the technical licence conditions are changed to a Block Edge Mask which will permit the use of both 3G and 4G technologies in the paired frequency ranges<sup>17</sup> (and any other technologies which can, in future, meet these technical conditions).
- 3.3 We note that these particular licences require the consent of the licensee to a variation of this nature.<sup>18</sup> It is for this reason that the proposals above are set out as they are.

### Licence variation requests to permit the use of 4G technologies

- 3.4 As set out in section 2, we are required under the RSPP Decision, subject to market demand, to carry out an authorisation process to liberalise the 900 MHz and 1800 MHz spectrum bands for LTE and WiMAX use by the end of 2012. In recognition of this, our statement on the decision to vary EE's 1800 MHz licence noted that, if we received licence variation requests in respect of licences in the 900 MHz and 1800 MHz bands, demonstrating that there is market demand, then we would consult on varying of those licences in accordance with the requirements of the relevant domestic legislation, and the Authorisation Directive.

<sup>17</sup> The unpaired, or TDD, frequency ranges included in the 2100 MHz licences are the subject of ongoing regulatory work in CEPT and RSC. They are not included within the scope of the liberalisation proposals set out in this document.

<sup>18</sup> The licences include a restriction of Ofcom's discretion to vary them without consent, although Ofcom can give 5 year's notice of an intention to vary the licences for reasons related to the management of the radio spectrum (though the variation can not come into effect before 31 December 2021 without the consent of the licensee in the case of the 2100 MHz licences).

- 3.5 In the absence of a request to vary their 900 and 1800 MHz licences, we wrote to both Telefónica and Vodafone in December 2012 indicating that we were minded to progress the outstanding variations to liberalise the 900 MHz and 1800 MHz licences for 4G services, asking if they wished their own licences to be so varied. Vodafone responded with a formal request that its 900 MHz and 1800 MHz licences be varied to permit 4G.
- 3.6 In respect of the 2100 MHz licences, H3G submitted a request towards the end of last year to have its 2100 MHz licence varied so as to permit the deployment of 4G technologies under the licence. In doing so, it noted the RSC Decision 2012/688/EU of November 2012. We wrote to the other holders of the 2100 MHz licences in December 2012 inviting them to request that their own 2100 MHz licences be so varied. Vodafone responded in December with a formal request that its 2100 MHz licences be varied to permit 4G.
- 3.7 Accordingly, we are in receipt of formal licence variation requests in respect of the 900 MHz and 1800 MHz licences (from Vodafone) and in respect of the 2100 MHz licences (from both H3G and Vodafone).

### Liberalisation policy

- 3.8 Ofcom has had a long standing policy to avoid unnecessary technology restrictions in spectrum licences and to maximise the flexibility with which spectrum can be used, subject to the need to limit the risk of harmful interference (“liberalisation”). More specifically, in the case of the existing MNO licences used for the provision of public mobile services (at 900 MHz, 1800 MHz and 2100MHz) our policy goal has been to remove the regulatory barriers that prevent the deployment of the latest available technology in these bands. In pursuit of this policy goal we have actively promoted, and participated in, the CEPT and EU work that has led to the adoption of common technical conditions that enable 4G use in the RSC Decisions summarised in section 2.
- 3.9 When considering the implementation of our liberalisation objective for these particular licences in the UK we have had to balance this objective with the need to protect and promote effective competition. The market effect of varying the MNO licences depends on the practical ability of the licensees concerned to take advantage of increased flexibility in order to provide services using new technologies. This, in turn depends on a wide variety of factors including: the inclusion of specific frequency bands in latest mobile technology standards for LTE and WiMAX; the availability of equipment to exploit the latest technology in the band concerned; the ability to clear spectrum of existing uses in order to make room for deployment of new technology. The fact that different mobile operators have different spectrum holdings means that licence variations of this nature have differential impacts on the competitive position of different MNOs.
- 3.10 Accordingly, we provided advice to the Secretary of State on the consumer and competition issues relating to the liberalisation of the 900 MHz and 1800 MHz licences before the Secretary of State directed Ofcom to vary the 900 MHz and 1800 MHz licences so as to permit the use of 3G technologies. Similarly, we carried out an assessment of the consumer and competition issues before deciding to vary EE’s 1800 MHz licence so as to permit the use of 4G in its 1800 MHz band from September 2012. For the further licence variations proposed in this consultation the competition issues are considered below.



- 3.11 An important point to note is that our policy of extending liberalisation is not contingent on whether or when the licensees intend to exploit the additional flexibility that liberalisation allows.
- 3.12 The most immediate interest in exploiting the ability to deploy 3G services following the licence variations in early 2011 was in Telefónica's 900 MHz holding. However, the variation of the other 900 MHz and 1800 MHz licences had the effect of extending the right to deploy 3G services across all MNO licences, irrespective of immediate interest in exploiting the increased flexibility in all the licences concerned.
- 3.13 By the same token, having decided to vary EE's 1800 MHz licence so as to permit the use of 4G in its 1800 MHz band, we consider that it would be in keeping with our liberalisation policy to extend the right to deploy 4G technology to all other existing MNO licences at 900 MHz, 1800 MHz and 2100 MHz and to do so now, subject to an assessment of the likely competition effects, irrespective of whether or not the operators wish to exploit this additional flexibility in the immediate future.

### Impact on competition

- 3.14 As explained in section 2 above, we have considered whether the likely benefits to consumers from varying the 900 MHz, 1800 MHz and 2100 MHz licences for 4G services, for example from improved data rates as a result of the deployment of 4G services in those bands, are likely to be outweighed by any negative effects on consumers as a result of a reduction in competition. For example, if a licence variation allows operator X to offer more attractive mobile services, then, in principle, X's competitors could be significantly reduced in scale or X may gain a persistent reputation advantage over its competitors.<sup>19</sup> If this were the case then operator X might be able to charge higher prices and/or offer a lower quality of service to consumers than would otherwise be the case. We consider below the potential for this to happen in these cases.

### Consumer benefits

- 3.15 We consider that the proposed licence variations to permit 4G use are likely to result in consumer benefits over time. Telefónica and Vodafone currently use 900 MHz spectrum to provide 2G and/or 3G mobile services. They use 1800 MHz spectrum to provide 2G mobile services. Vodafone, Telefónica, EE and H3G all currently use the 2100 MHz band to provide 3G mobile services. Where spectrum is used for 4G services, consumers are likely to benefit from increased data speeds (particularly in comparison to 2G). This reflects the technical characteristics of 4G mobile services, such as superior spectral efficiency. There may also be some benefits for consumers due to reduced latency and/or the potential for quality of service guarantees (e.g. 'guaranteed data rates'). In the medium term, liberalisation may give operators greater flexibility to decide which technology to deploy in which bands. This may allow them to supply services that better meet their customers' preferences.
- 3.16 As discussed in paragraphs [3.19] and [3.22] below, we recognise that operators may not immediately deploy 4G services in the newly liberalised bands. If so, then the consumer benefits associated with liberalisation would not occur immediately. However, it is likely that the operators will take advantage of the increased flexibility, and that consumer benefits will flow from this, in due course.

<sup>19</sup> Specifically, consumers may be disadvantaged where an operator enjoys an unwarranted reputation advantage. For further explanation see *Decision to vary Everything Everywhere's 1800 MHz spectrum licences to allow use of LTE and WiMax technologies*, 21 August 2012, paragraphs 3.114-3.116.



## Likelihood of consumer detriment due to distorted competition

3.17 We now consider whether the proposed 4G licence variations are likely to lead to consumer detriment as a consequence of there being a material risk of competition being distorted.

### 900 MHz and 1800 MHz

3.18 We consider that the proposed 900 MHz and 1800 MHz licence variations are unlikely to lead to consumer detriment that flows from any distortion of competition. Liberalisation will remove a barrier to Telefónica and Vodafone offering more attractive services in their existing spectrum using 4G technology. However, this is unlikely to result in these operators gaining a market position that allows them to charge higher prices and/or offer a lower quality of service than would otherwise be the case as a result of a weakening in competition.

3.19 If and when Telefónica and Vodafone do deploy 4G technology in the 900 MHz and 1800 MHz bands, they are likely to face competitive constraints from rival operators that already have access to liberalised spectrum:

- EE is already offering 4G services since its 1800 MHz spectrum has already been liberalised. H3G will soon be able to do so, using 1800 MHz spectrum divested by EE.
- A large amount of spectrum will be available for provision of 4G services during 2013 as a result of the Combined Award, some of which (at least) will be acquired by competitors to Telefónica and Vodafone.

3.20 In any event, in terms of timing it is also worth noting that the operators will not necessarily deploy 4G services in these bands in the immediate future. Telefónica and Vodafone's existing 900 MHz and 1800 MHz spectrum is currently used for 2G and 3G traffic and would require refarming before it could be used for 4G services. Moreover, if these companies win licences at 800MHz and 2.6 GHz in the Combined Award then these new bands are likely to provide the focus for their immediate 4G deployment strategies.

3.21 We have framed the above question in terms of whether the proposed liberalisation of the 900 MHz and 1800 MHz licences of Telefónica and Vodafone could lead to consumer detriment through a distortion to competition. We note, of course, that the impact on competition as a result of the liberalisation, although limited, could be in either direction.<sup>20</sup>

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<sup>20</sup> In other words, it could act over time to increase a competitive advantage that Vodafone and / or Telefónica might then have over EE and / or H3G or, alternatively, it could act over time to reduce the competitive gap that Vodafone and / or Telefónica might have compared to EE and / or H3G.

## 2100 MHz

3.22 We also consider that consumers are unlikely to experience detriment by varying the 2100 MHz licences for 4G. 2100 MHz liberalisation would potentially allow all mobile operators to offer more attractive mobile services by deploying 4G technology in this spectrum in due course, although the ability of different operators to do so may vary. Telefónica has the least spectrum in this band (2x10 MHz), Vodafone and H3G each have 2x15 MHz, while EE has the largest holdings (2x20 MHz). As a result, the relative attractiveness of different operators' services may change over time as a result of the ability to deploy 4G technology in the 2100 MHz band. However we consider that it is unlikely that any impact on operators' competitive positions would be sufficiently large as to lead to a distortion of competition that harms consumers:

- Operators currently have spectrum holdings in other bands. For example, Telefónica (like Vodafone but unlike EE and H3G) currently holds spectrum in the 900 MHz band, which is attractive for in-building coverage.<sup>21</sup>
- Moreover all operators have the opportunity to acquire further spectrum in the Combined Award. In the light of the large amounts of spectrum available in that award, it seems unlikely that competition will be materially distorted as a result of the 2x5 MHz or 2x10 MHz differences in holdings of liberalised 2100 MHz spectrum set out above. Indeed, as part of our competition assessment in the Award Statement we considered whether there might be less than four credible national (mobile) wholesalers. We considered that the likelihood that Telefónica or Vodafone would not be credible was low. We specifically reserved spectrum in the Combined Award in order to address our concern that a fourth national wholesaler such as H3G might not be credible.<sup>22</sup>
- Moreover the 2100 MHz band is already carrying 3G traffic. In the short term, operators with larger holdings in the 2100 MHz band may be able to deploy 4G services using that band in some places. However it may be harder for them to do so in more congested urban areas, where this spectrum is currently used for 3G traffic. In addition to any issues associated with clearing spectrum of 3G traffic, time may be required for planning and deploying any network changes to accommodate the use of this band for 4G services. It is therefore likely that, by the time any operator was in a position to make any material 4G deployment at 2100 MHz, they will already have more extensive 4G deployments in one or more of the 800 MHz, 1800 MHz or 2.6 GHz bands. This will dilute the the impact on competition of liberalising the 2100 MHz band)..

### **Provisional conclusion on competition and consumer issues**

3.23 Our provisional conclusion is that the proposed variations to the 900 MHz, 1800 MHz and 2100 MHz licences to authorise 4G services are likely to result in consumer benefits. As set out above, these benefits are unlikely to be outweighed by consumer detriment that flows from any distortion of competition. In reaching this provisional conclusion, we note in particular the large amounts of liberalised 800 MHz and 2.6 GHz spectrum that will be available as a result of the Combined Award.

3.24 We thus consider that the proposed 900 MHz, 1800 MHz and 2100 MHz licence variations to permit the deployment of 4G technologies are likely to be beneficial to consumers overall.

<sup>21</sup> Indeed, as shown in Figure 1, Telefónica currently has a larger share of spectrum than H3G.

<sup>22</sup> Award Statement, see in particular Figure 4.9 after paragraph 4.219.

## Impact on spectrum management

- 3.25 As explained in section 2 above, we have considered whether varying the relevant licences without delay would be consistent with setting the technical conditions at the minimum necessary to provide adequate protection against harmful interference.
- 3.26 The 900 MHz, 1800 MHz and 2100 MHz licences all permit the use of 3G services at present, subject to an in-band power limit of 62 dBm e.i.r.p. per carrier in the case of the 900 MHz and 1800 MHz licences and 65 dBm e.i.r.p. per carrier in the case of the 2100 MHz licences. We propose that the same in-band power limits (re-expressed in terms of a power limit “per 5MHz”, rather than “per carrier”) would apply to the licences when varied so as to permit 4G use.
- 3.27 By setting the proposed power limits for 4G deployment in a way that is equivalent to permitted UMTS use at each frequency band, we consider that the proposed licence variations to permit 4G use will not adversely affect adjacent users by comparison with the existing position. This is on the basis that, to a first order, the interference potential from UMTS base stations is the same as that from WiMAX or LTE transmitting in an equivalent bandwidth at the same power. Not only is the impact on adjacent users of the in-band power limit equivalent, but:
- for the 900 and 1800 MHz bands, the out-of-band spectrum emission masks are identical for UMTS and for 5, 10, 15 and 20 MHz LTE<sup>23</sup> carriers and there are only minor differences between UMTS and 5 and 10 MHz WiMAX carriers
  - for the 2100 MHz band, a technology neutral block-edge-mask is being applied, hence the out-of-band requirements are identical for UMTS, LTE and WiMAX.

## Overall provisional conclusion

- 3.28 In light of the above considerations, we propose to vary the 2100MHz licences of H3G and Vodafone and the 900MHz and 1800MHz licences of Vodafone so as to permit the use of 4G technology. If we receive formal requests from Telefónica to make equivalent variations to their 900 MHz, 1800 MHz and 2100 MHz licences and / or from EE to make equivalent variations to their 2100 MHz licence, either during this consultation process, or subsequent to it, then we would propose to make the appropriate licence variations in accordance with the decisions we reach following consideration of the responses to this consultation.
- 3.29 In so far as we maintain our provisional conclusion, we would propose to authorise 4G services:
- in the case of the 900 MHz and 1800MHz licences by adding WiMAX and LTE to the permitted technologies in the technical schedule to these licences, as set out in Annex 4;
  - in the case of the 2100 MHz licences by replacing the current technical licence condition with a technology neutral block-edge-mask, as set out in Annex 5.
- 3.30 The in-band power limits applicable to the authorisation of 4G services would be equivalent to the in-band power level for 3G services in the licence concerned.

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<sup>23</sup> Note that 15 and 20 MHz LTE carriers are not included in the current 3GPP specifications for the 900 MHz band

*Question 1: do you agree with the proposal to vary Vodafone's 900 MHz, 1800 MHz and 2100 MHz licences and H3G's 2100 MHz licence so as to permit those frequencies to be used to deploy 4G technologies?*

*Question 2: do you agree with the proposal to vary Telefónica's 900 MHz, 1800 MHz and 2100 MHz licences and EE's 2100 MHz licence so as to permit those frequencies to be used to deploy 4G technologies where we receive formal requests to do so?*

## Section 4

# Increase in the 900 MHz maximum permitted base station transmit power for UMTS and 4G technology

4.1 Towards the end of 2012 we received a request from both Telefónica and Vodafone to vary their 900 MHz licences to increase the maximum permitted base station transmit power for UMTS 900 technology by 3 dB. This would take the current power limit from 62 dBm e.i.r.p. per carrier<sup>24</sup> to 65 dBm e.i.r.p. per carrier. Given the timing of these requests we have combined this consultation on this power increase at 900 MHz (as set out in this section 4) with the consultation on the variation of the existing MNO licences to permit 4G (as set out in section 3). In the event that the 900 MHz licences are varied to permit the use of 4G technology then a higher power limit would apply to the use of 4G technology as well as to the use of 3G technology, as explained below.

## Impact on competition

4.2 As explained in section 2 above, we have considered whether the likely benefits to consumers from varying the 900 MHz licences to increase the maximum permitted base station transmit power are likely to be outweighed by negative effects on consumers as a result of a reduction in competition.

## Potential Benefits for consumers

4.3 There are a number of benefits that an increase in power could bring for an operator in providing service to consumers, for instance:

- improving coverage and capacity;
- improving the ability to penetrate deep into buildings; and
- providing flexibility to match coverage and hence efficiently handover between network layers operating at different frequencies.

4.4 We understand that base stations, for the most part, operate at lower power than the maximum transmit powers contained in the licences (see, for example, data on the Sitefinder database). This reflects the fact that the base station transmit power is one of the key parameters used when optimising network performance. Its optimal level will vary from site to site dependant a number of factors including cell size, site distribution and traffic loading. Allowing a higher maximum permitted base station transmit power will give operators greater flexibility to organise their networks to meet customer demands and expectations.

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<sup>24</sup> UMTS carriers use a nominal frequency separation of 5 MHz but operators have the option to squeeze carriers together (at the expense of overall performance) if there is a need – potentially down to 4.4 MHz.

- 4.5 To the extent that the additional flexibility provided by the increase in maximum permitted base station transmit power enables the operators to provide improved quality of service and / or reduce the cost of providing a given level of service, then we consider that this will lead to consumer benefits over time.

### Competition considerations

- 4.6 The 900 MHz licence holders, Telefónica and Vodafone, and their customers, are likely to benefit from the additional flexibility provided by an increase in maximum permitted base station transmit power at 900 MHz. Compared to the situation where the power limit remains unchanged, the maximum power increase potentially raises the attractiveness of these operators' services, (through improved service and / or lower prices), relative to other mobile operators. The mechanism by which this could potentially harm competition, and ultimately consumers, is the same as that discussed in section 3 above, in the context of liberalisation to permit the use of 4G services.
- 4.7 However, the magnitude of any effects from increasing the maximum power limit by 3dB are, in our view, likely to be smaller than the magnitude of any effects from liberalising licences to allow the deployment of newer generations of mobile technology (moving from 2G to 3G or from 3G to 4G).<sup>25</sup> Thus, in light of the advice we gave to the Secretary of State in the context of the 3G variations for the 900 MHz and 1800 MHz licences, and in light of decision we reached to vary EE's 1800 MHz licence to permit 4G use (together with our provisional conclusions in section 3 that liberalisation of the 900 MHz, 1800 MHz and 2100 MHz licences is likely to be beneficial to consumers overall), we consider that the increase in the maximum permitted base station transmit power at 900 MHz by 3dB is unlikely to distort competition in a way that harms consumers.

## Impact on spectrum management

### Technical analysis

- 4.8 In Annex 6 we present the results of an assessment of the potential risk of interference to systems operating in neighbouring spectrum bands from the requested power increase for 3G. Given that section 3 is consulting on the proposal to vary the 900 MHz licences so as to permit use of 4G technology, Annex 6 also considers the impact of an equivalent maximum permitted base station transmit power for WiMAX and LTE technologies in the 900 MHz band (65 dBm e.i.r.p. per 5 MHz).
- 4.9 The provisional conclusions of this analysis are as follows:
- we believe that there is unlikely to be a significant increase in the interference environment experienced by existing systems operating in neighbouring spectrum bands if we allow the requested 3 dB increase in the maximum permitted base station transmit power for UMTS systems licensed for use in the 925.1 -959.9 MHz band (65 dBm e.i.r.p. per carrier);
  - we also believe that there is unlikely to be a significant increase in the interference environment experienced by existing systems operating in neighbouring spectrum bands if we allow LTE and WiMAX technologies to operate in the 900 MHz band at an equivalent maximum permitted base station transmit power (65 dBm e.i.r.p. per 5 MHz).

<sup>25</sup> This applies to both the positive effects for consumers of this change as any potential negative impacts on competition.

## International comparisons

- 4.10 We have made enquiries with a number of European countries to ask whether they limit base station transmit power. Germany, Portugal, and Finland, do not have a specific maximum base station transmit power limit stated in their 3G licences (including the 900MHz licences). Sweden set a base station transmit power limit of 68 dBm / 5 MHz which is higher than the maximum permitted base station transmit power we are proposing here.

## Emissions from cellular base stations

- 4.11 Emissions near to mobile phone base stations have been consistently found to be only a small fraction of the safety levels for exposure published by the UK Health Protection Agency<sup>26</sup> which refer to levels set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). No installation tested by us has exceeded 0.5% of the specified emission safety level (i.e. the highest measurement was still a factor of 200 times smaller than the ICNIRP limit) and in recent years the results<sup>27</sup> have been consistently found to be significantly less than this.
- 4.12 The proposed increase in the maximum permitted base station transmit power of 3 dB (which represents a doubling in maximum permitted power), results in a similar maximum permitted base station transmit power as granted for licences in the 2100 MHz band following consultation on a variation request in 2009, is therefore unlikely to make a material change in this position.

## Provisional conclusions

- 4.13 In light of the above considerations, subject to considering responses to this consultation, we propose to vary Telefónica and Vodafone's 900 MHz licences to increase the maximum permitted base station transmit power for UMTS by 3dB from 62 dBm e.i.r.p. per carrier to 65 dBm e.i.r.p. per carrier.

*Question 3: do you agree with the proposal to vary the 900 MHz licences to increase the maximum power limit for UMTS by 3dB from 62 dBm e.i.r.p. per carrier to 65 dBm e.i.r.p. per carrier?*

<sup>26</sup> <http://stakeholders.ofcom.org.uk/sitefinder/audit-info>

<sup>27</sup> <http://stakeholders.ofcom.org.uk/sitefinder/mobile-base-station-audits/>

## Section 5

# Other proposed changes to the 900 MHz, 1800 MHz and 2100 MHz licences

- 5.1 We are taking this opportunity to consult on a number of other “housekeeping” changes to the licences (i.e. of a more administrative nature). We are proposing to time-limit the applicability of the 80% coverage obligation in the 2100 MHz licence, given that a new 90% coverage obligation will take effect in June 2013. In addition, we consider that it would be desirable to align the terms and conditions in the existing licences (which were drafted many years ago) more closely with the terms and conditions in the licences that will be awarded in the 800 MHz and 2.6 GHz spectrum.
- 5.2 We note that these changes require the consent of the licensees.<sup>28</sup>

## The 80% coverage obligation in 2100 MHz licences

- 5.3 The 2100 MHz (3G) licences awarded by auction in 2000 contained a condition requiring the provision of a Communication Service covering, from 31 December 2007, an area where 80% of the UK population live. All 2100 MHz licensees have exceeded this requirement with their network deployments at 2100 MHz.
- 5.4 The 2100 MHz licences of all four MNOs have been varied (over the past 18 months) in a way that introduces a new obligation to cover, from June 2013, 90% of the population with 90% probability of at least 768kbps outdoors in a lightly loaded cell. In order to meet this new 90% coverage obligation, the licensees can use any spectrum available to them (e.g. using spectrum held via other licences in the 800 MHz, 900 MHz, 1800 MHz or 2.6 GHz bands as well as spectrum in the 2100 MHz band itself) even though the obligation itself is located in the 2100 MHz licences. The inclusion of this flexibility (to meet the obligation using any frequency bands) in the new 90% coverage obligation reflects a deliberate policy to allow the MNOs to meet the obligation in the most efficient way.
- 5.5 We believe that there will be no practical consumer benefit in retaining the original 80% coverage obligation once the new 90% coverage obligation comes into effect. Moreover, the only practical significance of the 80% obligation post June 2013 is that it could constrain the flexibility of the MNOs to optimise their provision of services to customers using a combination of different frequency bands; it could therefore prevent a reduction in the cost of service provision, the benefit of which should be passed to consumers in due course in a competitive market. The reason for this is that the wording of the 80% coverage obligation requires that it is met by using radio equipment that operates at 2100 MHz (something that made sense when the 2100 MHz band was the only way in which a non 2G data service could be provided). For example, this constraint would prevent the MNOs from scaling back UMTS 2100 deployment and meeting the 90% coverage obligation using UMTS 900 or LTE in other bands such as 800 MHz, 900 MHz, 1800 MHz or 2.6 GHz.
- 5.6 We propose therefore that the 80% coverage requirement in the 2100 MHz licences should cease to apply after 30 June 2013 when the new 90% obligation comes into effect.

<sup>28</sup> Although Ofcom may give 5 years' notice of these changes in writing for spectrum management reasons (such notice not to be given before 31<sup>st</sup> December 2016 in the case of the 2100 MHz licences)



## Closer alignment of terms and conditions across mobile licences

- 5.7 From a spectrum management perspective we consider that it would be desirable to align the terms and conditions in the existing licences more closely with the terms and conditions in the new licences that will be awarded in the 800 MHz and 2.6 GHz spectrum. We would not expect these changes to have any significant practical impact on the licensees (nor do we consider that they constitute any substantive change to the existing licence conditions). The proposed changes that are necessary to achieve this are shown as tracked changes in annexes 4 and 5. We comment briefly on a number of the changes.

### Direction from Secretary of State

- 5.8 A new clause 3 (d) would clarify that, notwithstanding terms contained within a licence, Ofcom could be obliged to revoke or vary any licences(s) if so Directed by the Secretary of State. Including this within the licence (also consistent with the terms of licences for the award at 800 MHz and 2.6 GHz) is thus not imposing a new requirement but is instead explicitly stated in the licence for the avoidance of doubt.

### Clarification of geographic coverage

- 5.9 The current 900 MHz, 1800 MHz and 2100 MHz licences make no reference to their geographic extent other than to state that they do not extend to the Channel Islands or to the Isle of Man. Wording is therefore proposed (in the template licences in annexes 4 and 5) which states explicitly that the area covered is the United Kingdom including its territorial sea, again consistent with the terms of licences for award at 800 MHz and 2.6 GHz. We consider that this would make the current extent of the licences more explicit on the face of those licences.

### Keeping of information

- 5.10 The wording in paragraph 3(a) of current licences was formulated some 20 years ago and is therefore less precise than information now typically held by operators. In particular, we understand that licensees already keep information to a 1m resolution; if so, then this alignment with the equivalent condition in the Combined Award licences should place no burden on the licensees and can be considered a housekeeping change (noting also that Ofcom has powers to request information to this level of accuracy anyway).

*Question 4: do you agree with the changes proposed in this section?*

## Section 6

# Next Steps

- 6.1 Following consideration of comments from stakeholders we plan publish our decision on the proposed variation of 900 MHz, 1800 MHz and 2100 MHz licences.
- 6.2 The variation will then be available on request to any licensee within these bands, at any time and without the need for further consultation.
- 6.3 Our provisional timetable is:

	<b>Date</b>
Publication of consultation on liberalisation proposals	1 February 2013
Consultation closes	29 March 2013
Publish statement of our decision	Q2 2013

## Annex 1

# Responding to this consultation

## How to respond

- A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 29 March 2013**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <https://stakeholders.ofcom.org.uk/consultations/variation-900-1800-2100/howtorespond/form>, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.
- A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please email [cliff.mason@ofcom.org.uk](mailto:cliff.mason@ofcom.org.uk) attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A1.4 Responses may alternatively be posted or faxed to the address below, marked with the title of the consultation.
- Cliff Mason  
Spectrum Policy Group  
Authorisations Team  
Riverside House  
2A Southwark Bridge Road  
London SE1 9HA
- Fax: 020 7981 3333
- A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.
- A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 7. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

## Further information

- A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Cliff Mason on 020 7783 4353.

## Confidentiality

- A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk), ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.
- A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at <http://www.ofcom.org.uk/about/accoun/disclaimer/>

## Next steps

- A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in Q2 2013.
- A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: [http://www.ofcom.org.uk/static/subscribe/select\\_list.htm](http://www.ofcom.org.uk/static/subscribe/select_list.htm)

## Ofcom's consultation processes

- A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.
- A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at [consult@ofcom.org.uk](mailto:consult@ofcom.org.uk) . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell  
Ofcom  
Riverside House  
2a Southwark Bridge Road  
London SE1 9HA

Tel: 020 7981 3601

Email [Graham.Howell@ofcom.org.uk](mailto:Graham.Howell@ofcom.org.uk)

## Annex 2

# Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

### Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. 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

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 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 to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

### After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

## Annex 3

# Consultation response cover sheet

- A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk).
- A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.
- A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.
- A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at [www.ofcom.org.uk/consult/](http://www.ofcom.org.uk/consult/).
- A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

## Cover sheet for response to an Ofcom consultation

### 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	<input type="checkbox"/>	Name/contact details/job title	<input type="checkbox"/>
Whole response	<input type="checkbox"/>	Organisation	<input type="checkbox"/>
Part of the response	<input type="checkbox"/>	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)

**Annex 4**

# Template 900 MHz / 1800 MHz licence





[Name of Licensee] – Template 900/1800 MHz Licence  
Company registration number: xxxxxx  
First issued: xx xxxx xxxx – Licence Number: xxxxx

## Wireless Telegraphy Act 2006 Office of Communications (Ofcom)

### PUBLIC WIRELESS NETWORK LICENCE

This Licence replaces the Licence issued by the Office of Communications (Ofcom) on [date] to [Company Name]

Licence no. **XXXXX**  
Date of issue: **[DATE]**  
Fee payment date: **[DATE]** (annually)

1. The Office of Communications (Ofcom) grants this wireless telegraphy licence ("the Licence") to

**[Company Name]**  
(Company registration number xxxxxxx)  
("the Licensee")  
**xxxxxxxxxxx**  
**xxxxxxxxxxx**  
**xxxxxxxxxxx**  
**xxxxxxx**

to establish, install and use ~~radio transmitting and receiving~~ wireless telegraphy stations and/or ~~radio~~ wireless telegraphy apparatus as described in the ~~s~~Schedule(s) to this Licence (~~herein after~~ together ~~called~~ "the Radio Equipment") subject to the terms, set out below.

### Licence Term

2. This Licence shall continue in force until revoked by Ofcom or surrendered by the Licensee.

### Licence Variation and Revocation

3. Pursuant to Schedule 1 paragraph (8) of the Wireless Telegraphy Act 2006 ("the ~~2006~~ Act"), Ofcom may not revoke or vary this Licence under Schedule 1 paragraph (6) of the ~~2006~~ Act ~~save at the request or with the consent of the Licensee~~ except:
  - (a) ~~in accordance with clause 6 of this Licence;~~
  - (b) ~~in accordance with Schedule 1 paragraph 8(5) of the 2006 Act;~~

- ~~(c) for reasons related to the management of the radio spectrum, provided that in such case the power to revoke may only be exercised after five years notice is given in writing and after Ofcom has considered any pertinent factors;~~
  - ~~(d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of Regulations made by Ofcom under the powers conferred by section 30(1) and (3) of the Act<sup>29</sup>~~
  - ~~(e) if there has been a breach of any of the terms of this Licence or the schedule(s) hereto.~~
  - (a) at the request, or with the consent, of the Licensee;
  - (b) if there has been a breach of any of the terms of this Licence;
  - (c) in accordance with Schedule 1 paragraph 8(5) of the Act;
  - (d) if it appears to Ofcom to be necessary or expedient to revoke or vary the licence for the purpose of complying with a direction by the Secretary of State given to Ofcom under Section 5 of the Act or Section 5 of the Communications Act 2003;
  - (e) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of regulations made by Ofcom under the powers conferred by section 30(1) and 30(3) of the Act<sup>29</sup>;
  - (f) for reasons related to the management of the radio spectrum, provided that in such a case the power to revoke may only be exercised after at least five years' notice is given in writing and after Ofcom has considered any pertinent factors.
4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Schedule 1 paragraphs 6, 6A and 7 of the Act.

## ChangesTransfer

5. This Licence may not be transferred. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30 of the Act.<sup>30</sup>

## Changes to Licensee details

6. The Licensee must give prior ~~or immediate~~ notice to Ofcom in writing of any change in the details of the name and/or address recorded in paragraph 1 of this licence.

<sup>29</sup> These are regulations on spectrum trading.

<sup>30</sup> See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

## Fees

7. The Licensee shall each year pay to Ofcom the relevant fee(s) as provided in section 12 of the ~~2006~~-Act and the ~~R~~regulations made thereunder on or before the fee payment date shown above ~~each year~~, or on or before such dates as shall be notified in writing to the Licensee, ~~failing which Ofcom may revoke this Licence.~~

## Radio Equipment Use

8. The Licensee ~~must~~ shall ensure that the Radio Equipment is ~~constructed~~ established, installed and used only in accordance with the provisions specified in Schedule 1 of this Licence. Any proposal to amend any detail specified in Schedule 1 of this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.
9. The Licensee must ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.

## Access and Inspection

10. The Licensee shall permit a person authorised by Ofcom:
  - (a) to have access to the Radio Equipment; and
  - (b) to inspect this Licence and to inspect, examine and test the Radio Equipment,at any and all reasonable times or, when in the opinion of that person an urgent situation exists, at any time to ensure the Radio Equipment is being used in accordance with the terms of this Licence.

## Modification, Restriction and Closedown

11. A person authorised by Ofcom may require the Radio Equipment, or any part thereof, to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:
  - (a) a breach of this Licence has occurred; and/or
  - (b) the use of the Radio Equipment is causing or contributing to undue interference to the use of other authorised radio equipment.

12. Ofcom may ~~in the event of a national or local state of emergency being declared~~ require the Radio Equipment to be modified or restricted in use, or temporarily or permanently closed down either immediately or on the expiry of such period as ~~Ofcom may specify~~ may be specified in the event of a national or local state of emergency being declared. Ofcom ~~shall~~ may exercise this power by a written notice served on the Licensee or by a general notice applicable to holders of this class of Licence.

## Geographical Boundaries

13. ~~This Licence does not authorise the establishment and use of the Radio Equipment on the Isle of Man or any of the Channel Islands.~~ Subject to the requirements of any coordination procedures notified to the Licensee pursuant to paragraphs 5 and 6 of Schedule 1 to this Licence, the Licensee is authorised to establish, install and use the Radio Equipment in the United Kingdom. For the avoidance of doubt, the United Kingdom includes the United Kingdom territorial sea (measured in accordance with section 1 of the Territorial Sea Act 1987) and does not include the Channel Islands or the Isle of Man.

## Interpretation

14. In this Licence:
- (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of wireless telegraphy stations and installation and use of wireless telegraphy apparatus for wireless telegraphy as specified in section 8(1) of the ~~2006~~ Act;
  - (b) the expression "interference" shall have the ~~same~~ meaning ~~that it has under given by section 115 of the 2006 Act (Section 115)~~;
  - (c) ~~the expression "inspect" includes examine and test~~ the expressions "wireless telegraphy station" and "wireless telegraphy apparatus" shall have the meanings given by section 117 of the Act;
  - (d) the schedule forms part of this Licence together with any subsequent schedule(s) which Ofcom may issue as a variation to this Licence ~~at a later date~~; and
  - (e) the Interpretation Act 1978 shall apply to the Licence as it applies to an Act of Parliament.

## Issued by Ofcom

## Office of Communications

SCHEDULE 1 TO LICENCE NUMBER: **XXXXXX**

Licence Category: **Public Wireless Network**

This schedule forms part of licence no **[XXXXXX]**, issued to **[Company name]**, the Licensee on **[Date]**, and describes the Radio Equipment covered by the Licence and the purpose for which the Radio Equipment may be used.

### Description of Radio Equipment Licensed

1. In this Licence, the Radio Equipment means the base transceiver stations or repeater stations forming part of the Network (as defined in paragraph 2 below).

### Purpose of the Radio Equipment

2. The Radio Equipment shall form part of a radio telecommunications network ("the Network"), in which User Stations which meet the appropriate technical performance requirements as set out in the relevant Wireless Telegraphy (Exemption) Regulations made by Ofcom communicate by radio with the Radio Equipment to provide a telecommunications service.

### ~~Approved Standards~~ Interface Requirements for the Radio Equipment

3. ~~Use of the Radio Equipment shall be in accordance with the following covered by this Licence shall comply with the appropriate~~ Interface Requirements:

~~(IR 2014 – Public Wireless Networks; and/or  
IR 2019 – Third Generation Mobile; and/or  
IR 2087 – 900 / 1800 MHz LTE and WiMAX;)~~

or for equipment placed on the market before 8 April 2000, is required to be type approved in accordance with a recognised technical performance standard relating to the service licensed.

### Special Conditions relating to ~~the Operation of~~ the Radio Equipment

4.
  - (a) Subject to paragraph 4(b) of this Schedule, During the period that this Licence remains in force ~~and for 6 months thereafter, unless consent has otherwise been given by Ofcom,~~ the Licensee shall compile and maintain accurate written records of: ~~(i) — T~~he following details relating to the Radio Equipment:
    - i) postal address (including post code);
    - ii) National Grid Reference, ~~(to at least 100 Mmetres resolution)~~;

- iii) antenna height (~~AGL~~above ground level) and type, and boresight east of true north (if applicable); and
- iv) radio frequencies which the Radio Equipment uses;  
~~(ii) a statement of the number of subscribing customers using the Network;~~

and the Licensee must produce these above records when if requested by a person authorised by Ofcom ~~requires him to do so.~~

- (b) ~~In respect of femtocell equipment and smart/intelligent low power repeater equipment,~~ The conditions relating to the keeping of records contained in subparagraphs 4(a)i), 4(a)ii) and 4(a)iii), shall not apply in respect of femtocell equipment and smart/intelligent low power repeater equipment.

~~(c) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph (a) above shall be kept.~~

- (c) The Licensee ~~must~~shall submit to Ofcom copies of the records detailed in sub-paragraph (a) above at such intervals as Ofcom shall notify to the Licensee.

~~(d) The Licensee shall, upon request, supply Ofcom or any person authorised on their behalf with the name and address of any subscribing customers to the Network, or require its agents to provide such information on its behalf.~~

**Co-ordination at Frequency and Geographical Boundaries and Compliance with Other Procedures Relating to Interference**  
**TECHNICAL PERFORMANCE REQUIREMENTS**

- 5. The Licensee shall ensure that the Radio Equipment ~~shall be~~is operated in compliance with such co-ordination and sharing procedures as may be ~~considered necessary and~~ notified to the Licensee by Ofcom from time to time ~~(formerly the Radiocommunications Agency).~~

**International Cross-Border Coordination**

- 6. The Licensee shall ensure that the Radio Equipment is operated in compliance with such cross-border co-ordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time.

~~The Licensee must ensure that the Radio Equipment performs in accordance with the following technical performance requirements.~~

**Permitted Frequency Blocks ~~ies~~ of Operation**

- 7. The Radio Equipment may ~~operate on any of the~~ only transmit on downlink frequencies within the following frequency bands (the Permitted Frequency Blocks):

<b>Downlink frequencies</b>	<b>Uplink frequencies</b>
[880 – 915 MHz]	[925 – 960 MHz]
[1710 – 1785 MHz]	[1805 – 1880 MHz]

~~Base Transmit / Base Receive /  
Mobile Receive Mobile Transmit~~

~~[Insert frequency bands] MHz [Insert frequency bands] MHz~~

~~[Insert frequency bands] MHz [Insert frequency bands] MHz~~

## **Radio Frequency Carrier Spacing**

8. In the absence of bilateral or multilateral agreements which have been notified to Ofcom specifying alternative arrangements between the licensee and the licensee(s) of neighbouring networks the licensee must ensure that in respect of the frequencies set out at paragraph 6 of this schedule:
- the centre frequency of any of their GSM carriers is 100 kHz or more inside any edge of their permitted frequency ~~blocks bands~~; and
  - the centre frequency of any of their UMTS carriers is 2.7 MHz or more inside any edge of their permitted frequency ~~blocks bands~~ where a neighbouring licensee has deployed a GSM carrier or carriers (including GSM-R) in the immediately adjacent spectrum; and
  - the centre frequency of any of their UMTS carriers is 2.5 MHz or more inside any other edge of their permitted frequency ~~blocks bands~~.
  - ~~the channel edge of any of their LTE carriers does not extend beyond their permitted frequency blocks;~~
  - ~~the channel edge of any of their WiMAX carriers is 200 kHz or more inside any edge of their permitted frequency blocks where a neighbouring licensee has deployed a GSM carrier or carriers (including GSM-R) in the immediately adjacent spectrum; and~~
  - ~~the channel edge of any of their WiMAX carriers does not extend beyond their permitted frequency blocks.~~

## **ITU Class of Emission**

9. For GSM:	271KG7W
For UMTS:	5M00D7W
<del>For 1.4 MHz LTE:</del>	<del>1M40D7W</del>
<del>For 3 MHz LTE:</del>	<del>3M00D7W</del>
<del>For 5 MHz LTE:</del>	<del>5M00D7W</del>
<del>For 10 MHz LTE:</del>	<del>10M0D7W</del>
<del>For 15 MHz LTE:</del>	<del>15M0D7W</del>
<del>For 20 MHz LTE:</del>	<del>20M0D7W</del>
<del>For 5 MHz WiMAX:</del>	<del>5M00D7W</del>
<del>For 10 MHz WiMAX:</del>	<del>10M0D7W</del>

## Maximum Permissible Downlink Transmit Power e.i.r.p.

10. The power transmitted (in e.i.r.p.) in any direction on the downlink frequencies of the Permitted Frequency Blocks by the Radio Equipment shall not exceed:

<u>Technology</u>	<u>900 MHz spectrum</u>	<u>1800 MHz spectrum</u>
<u>for GSM</u>	<u>62 dBm per carrier</u>	<u>62 dBm per carrier</u>
<u>for UMTS</u>	<u>65 dBm per carrier</u>	<u>62 dBm per carrier</u>
<u>for LTE</u>	<u>65 dBm per 5 MHz</u>	<u>62 dBm per 5 MHz</u>
<u>for WiMAX</u>	<u>65 dBm per 5 MHz</u>	<u>62 dBm per 5 MHz</u>

The maximum e.i.r.p. per carrier for GSM is **32 dBW**.

The maximum e.i.r.p. per carrier for UMTS is **32 dBW**.

## Interpretation

11. In this Schedule:

- (a) “900 MHz spectrum” means frequencies in the range 880 MHz to 915 MHz paired with 925 MHz to 960 MHz;
- (b) “1800 MHz spectrum” means frequencies in the range 1710 MHz to 1785 MHz paired with 1805 MHz to 1880 MHz;
- (c) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt);
- (d) “e.i.r.p.” means the effective isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- (e) “A femtocell” is a base station of the Network means Radio Equipment transmitting on the downlink frequencies, which operates at a power not exceeding 20dBm e.i.r.p. per carrier which may be established by customers of the Network but which is or will be used only by and under the control of the Network, following the establishment of a telecommunications link between the femtocell and the Network;
- (f) “GSM system” means an electronic communications network that complies with GSM standards, as published by ETSI, in particular EN 301 502 and EN 301 511 and “GSM” means pertaining to such a network or its Radio Equipment;
- (g) “GSM-R” means the variant of GSM for railways as specified in IR2064;
- (h) "IR" means a United Kingdom Radio Interface Requirement published by Ofcom in accordance with Article 4.1 of Directive 1995/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment (RTTE) and the mutual recognition of their conformity.
- (i) "ITU" means the International Telecommunications Union, and "Class of Emission" shall have the meaning as defined in the ITU Radio Regulations Appendix 1.



- (j) “LTE system” means an electronic communications network that complies with the LTE standards as published by ETSI, in particular EN 301 908-1, EN 301 908-13, EN 301 908-14, EN 301 908-15 and EN 301 908-11 and “LTE” means pertaining to such a network or its Radio Equipment;
- (k) “Permitted Frequency Blocks” has the same meaning given to it in paragraph 6 of this Schedule;
- ~~(g) “RF” means Radio Frequency;~~
- (l) "User Station" means any vehicle mounted or hands portable mobile station designed for mobile use and/ or any station designed or adapted to be established and used from static locations which meet the appropriate technical performance requirements as set out in the Wireless Telegraphy (Exemption) Regulations and either complies with the appropriate Interface Regulation listed in paragraph 3, or for equipment placed on the market before 8 April 2000, is type approved in accordance with a recognised technical standard relating to the service licensed.
- ~~(i) “A femtocell” is a base station of the Network which operates at a power not exceeding 20dBm e.i.r.p. per carrier which may be established by customers of the Network but which is or will be used only by and under the control of the Network, following the establishment of a telecommunications link between the femtocell and the Network;~~
- (m) A “smart/intelligent low power repeater” ~~is means~~ a repeater ~~of the Network~~ which operates with power not exceeding 24dBm e.i.r.p. per carrier, which may be established by customers of the Licensee Network who have written agreements with the Licensee and:
- The Licensee has ultimate control of the repeater, i.e. each individual repeater can be disabled remotely by the Licensee;
  - The repeater operates only on the Licensee’s frequencies and with their valid Public Land Mobile Network Identifier;
  - Must not cause undue interference to other spectrum users; and
  - The repeater only transmits on the Licensee’s Base Receive frequencies when actively carrying a call (voice, video or data) or signalling from serviced handsets.
- ~~(k) “GSM system” means an electronic communications network that complies with GSM standards, as published by ETSI, in particular EN 301 502 and EN 301 511 and “GSM” means pertaining to such a network or its Radio Equipment;~~
- ~~(l) “GSM-R” means the variant of GSM for railways as specified in IR2064; and~~
- (n) “UMTS system” means an electronic communications network that complies with the UMTS standards as published by ETSI, in particular EN 301 908-2, EN 301 908-3 and EN 301 908-11 and “UMTS” means pertaining to such a network or its Radio Equipment; and

- (o) “WiMAX system” means an electronic communications network that complies with the WiMAX standards as published by ETSI, in particular EN 301 908-1, EN 301 908-21 and EN 301 908-22 and “WiMAX” means pertaining to such a network or its Radio Equipment.

**Ofcom**

## **Annex 5**

# **Template 2100 MHz licence**



[Name of Licensee] – Template 2100 MHz Licence  
Company registration number: xxxxxx  
First issued: xx xxxx xxxx – Licence Number: xxxxx

**Office of Communications (Ofcom)  
Wireless Telegraphy Act 2006**

**THIRD-GENERATION MOBILE SPECTRUM ACCESS 2100 MHz LICENCE**

This Licence replaces the licence issued by the Office of Communications (Ofcom) on [date] to [Company Name].

Licence no: **xxxxxx**  
Date of issue: **[DATE]**  
Fee payment date **1 January (annually)**  
(from 1 January 2022)

1. The Office of Communications (Ofcom) grants this wireless telegraphy Licence authorises ("the Licence") to

**[Company Name]**  
(Company registration number xxxxxxx)  
("the Licensee")  
xxxxxxxxxxxx  
xxxxxxxxxxxx  
xxxxxxxxxxxx  
xxxxxx

to establish, install and use ~~radio transmitting and receiving~~ wireless telegraphy stations and/or ~~radio~~ wireless telegraphy apparatus as described in the ~~s~~Schedule(s) to this Licence (~~herein after~~ together ~~called~~ "the Radio Equipment") subject to the terms, set out below.

**Licence Term**

2. This Licence shall continue in force until revoked by Ofcom or surrendered by the Licensee.

**Licence Variation and Revocation**

3. (1) Pursuant to Schedule 1 paragraph (8) of the Wireless Telegraphy Act 2006 ("the ~~2006~~ Act"), Ofcom may not revoke or vary this Licence under Schedule 1 paragraph (6) of the ~~2006~~ Act ~~save at the request or with the consent of the Licensee~~ except:

(a) ~~in accordance with clause 7 of this Licence;~~

- ~~(b) in accordance with Schedule 1 paragraph 8(5) of the 2006 Act;~~
  - ~~(c) for reasons related to the management of the radio spectrum, provided that in such a case the power to revoke may only be exercised after five years' notice is given in writing and after Ofcom has considered any pertinent factors (such notice not to be given before 31 December 2016);~~
  - ~~(d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of regulations made by Ofcom under the powers conferred by section 30(1) and (3) of the 2006 Act<sup>31</sup>;~~
  - ~~(e) if there has been a material breach of any of the terms of this Licence or the schedules(s) hereto;~~
  - (a) at the request, or with the consent, of the Licensee;
  - (b) if there has been a breach of any of the terms of this Licence;
  - (c) in accordance with Schedule 1 paragraph 8(5) of the Act;
  - (d) if it appears to Ofcom to be necessary or expedient to revoke the licence for the purpose of complying with a direction by the Secretary of State given to Ofcom under Section 5 of the Act or Section 5 of the Communications Act 2003;
  - (e) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of regulations made by Ofcom under the powers conferred by section 30(1) and 30(3) of the Act<sup>31</sup>;
  - (f) for reasons related to the management of the radio spectrum, provided that in such a case the power to revoke may only be exercised after at least five years' notice is given in writing and after Ofcom has considered any pertinent factors (such notice not to be given before 31 December 2016).
- (2) In the period before 31 December 2021, pursuant to Schedule 1 paragraph 8(1) of the 2006 Act, Ofcom may not vary this Licence under Schedule 1 paragraph 6 of the 2006 Act save at the request or with the consent of the Licensee except:
- (a) in the circumstances specified in paragraphs (b), (c) and (d) of subparagraph (1) of the paragraph; or
  - (b) in relation only to paragraphs 7 and 8 of Schedule 1, if Ofcom has reasonable grounds for concluding that use of the Radio Equipment in accordance with either or both of these paragraphs is causing, or is likely to cause, undue interference to other authorised radio equipment.

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<sup>31</sup> These are regulations on spectrum trading.

4. After 31 December 2021, Ofcom may only vary this Licence by notification in writing to the Licensee and in accordance with [Schedule 1](#) paragraphs 6, [6A](#) and 7 ~~of Schedule 1~~ of the [2006](#) Act.

## **Transfer Changes**

5. This Licence may not be transferred. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30 of the [2006](#)-Act<sup>32</sup>.

## **Changes to Licensee details**

6. The Licensee shall give prior ~~or immediate~~ notice to Ofcom in writing of any changes to the ~~details of the~~ Licensee's [name](#) and/or address as recorded in paragraph 1 of this Licence.
7. If the Licence is surrendered or revoked no refund of the fee which was paid by xxxxx Limited whether in whole or in part will be made except at the absolute discretion of the Secretary of State in accordance with regulation 5 of the Wireless Telegraphy (Third Generation Licences) Regulations 1999.

## **Fees**

8. ~~From 1 January 2022, the~~ Licensee shall each year pay [to](#) Ofcom the relevant fee(s) as provided in section 12 of the [2006](#) Act and the regulations made thereunder on or before the fee payment date shown above, or on or before such dates as shall be notified in writing to the Licensee, ~~failing which Ofcom may revoke this Licence.~~
9. The Licensee shall also pay interest to Ofcom on any amount which is due [to Ofcom](#) under the terms of this Licence or provided for in any regulations made by Ofcom under sections 12 and 13(2) of the [2006](#) Act from the date such amount falls due until the date of payment, calculated with reference to the Bank of England base rate from time to time. In accordance with section 15 of the [2006](#) Act any such amount and any such interest is recoverable by Ofcom.
10. If the Licence is surrendered or revoked, no refund, whether in whole or in part of any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 13(2) of the [2006](#) Act will be made, except at the absolute discretion of Ofcom.

## **Penalty**

11. Ofcom may impose a penalty on the Licensee in accordance with section 43A of the [2006](#) Act if the Licensee is or has been in contravention of the provisions specified in [Schedule 1](#) paragraph 4(b) of this Licence.

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<sup>32</sup> See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

## Radio Equipment Use

12. The Licensee shall ensure that the Radio Equipment is constructed and used only in accordance with the provisions specified in Schedule 1 of this Licence. Any proposal to amend any detail specified in Schedule 1 of this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.
13. The Licensee shall ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.

## Access and Inspection

14. The Licensee shall permit a person authorised by Ofcom:
  - (a) to have access to the Radio Equipment; and
  - (b) to inspect this Licence and to inspect, examine and test the Radio Equipment,

at any and all reasonable times or, when in the opinion of that person an urgent situation exists, at any time to ensure the Radio Equipment is being used in accordance with the terms of this Licence.

## Modification, Restriction and Closedown

15. A person authorised by Ofcom may require the Radio Equipment or any part thereof, to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:
  - (a) a ~~material~~ breach of this Licence has occurred; and/or
  - (b) the use of the Radio Equipment is, or may be, causing or contributing to undue interference to the use of other authorised radio equipment.
16. Ofcom may ~~in the event of a national or local state of emergency being declared~~ require any of the Radio Equipment to be modified or restricted in use, or temporarily ~~or permanently~~ closed down either immediately or on the expiry of such period as ~~Ofcom~~ may be specified in the event of a national or local state of emergency being declared. Ofcom ~~shall~~ may only exercise this power ~~by~~ after a written notice has been served on the Licensee or by a general notice applicable to holders of this class of Licence has been published.

## Geographical Boundaries

17. ~~This Licence does not authorise the establishment and use of the Radio Equipment on the Isle of Man or any of the Channel Islands. Subject to the requirements of any coordination procedures notified to the Licensee pursuant to paragraphs 5 and 6 of Schedule 1 to this Licence, the Licensee is authorised to establish, install and use the Radio Equipment in the United Kingdom. For the avoidance of doubt, the United Kingdom includes the United Kingdom territorial sea (measured in accordance with section 1 of the Territorial Sea Act 1987) and does not include the Channel Islands or the Isle of Man.~~

## Interpretation

18. In this Licence:
- (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of wireless telegraphy stations and installation and use of wireless telegraphy apparatus for Wireless Telegraphy as specified in section 8(1) of the ~~2006~~ Act;
  - (b) the expression "interference" shall have the ~~same~~ meaning ~~that it has under given by Section 115 of the 2006 Act (Section 115);~~
  - (c) ~~the expression "inspect" includes examine and test~~ the expressions "wireless telegraphy station" and "wireless telegraphy apparatus" shall have the meanings given by section 117 of the Act;
  - (d) the schedules ~~and Annex~~ form part of this Licence together with any subsequent schedule(s) which Ofcom may issue as a variation to this Licence ~~at a later date~~; and
  - (e) the Interpretation Act 1978 shall apply to the Licence as it applies to an Act of Parliament.

## Issued by Ofcom

## Office of Communications



SCHEDULE 1 TO LICENCE NUMBER: **xxxxxxx**

~~Schedule date: xx xxxx 2012~~

Licence ~~Category~~class: **Third-Generation Mobile Spectrum Access Licence (2100 MHz – Paired Spectrum)**

~~Schedule date: xx xxxx 2012~~

~~This schedule forms part of Licence no. xxxxxxx, issued to xxxxxx Limited (“the Licensee”) on xx xxxxxx 2012.~~

## Description of Radio Equipment Licensed

1. In this Licence, the Radio Equipment means the base transceiver stations or repeater stations forming part of the Network (as defined in paragraph 2 below).

## Purpose of the Radio Equipment

2. The Radio Equipment shall form part of a radio telecommunications network ("the Network"), in which approved user stations communicate by radio with the Radio Equipment to provide a telecommunications service.

## Approved Standards for the Radio Equipment

3. ~~Use of the Radio Equipment shall be in accordance with the following covered by this Licence shall comply with the appropriate~~ Interface Requirements:

~~{IR 2019 – Third Generation Mobile};~~

~~IR 2092 – Terrestrial systems capable of providing electronic communications services in the frequency bands 1920 – 1980 MHz and 2110 – 2170 MHz;~~

or for equipment placed on the market before 8 April 2000, is required to be type approved in accordance with a recognised technical performance standard relating to the service licensed.

## Special Conditions relating to the Radio Equipment

4.
  - (a) The Licensee shall install, maintain and use Radio Equipment (as specified in paragraph 9 of Schedule 1) in such a way as to enable the provision of, by no later than 31 December 2007, and to maintain thereafter, a telecommunications service by means of the Radio Equipment to an area where at least 80% of the population of the UK live. This condition shall cease to have effect from 30 June 2013.

- (b) The Licensee shall by no later than 30 June 2013 provide and thereafter maintain an electronic communications network that is capable of providing mobile telecommunications services to an area within which at least 90% of the population of the United Kingdom lives and with a 90% probability that users in outdoor locations within that area can receive the service with a sustained downlink speed of not less than 768kbps in a lightly loaded cell. Section 43A of the 2006 Act shall apply to any contravention of this provision.
- (c) Subject to paragraph 4(d) of this Schedule, During the period that this Licence remains in force and for 6 months thereafter, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate records of: ~~(i)~~ the following details relating to the Radio Equipment:
- v) postal address (including post code);
  - vi) National Grid Reference, ~~(to at least 100 Metres resolution);~~
  - vii) antenna height (AGL above ground level) and type, and boresight east of true north (if applicable);
  - viii) radio frequencies which the Radio Equipment uses in operation during the Licence term; and

~~(ii) a statement of the number of subscribing customers using the Network;~~

without prejudice to this paragraph (c), the Licensee shall furnish to Ofcom in such a manner and at such times as reasonably requested, information in the form of documents, accounts, estimates, returns and any other information, which may be reasonably required for the purposes of verifying compliance with this Licence and for statistical purposes.

- (d) ~~In respect of femtocell equipment and smart/intelligent low power repeater equipment, the conditions relating to the keeping of records contained in sub-paragraphs 4(c)(i)(a), 4(c)(i)(b) and 4(c)(iii)(e) shall not apply in respect of femtocell equipment and smart/intelligent low power repeater equipment.~~

~~(e) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph (c) above shall be kept.~~

- (e) The Licensee shall submit to Ofcom copies of the records detailed in sub-paragraph 4(c) above at such intervals as Ofcom shall notify to the Licensee.
- (f) The Licensee shall, upon request, supply Ofcom or any person authorised on their behalf with the name and address of any subscribing customers of the Network, or require its agents to provide such information on its behalf.

**Co-ordination at Frequency and Geographical Boundaries and Compliance with Other Procedures Relating to Interference TECHNICAL PERFORMANCE REQUIREMENTS**

The Licensee shall ensure that the Radio Equipment performs in accordance with the following technical requirements:

- 5. The Licensee shall ensure that the Radio Equipment is operated in compliance with such co-ordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time.

**International Cross-Border Coordination**

- 6. The Licensee shall ensure that the Radio Equipment is operated in compliance with such cross-border co-ordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time

**Permitted Frequency Blocks and(s) of Operation**

- 7. Subject to the emissions permitted under paragraph 8 of this Schedule, the Radio Equipment may only transmit within the following frequency bands (the “Permitted Frequency Blocks”):

<b><u>Downlink frequencies</u></b>	<b><u>Uplink frequencies</u></b>
<u>[1920 – 1980 MHz]</u>	<u>[2110 – 2170 MHz]</u>

The Radio Equipment is authorised to operate in the following frequency bands

~~xxxx – xxxx MHz: Base Receive~~

~~xxxx – xxxx MHz: Base Transmit~~

~~xxxx – xxxx MHz: Base Transmit/Receive in Time Division Duplex~~

**Maximum Permissible Transmit Power EIRP**

- 8. The power transmitted in any direction in the Permitted Frequency Blocks by the Radio Equipment shall not exceed:

- (a) Downlink frequencies

	<b><u>Maximum mean e.i.r.p.</u></b>	<b><u>Measurement bandwidth</u></b>
<u>Radio Equipment</u>	<u>65 dBm</u>	<u>5 MHz</u>

- (b) Uplink Frequencies

	<b><u>Maximum mean</u></b>
<u>Mobile or nomadic Radio Equipment</u>	<u>24 dBm TRP</u>
<u>Fixed or installed Radio Equipment</u>	<u>24 dBm e.i.r.p.</u>

- (a) ~~Frequency Division Duplex (FDD)~~

The Radio Equipment in Frequency Division Duplex (FDD) mode, is required to conform with the following EIRP limits:

Maximum EIRP per carrier	Maximum EIRP per MHz
65 dBm	61 dBm/MHz

~~(b) Time Division Duplex (TDD)~~

~~The Radio Equipment in Time Division Duplex (TDD) mode is required to conform with the following EIRP limits:~~

Maximum EIRP per carrier	Maximum EIRP per MHz
62 dBm	58 dBm/MHz

~~(c) Time Division Duplex (TDD) operated in the base receive or base transmit frequency bands~~

***If the Licensee chooses to operate Radio Equipment in Time Division Duplex (TDD) mode in either the base receive or the base transmit frequency band of operation, the EIRP limits for TDD defined in Section 6(b) also apply as a minimum. In addition to this, the Licensee may be required to take additional measures to ensure that deployment of TDD Radio Equipment in the base receive or base transmit frequency band does not cause undue interference to FDD Radio Equipment operated by a neighbouring licensee.***

**ITU Emission Code**

~~9 5M00G7W~~

**Maximum Power outside the Permitted Frequency Blocks**  
**Permissible Out of Block Emissions**

9. For transmissions on the downlink frequencies, the e.i.r.p. emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks shall not exceed the higher (least stringent) of (a) the baseline requirement and (b) the block specific requirements for that frequency;

(a) Frequency Division Duplex (FDD) Baseline Requirements

	<u>Maximum mean e.i.r.p.</u>	<u>Measurement bandwidth</u>
<u>Frequencies spaced more than 10 MHz from the lower or upper block edge</u>	<u>9 dBm</u>	<u>5 MHz</u>

(b) Block-specific requirements

<u>Frequency range</u>	<u>Maximum mean e.i.r.p.</u>	<u>Measurement bandwidth</u>
<u>-10 to -5 MHz from lower block edge</u>	<u>11.0 dBm</u>	<u>5 MHz</u>
<u>-5 to 0 MHz from lower block edge</u>	<u>16.3 dBm</u>	<u>5 MHz</u>
<u>0 to +5 MHz from upper block edge</u>	<u>16.3 dBm</u>	<u>5 MHz</u>
<u>+5 to +10 MHz from upper block edge</u>	<u>11.0 dBm</u>	<u>5 MHz</u>

The baseline and block-specific requirements are defined per antenna and applicable to configurations with up to four antennas per sector.

~~Out of block emissions from the Radio Equipment in Frequency Division Duplex (FDD) mode must not exceed the following:~~

<del>Offset from edge of block</del>	<del>Maximum permitted level</del>	<del>Measurement bandwidth</del>
<del>0 to 0.2 MHz</del>	<del>-14 dBm</del>	<del>30 kHz</del>
<del>0.2 to 1.0 MHz</del>	<del>-14-15(<math>\Delta f^*</math>-0.2) dBm</del>	<del>30 kHz</del>
<del>Beyond 1.0 MHz</del>	<del>-13 dBm</del>	<del>1.0 MHz</del>

~~\*Note:  $\Delta f$  is the offset from the edge of the frequency block in MHz.~~

~~(b) — Time Division Duplex (TDD)~~

~~Out of block emissions from the Radio Equipment in Time Division Duplex (TDD) mode must not exceed the following:~~

<del>Offset from edge of block</del>	<del>Maximum permitted level</del>	<del>Measurement bandwidth</del>
<del>0 to 5 MHz</del>	<del>-23 dBm</del>	<del>1.0 MHz</del>
<del>Beyond 5 MHz</del>	<del>-30 dBm</del>	<del>1.0 MHz</del>

~~(c) — Time Division Duplex (TDD) operated in the base receive or base transmit frequency bands.~~

~~If the Licensee chooses to operate Radio Equipment in Time Division Duplex (TDD) mode in either the base receive or the base transmit frequency bands of operation, the limits for TDD defined in Section 8(b) also apply as a minimum. In addition to this, the Licensee may be required to take additional measures to ensure that deployment of TDD Radio Equipment in the base receive or base transmit frequency band does not cause undue interference to FDD Radio Equipment operated by a neighbouring licensee.~~

### **Relevant Performance Standards**

~~11 — The Radio Equipment is required either to comply with the relevant performance standards applicable at the time of installation or with other requirements in any applicable Interface Requirements, as referred to in article 4.1 of the "Radio Equipment and Telecommunications Terminal Equipment Directive" and issued to the Licensee.~~

~~The current relevant performance standards are:~~

- ~~(a) UK Radio Licence Interface Requirement 2019 - Third Generation Mobile;~~
- ~~(b) ETSI TS 125.104: UTRA (BS) FDD; Radio Transmission and Reception;~~
- ~~(c) ETSI TS 125.105: UTRA (BS) TDD; Radio Transmission and Reception.~~

### **Co-ordination**

~~12 — The Radio Equipment shall be operated in compliance with such co-ordination procedures as are required by any Memorandum of Understanding with another neighbouring administration (including the administrations of the Isle of Man and the Channel Islands) as notified by Ofcom.~~

## Interpretation

10. In this Schedule:

- (a) “2100 MHz paired spectrum” means frequencies in the range 1920 MHz to 1980 MHz paired with 2110 MHz to 2170 MHz;
- (b) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt) is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW);
- (c) “e.i.r.p.” means the effective isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);

~~(a) — “Maximum EIRP per carrier”. The EIRP (effective isotropic radiated power) is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna. The maximum EIRP in any direction from the base station should be below this limit for any transmitted carrier. Power for this limit is defined as the mean modulated carrier power time averaged over any suitable time period in which the transmitter is continuously transmitting at its maximum operational power level;~~

~~(b) — “Maximum EIRP per MHz”. The EIRP per MHz is defined as the sum of the EIRP radiated by all transmitted carriers in any given direction within any contiguous 5 MHz block within an operator’s spectrum allocation, divided by 5;~~

~~(c) — The EIRP per carrier and the EIRP per MHz limits are to be considered separately for any deployment and the more stringent is to be complied with;~~

~~(d) — “Frequency block” means the frequency band of operation of the licensee defined in Section 6 of this Schedule;~~

~~(d) A “femtocell” means Radio Equipment transmitting on the downlink frequencies is a base station of the Network which operates at a power not exceeding 20dBm E.I.R.P. e.i.r.p. per carrier which may be established by customers of the Network but which is or will be used only by and under the control of the Network, following the establishment of a telecommunications link between the femtocell and the Network;~~

(e) “Fixed or installed” means used or installed at specific fixed points;

(f) “IR” means a United Kingdom Radio Interface Requirement published by Ofcom in accordance with Article 4.1 of Directive 1995/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment (RTTE) and the mutual recognition of their conformity;

(g) “lower block edge” means, in relation to the Permitted Frequency Block, the lowest frequency in that Permitted Frequency Block;

(h) “measurement bandwidth” means the size of an individual spectrum segment within the specified frequency range that is used to measure compliance with the specified power limit;

(i) “mobile or nomadic” means intended to be used while in motion or during halts at unspecified points;

(j) “Permitted Frequency Blocks” has the same meaning given to it in paragraph 6 of this Schedule;

~~(e) “Out of block emissions” are defined as Radio Frequency (RF) emissions generated by the system operated by the licensee but radiated into the spectrum adjacent to the licensee’s frequency block;~~

~~(f) “Maximum permitted level” (of out of block emissions) is the maximum power, integrated over the corresponding measurement bandwidth, that may be supplied by the transmitter to the antenna feeder line. Power is defined as the mean RF power time averaged over any suitable time period during which the transmitter is continuously transmitting at its maximum rated power;~~

~~(g) “Frequency Division Duplex (FDD)” operation is defined as bi-directional communication in which one radio frequency carrier is used for transmission and a separate radio frequency carrier is used for reception;~~

~~(h) “Time Division Duplex (TDD)” operation is defined as bi-directional communication using a single radio frequency carrier for transmit and receive, with transmission/reception taking place using discrete time slots;~~

~~(i) “dBm” is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW);~~

~~(j) A “femtocell” is a base station of the Network which operates at a power not exceeding 20dBm E.I.R.P. per carrier which may be established by customers of the Network but which is or will be used only by and under the control of the Network, following the establishment of a telecommunications link between the femtocell and the Network;~~

(k) A “smart/intelligent low power repeater” means is a repeater ~~of the Network~~ which operates with power not exceeding 24dBm E.I.R.P. per carrier, which may be established by customers of the Network who have written agreements with the Licensee and:

- The Licensee has ultimate control of the repeater, i.e. each individual repeater can be disabled remotely by the Licensee;
- The repeater operates only on the Licensee’s frequencies and with their valid Public Land Mobile Network Identifier;
- Must not cause undue interference to other spectrum users; and
- The repeater only transmits on the Licensee’s Base Receive uplink frequencies when actively carrying a call (voice, video or data) or signalling from serviced handsets.

- (l) “TRP” means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere; and
- (m) “upper block edge” means, in relation to the Permitted Frequency Block, the highest frequency in that Permitted Frequency Block.
- (n) “User Station” means any vehicle mounted or hands portable mobile station designed for mobile use and/or any station designed or adapted to be established and used from static locations which meet the appropriate technical performance requirements as set out in the Wireless Telegraphy (Exemption) Regulation in force from time to time and either complies with the appropriate Interface Regulation listed in paragraph 3, or for equipment placed on the market before 8 April 2000, is type approved in accordance with a recognised technical standard relating to the service licensed.

**Ofcom**



SCHEDULE 2 TO LICENCE NUMBER: ~~xxxxxxx~~

~~Schedule date: xx xxxx 2012~~

Licence ~~Category~~class: ~~Third Generation Mobile Spectrum Access Licence (2100 MHz – Unpaired Spectrum)~~

~~Schedule date: xx xxxx 2012~~

~~This schedule forms part of Licence no. xxxxxxx, issued to xxxxxx Limited (“the Licensee”) on xx xxxxxx 2012.~~

## Description of Radio Equipment Licensed

1. In this Licence, the Radio Equipment means the base transceiver stations or repeater stations forming part of the Network (as defined in paragraph 2 below).

## Purpose of the Radio Equipment

2. The Radio Equipment shall form part of a radio telecommunications network ("the Network"), in which approved user stations communicate by radio with the Radio Equipment to provide a telecommunications service.

## Approved Standards for the Radio Equipment

3. ~~Use of the Radio Equipment shall be in accordance with the following covered by this Licence shall comply with the appropriate~~ Interface Requirement:

~~{IR 2019 – Third Generation Mobile};~~

or for equipment placed on the market before 8 April 2000, is required to be type approved in accordance with a recognised technical performance standard relating to the service licensed.

## Special Conditions relating to the Radio Equipment

4.
  - (a) ~~Subject to paragraph 4(b) of this Schedule, During~~ the period that this Licence remains in force ~~and for 6 months thereafter, unless consent has otherwise been given by Ofcom,~~ the Licensee shall compile and maintain accurate records of: ~~(i) —~~ ~~T~~the following details relating to the Radio Equipment:
    - i) postal address ~~(including post code);~~
    - ii) National Grid Reference, ~~(to at least 100 Mmetres resolution);~~

- iii) antenna height (AGL above ground level) and type, and boresight east of true north (if applicable);
- iv) radio frequencies which the Radio Equipment uses in operation during the Licence term; and

~~(ii) a statement of the number of subscribing customers using the Network;~~

without prejudice to this paragraph (a), the Licensee shall furnish to Ofcom in such a manner and at such times as reasonably requested, information in the form of documents, accounts, estimates, returns and any other information, which may be reasonably required for the purposes of verifying compliance with this Licence and for statistical purposes.

(b) ~~In respect of femtocell equipment and smart/intelligent low power repeater equipment, t~~he conditions relating to the keeping of records contained in sub-paragraphs 4(a)(i)(a), 4(a)(ii)(b) and 4(c)(iii)(e) shall not apply in respect of femtocell equipment and smart/intelligent low power repeater equipment.

~~(e) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph (c) above shall be kept.~~

(c) The Licensee shall submit to Ofcom copies of the records detailed in sub-paragraph 4(a) above at such intervals as Ofcom shall notify to the Licensee.

(d) The Licensee shall, upon request, supply Ofcom or any person authorised on their behalf with the name and address of any subscribing customers of the Network, or require its agents to provide such information on its behalf.

## **Co-ordination at Frequency and Geographical Boundaries and Compliance with Other Procedures Relating to Interference**

### **TECHNICAL PERFORMANCE REQUIREMENTS**

~~The Licensee shall ensure that the Radio Equipment performs in accordance with the following technical requirements:~~

- 5. The Licensee shall ensure that the Radio Equipment is operated in compliance with such co-ordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time.

### **International Cross-Border Coordination**

- 6. The Licensee shall ensure that the Radio Equipment is operated in compliance with such cross-border co-ordination and sharing procedures as may be notified to the Licensee by Ofcom from time to time

### **Permitted Frequency Block and(s) of Operation**

- 7. Subject to the emissions permitted under paragraph 8 of this Schedule, the Radio Equipment may only transmit within the following frequency band (the "Permitted Frequency Block"):

[1900 – 1920 MHz]

~~The Radio Equipment is authorised to operate in the following frequency bands~~

~~xxxx – xxxx MHz: Base Receive~~

~~xxxx – xxxx MHz: Base Transmit~~

~~xxxx – xxxx MHz: Base Transmit/Receive in Time Division Duplex~~

## Maximum Permissible EIRP e.i.r.p.

8. For downlink transmissions, the power transmitted (in e.i.r.p.) in any direction in the Permitted Frequency Block by the Radio Equipment shall not exceed:

<u>Maximum EIRP e.i.r.p. per carrier</u>	<u>Maximum EIRP e.i.r.p. per MHz</u>
<u>62 dBm</u>	<u>58 dBm/MHz</u>

~~(a) — Frequency Division Duplex (FDD)~~

~~The Radio Equipment in Frequency Division Duplex (FDD) mode, is required to conform with the following EIRP limits:~~

<del>Maximum EIRP per carrier</del>	<del>Maximum EIRP per MHz</del>
<del>65 dBm</del>	<del>61 dBm/MHz</del>

~~(b) — Time Division Duplex (TDD)~~

~~The Radio Equipment in Time Division Duplex (TDD) mode is required to conform with the following EIRP limits:~~

<u>Maximum EIRP per carrier</u>	<u>Maximum EIRP per MHz</u>
<u>62 dBm</u>	<u>58 dBm/MHz</u>

~~(c) — Time Division Duplex (TDD) operated in the base receive or base transmit frequency bands~~

***If the Licensee chooses to operate Radio Equipment in Time Division Duplex (TDD) mode in either the base receive or the base transmit frequency band of operation, the EIRP limits for TDD defined in Section 6(b) also apply as a minimum. In addition to this, the Licensee may be required to take additional measures to ensure that deployment of TDD Radio Equipment in the base receive or base transmit frequency band does not cause undue interference to FDD Radio Equipment operated by a neighbouring licensee.***

## ITU Class of Emission Code

9. **5M00G7W**

### Maximum Power outside the Permitted Frequency Blocks Permissible Out-of-Block Emissions

10. For transmissions on the downlink frequencies, the e.i.r.p. emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks shall not exceed the following:

(a) ~~Frequency Division Duplex (FDD)~~

~~Out of block emissions from the Radio Equipment in Frequency Division Duplex (FDD) mode must not exceed the following:~~

<del>Offset from edge of block</del>	<del>Maximum permitted level</del>	<del>Measurement bandwidth</del>
<del>0 to 0.2 MHz</del>	<del>-14 dBm</del>	<del>30 kHz</del>
<del>0.2 to 1.0 MHz</del>	<del>-14 -15(<math>\Delta f</math>-0.2) dBm</del>	<del>30 kHz</del>
<del>Beyond 1.0 MHz</del>	<del>-13 dBm</del>	<del>1.0 MHz</del>

~~\*Note:  $\Delta f$  is the offset from the edge of the frequency block in MHz.~~

(b) ~~Time Division Duplex (TDD)~~

~~Out of block emissions from the Radio Equipment in Time Division Duplex (TDD) mode must not exceed the following:~~

<del>Offset from edge of block</del>	<del>Maximum permitted level</del>	<del>Measurement bandwidth</del>
<del>0 to 5 MHz</del>	<del>-23 dBm</del>	<del>1.0 MHz</del>
<del>Beyond 5 MHz</del>	<del>-30 dBm</del>	<del>1.0 MHz</del>

~~(c) ~~Time Division Duplex (TDD) operated in the base receive or base transmit frequency bands.~~~~

~~If the Licensee chooses to operate Radio Equipment in Time Division Duplex (TDD) mode in either the base receive or the base transmit frequency bands of operation, the limits for TDD defined in Section 8(b) also apply as a minimum. In addition to this, the Licensee may be required to take additional measures to ensure that deployment of TDD Radio Equipment in the base receive or base transmit frequency band does not cause undue interference to FDD Radio Equipment operated by a neighbouring licensee.~~

### **Relevant Performance Standards**

~~11 The Radio Equipment is required either to comply with the relevant performance standards applicable at the time of installation or with other requirements in any applicable Interface Requirements, as referred to in article 4.1 of the "Radio Equipment and Telecommunications Terminal Equipment Directive" and issued to the Licensee.~~

~~The current relevant performance standards are:~~

- ~~(d) UK Radio Licence Interface Requirement 2019 - Third Generation Mobile;~~
- ~~(e) ETSI TS 125.104: UTRA (BS) FDD; Radio Transmission and Reception;~~
- ~~(f) ETSI TS 125.105: UTRA (BS) TDD; Radio Transmission and Reception.~~

### **Co-ordination**

~~12 The Radio Equipment shall be operated in compliance with such co-ordination procedures as are required by any Memorandum of Understanding with another neighbouring administration (including the administrations of the Isle of Man and the Channel Islands) as notified by Ofcom.~~

## Interpretation

11. In this Schedule:

- (a) “2100 MHz paired spectrum” means frequencies in the range 1920 MHz to 1980 MHz paired with 2110 MHz to 2170 MHz;
- (b) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt) is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW);
- (c) “e.i.r.p.” means the effective isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- ~~(c) — The EIRP per carrier and the EIRP per MHz limits are to be considered separately for any deployment and the more stringent is to be complied with;~~
- ~~(d) — “Frequency block” means the frequency band of operation of the licensee defined in Section 6 of this Schedule;~~
- (d) A “femtocell” means Radio Equipment transmitting on the downlink frequencies is a base station of the Network which operates at a power not exceeding 20dBm E.I.R.P. e.i.r.p. per carrier which may be established by customers of the Network but which is or will be used only by and under the control of the Network, following the establishment of a telecommunications link between the femtocell and the Network;
- (e) “IR” means a United Kingdom Radio Interface Requirement published by Ofcom in accordance with Article 4.1 of Directive 1995/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment (RTTE) and the mutual recognition of their conformity;
- (f) “Maximum EIRP e.i.r.p. per carrier”. The EIRP (effective isotropic radiated power) is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna. The maximum EIRP e.i.r.p. in any direction from the base-station should be below this limit for any transmitted carrier. Power for this limit is defined as the mean modulated carrier power time averaged over any suitable time period in which the transmitter is continuously transmitting at its maximum operational power level;
- (g) “Maximum EIRP e.i.r.p. per MHz”. The EIRP e.i.r.p. per MHz means is defined as the sum of the EIRP e.i.r.p. radiated by all transmitted carriers in any given direction within any contiguous 5 MHz block within an operator’s spectrum allocation, divided by 5;
- (h) “measurement bandwidth” means the size of an individual spectrum segment within the specified frequency range that is used to measure compliance with the specified power limit;

(i) “Permitted Frequency Blocks” has the same meaning given to it in paragraph 7 of this Schedule;

~~(e) “Out of block emissions” are defined as Radio Frequency (RF) emissions generated by the system operated by the licensee but radiated into the spectrum adjacent to the licensee’s frequency block;~~

~~(f) “Maximum permitted level” (of out of block emissions) is the maximum power, integrated over the corresponding measurement bandwidth, that may be supplied by the transmitter to the antenna feeder line. Power is defined as the mean RF power time averaged over any suitable time period during which the transmitter is continuously transmitting at its maximum rated power;~~

~~(g) “Frequency Division Duplex (FDD)” operation is defined as bi-directional communication in which one radio frequency carrier is used for transmission and a separate radio frequency carrier is used for reception;~~

~~(h) “Time Division Duplex (TDD)” operation is defined as bi-directional communication using a single radio frequency carrier for transmit and receive, with transmission/reception taking place using discrete time slots;~~

~~(i) “dBm” is an abbreviation for the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW);~~

~~(j) A “femtocell” is a base station of the Network which operates at a power not exceeding 20dBm E.I.R.P. per carrier which may be established by customers of the Network but which is or will be used only by and under the control of the Network, following the establishment of a telecommunications link between the femtocell and the Network;~~

(j) A “smart/intelligent low power repeater” means is a repeater ~~of the Network~~ which operates with power not exceeding 24dBm E.I.R.P. per carrier, which may be established by customers of the Network who have written agreements with the Licensee and:

- The Licensee has ultimate control of the repeater, i.e. each individual repeater can be disabled remotely by the Licensee;
- The repeater operates only on the Licensee’s frequencies and with their valid Public Land Mobile Network Identifier;
- Must not cause undue interference to other spectrum users; and
- The repeater only transmits on the ~~Licensee’s Base Receive~~ uplink frequencies when actively carrying a call (voice, video or data) or signalling from serviced handsets.

(k) “TRP” means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere; and

- (l) “upper block edge” means, in relation to the Permitted Frequency Block, the highest frequency in that Permitted Frequency Block.
  
- (m) “User Station” means any vehicle mounted or hands portable mobile station designed for mobile use and/or any station designed or adapted to be established and used from static locations which meet the appropriate technical performance requirements as set out in the Wireless Telegraphy (Exemption) Regulation in force from time to time and either complies with the appropriate Interface Regulation listed in paragraph 3, or for equipment placed on the market before 8 April 2000, is type approved in accordance with a recognised technical standard relating to the service licensed.

**Ofcom**

**Annex 6**

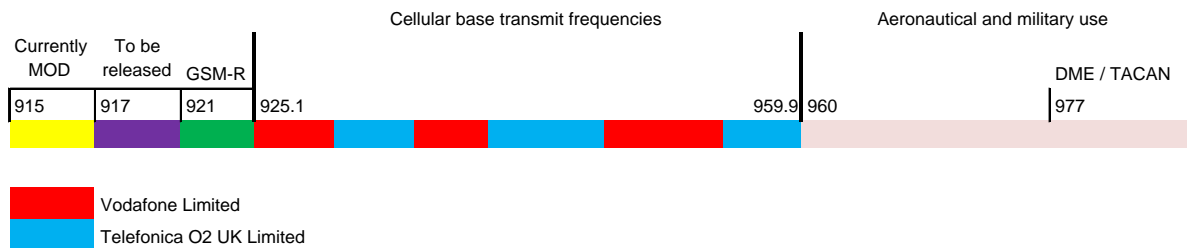
# Assessment of a 3 dB power increase for 900 MHz base transmit frequencies

## Introduction

- A6.1 In this annex we consider a request for a 3 dB increase in the maximum equivalent isotropically radiated power (e.i.r.p.) per carrier for UMTS systems licensed for use in the 925.1-959.9 MHz band (the 900 MHz band).
- A6.2 We assess the potential risk of interference to systems operating in neighbouring bands (see Figure 2) from the requested power increase.
- A6.3 Base station equipment manufacturers are increasingly offering systems that are capable of operating at power levels in excess of the current maximum power in the 900 MHz band licences for UMTS.
- A6.4 We are also consulting on a proposal to vary the 900 MHz licences to allow the deployment of other mobile broadband technologies (i.e. WiMAX FDD and LTE FDD). Consequently, in this annex we assess the impact of similar in-band power levels for the future use of LTE and WiMAX, as have been requested for UMTS 900. Where appropriate we draw on analysis from existing published studies undertaken within the European Conference of Postal and Telecommunications Administrations (CEPT).

## Band plan

- A6.5 The band plan below, Figure 2, shows the spectrum either side of the base transmit frequencies of the 900 MHz band.



- A6.6

**Figure 2: Band plan of spectrum either side of the 900 MHz band base station transmit frequencies**

## In-band power levels

- A6.7 Existing in-band maximum e.i.r.p. levels in the 900 MHz band licence for base transmit frequencies are listed below in Table 1. The requested maximum e.i.r.p. for UMTS base stations in the 900 MHz band is also included as are our proposed maximum e.i.r.p. levels for the LTE and WiMAX systems in the band.



<b>Technology</b>	<b>Current in-band maximum e.i.r.p.</b>	<b>Requested/proposed maximum in-band e.i.r.p.</b>
GSM	32 dBW per carrier	No change
UMTS	32 dBW per 3.84 MHz carrier	35 dBW per 3.84 MHz carrier
LTE FDD (all proposed bandwidths)	N/A	35 dBW per 5 MHz
WiMAX FDD (all proposed bandwidths)	N/A	35 dBW per 5 MHz

**Table 1: The in-band maximum e.i.r.p. levels being considered within this consultation document**

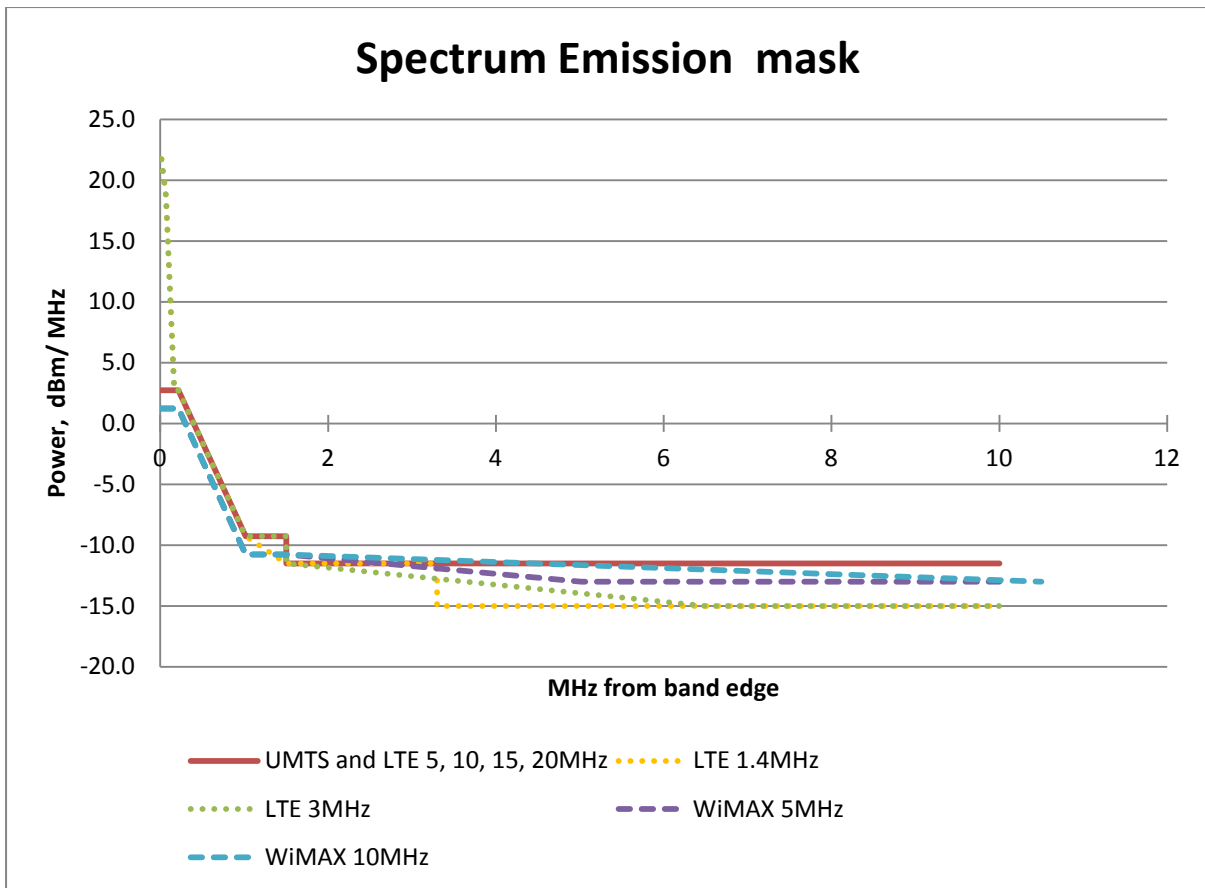
### **What happens to out-of-bands emission levels if we allow an increase of 3 dB?**

A6.8 This section looks the spectrum emission masks for the following systems:

- UMTS (taken from ETSI EN 301 908-11);
- LTE for bandwidths of 1.4 MHz, 3 MHz, 5 MHz, 10MHz, 15 MHz, 20 MHz (taken from ETSI EN 301 908-14);
- WiMAX for bandwidths of 5 MHz and 10 MHz (taken ETSI EN 301 908-22).

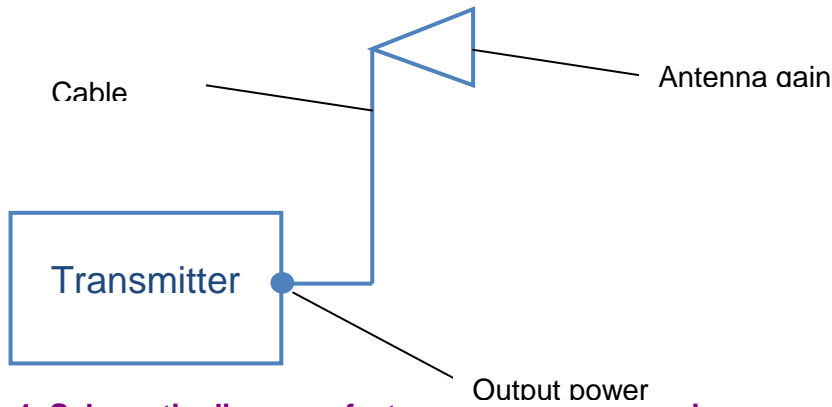
A6.9 This section also looks at the potential increase in the out-of-band emissions if we allow an increase in the in-band maximum e.i.r.p. of 3 dB compared to the current licence conditions for UMTS base stations in the 900 MHz band.

A6.10 Figure 3 below is a diagram of the spectrum emission mask showing the maximum permissible out-of-band transmit powers from base stations in the in the 900 MHz band for UMTS, LTE and WiMAX systems.



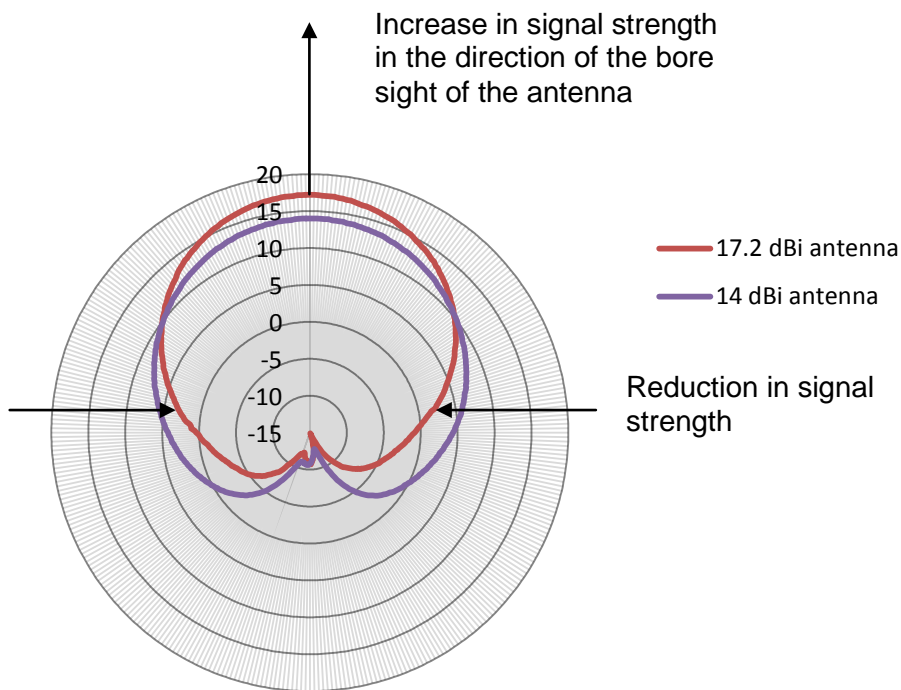
**Figure 3: Spectrum emission masks for UMTS, LTE and WiMAX**

- A6.11 The maximum permissible out-of-band transmit powers as specified in the relevant ETSI standard, for UMTS, and LTE for bandwidths of 5 MHz and above are the same. The maximum permissible out-of-band transmit powers for WiMAX FDD are, for most frequency offsets, slightly less for the 5 MHz and 10 MHz bandwidth. The maximum permissible out-of-band transmit powers for the LTE for bandwidths below 5 MHz (i.e. at bandwidths of 1.4 MHz and 3 MHz) are greater than the other bandwidths up to 0.2 MHz from the band edge. After 0.2 MHz from the band edge the maximum permissible out-of-band transmit powers either follows those of the other LTE systems or are lower.
- A6.12 Figure 4 below shows a transmitter which has a power output into the cable and antenna. The out-of-band power from the transmitter is fixed below a maximum level as determined by the relevant ETSI standard. This fixed out-of-band transmission is taken up the cable and through the antenna before the electro-magnetic wave is emitted. There is a loss in the power through the cable and a gain in the power from the antenna focussed in the direction of the area being served. The in-band and out-of-band radiated emissions can be increased by the gain of the antenna. A higher gain antenna focuses the electromagnetic wave in a narrower direction around the base station.



**Figure 4: Schematic diagram of a transmitting base station**

- A6.13 An increase in e.i.r.p. of 3 dB, is likely to be more easily achieved on an existing base station by increasing the transmitter power (where the maximum out-of-band power stays constant) than by changing the antenna being used to one with a higher gain, which will also have a more directional beam.
- A6.14 An operator may be using three sector antennas to produce coverage around a base station. The effect of using a more directional antenna will be to increase the signal strength around the bore sight of the antenna, but will also reduce the signal strength in other directions in the sector. This is illustrated in Figure 5 where we overlay example patterns for antennas with gains of 14 dBi and 17.2 dBi.



**Figure 5: The effect on the transmitted signal strength of using a more directional (higher gain) antenna**

- A6.15 The current in-band maximum e.i.r.p. level (i.e. 56.2 dBm / MHz, equivalent to 62 dBm in the 3.84 MHz channel) and the resultant out-of-band e.i.r.p. levels of UMTS base stations in the 900 band are given in the Table 2 below assuming a typical antenna with a gain of 16 dBi. The first row (darker purple) shows the in-band maximum e.i.r.p. (in dBm / MHz). The following rows (paler purple) give the resultant maximum out-of-band e.i.r.p. levels.

Frequency offset from centre frequency, MHz	Power level from transmitter, dBm	Measurement bandwidth	Maximum level, dBm / MHz	Cable loss, dB	Antenna gain, dBi	In-band and out-of-band e.i.r.p., dBm / MHz
0	48	3.84 MHz	42.2	2	16	56.2
2.515	-12.5	30 kHz	2.7	2	16	16.7
2.715	-12.5	30 kHz	2.7	2	16	16.7
3.515	-24.5	30 kHz	-9.3	2	16	4.7
4	-24.5	30 kHz	-9.3	2	16	4.7
4	-11.5	1 MHz	-11.5	2	16	2.5
8	-11.5	1 MHz	-11.5	2	16	2.5
12.5	-11.5	1 MHz	-11.5	2	16	2.5

**Table 2: Current in-band and out-of-band e.i.r.p. levels for UMTS bases stations in the 900 band, assuming a 16dBi antenna and 2dB cable loss.**

- A6.16 The requested in-band maximum e.i.r.p. level (i.e. 59.2 dBm / MHz equivalent to 65 dBm in the 3.84 MHz channel) and the resultant out-of-band e.i.r.p. levels of UMTS base stations in the 900 band are given in the Table 3 below, again assuming a typical antenna with a gain of 16 dBi.

Frequency offset from centre frequency, MHz	Power level from transmitter, dBm	Measurement bandwidth	Maximum level, dBm / MHz	Cable loss, dB	Antenna gain, dBi	In-band and out-of-band e.i.r.p., dBm / MHz
0	51	3.84 MHz	45.2	2	16	59.2
2.515	-12.5	30 kHz	2.7	2	16	16.7
2.715	-12.5	30 kHz	2.7	2	16	16.7
3.515	-24.5	30 kHz	-9.3	2	16	4.7
4	-24.5	30 kHz	-9.3	2	16	4.7
4	-11.5	1 MHz	-11.5	2	16	2.5
8	-11.5	1 MHz	-11.5	2	16	2.5
12.5	-11.5	1 MHz	-11.5	2	16	2.5

**Table 3: The resultant out-of-band e.i.r.p. levels when the in-band e.i.r.p. has the requested 3 dB increase, assuming it is achieved by an increase in the transmitter power.**

- A6.17 As can be seen from Table 2 and Table 3, the out-of-band e.i.r.p. levels are the same in both cases. If however the requested 3 dB e.i.r.p. increase is achieved by using a different antenna with a higher gain, then the out-of-band e.i.r.p. level will increase up to 3 dB from the bore sight of the antenna. The increase in the out-of-band e.i.r.p. levels that result from using an antenna with a gain of 19 dBi are shown in Table 4 below.

Frequency offset from centre frequency, MHz	Power level from transmitter, dBm	Measurement bandwidth	Maximum level, dBm / MHz	Cable loss, dB	Antenna gain, dBi	In-band and out-of-band e.i.r.p., dBm / MHz
0	48	3.84 MHz	42.2	2	19	59.2
2.515	-12.5	30 kHz	2.7	2	19	19.7
2.715	-12.5	30 kHz	2.7	2	19	19.7
3.515	-24.5	30 kHz	-9.3	2	19	7.7
4	-24.5	30 kHz	-9.3	2	19	7.7
4	-11.5	1 MHz	-11.5	2	19	5.5
8	-11.5	1 MHz	-11.5	2	19	5.5
12.5	-11.5	1 MHz	-11.5	2	19	5.5

**Table 4: The resultant out-of-band e.i.r.p. levels when the in-band e.i.r.p. has the requested 3 dB increase, assuming a 19 dBi antenna gain.**

A6.18 The equivalent out-of-band e.i.r.p. levels could, in theory, be achieved within the existing licence conditions if operators deployed the same higher gain antenna, as used for Table 4. These equivalent out-of-band e.i.r.p. levels that result from the use of a 19 dBi antenna within the current licence conditions, ie using a lower e.i.r.p., are shown in Table 5 below.

Frequency offset from centre frequency, MHz	Power level from transmitter, dBm	Measurement bandwidth	Maximum level, dBm / MHz	Cable loss, dB	Antenna gain, dBi	In-band and out-of-band e.i.r.p., dBm / MHz
0	42	3.84 MHz	36.2	2	19	53.2
2.515	-12.5	30 kHz	2.7	2	19	19.7
2.715	-12.5	30 kHz	2.7	2	19	19.7
3.515	-24.5	30 kHz	-9.3	2	19	7.7
4	-24.5	30 kHz	-9.3	2	19	7.7
4	-11.5	1 MHz	-11.5	2	19	5.5
8	-11.5	1 MHz	-11.5	2	19	5.5
12.5	-11.5	1 MHz	-11.5	2	19	5.5

**Table 5: The resultant out-of-band e.i.r.p. levels when the in-band e.i.r.p. is within the current licence levels, assuming a 19 dBi antenna gain.**

A6.19 Table 2, Table 3, Table 4 and Table 5 show that the out-of-band emissions are dependent on the gain of the antenna used, and not the in-band e.i.r.p. levels. The equivalent out-of-band e.i.r.p. can be achieved with the existing licence conditions and a higher gain antenna.

A6.20 It is possible that an operator may only require an additional 3 dB in limited locations. Our Sitefinder website<sup>33</sup> which contains base station information submitted by various operators on a voluntary basis, indicates that most base stations are not currently using the maximum e.i.r.p. permitted under the licences.

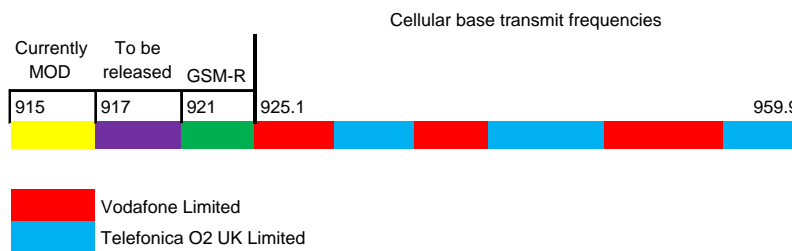
<sup>33</sup> <http://www.sitefinder.ofcom.org.uk/>

A6.21 Due to power control used by the base station and loading of the cell due to traffic levels, it is possible that the maximum e.i.r.p. will not be used for the majority of the time.

### Impact below the 925 – 960 MHz band

A6.22 This section of the annex, considers the impact of an increase in licensed power to the neighbouring uses of the spectrum below 925 MHz.

A6.23 Figure 6 below shows the use of the spectrum below the 900 MHz band base transmit frequencies.



**Figure 6: Band plan of spectrum below the 900 MHz band base transmit frequencies**

A6.24 Ofcom last published an update on the bands 872 – 876 MHz / 917 – 921 MHz in February 2010<sup>34</sup>. In our 2010 update we said we should take account of work under way in Europe on the possibility of co-channel sharing between Global System for Mobiles - Railway (GSM-R), short-range devices (SRDs) and radio-frequency identification (RFID) before considering further the choice of authorisation approach for releasing the bands.

A6.25 In light of the progress of European Conference of Postal and Telecommunications Administrations (CEPT) work on 870 – 876 MHz and 915 – 921 MHz subsequent to our 2010 update, we are now planning to publish a further document in Q1 2013 which will consider if the UK should seek to release this band in line with the CEPT, for example to enable use of low power, licence exempt, short range devices. It will also consider the potential release of the 870 – 872 / 915 – 917 MHz alongside 872 – 876 MHz / 917 – 921 MHz if and when management of this is transferred to Ofcom from government.

A6.26 Paragraphs A6.30 to A6.35 describe existing use of the band by a wind profile radar and give a qualitative analysis of the potential impact to this radar if we increase the licensed in-band maximum e.i.r.p. for UMTS base stations in the 900 MHz band by the requested 3 dB.

A6.27 Paragraphs A6.36 to A6.39 provide a high level technical analysis of the potential impact to future short range devices if we increase the licensed in-band maximum e.i.r.p. for UMTS base stations in the 900 MHz band by the requested 3 dB.

A6.28 Between paragraphs A6.40 to A6.46 there is a description of the existing use of the band, GSM-R, and an assessment of the impact of a 3 dB power increase.

<sup>34</sup> [http://stakeholders.ofcom.org.uk/consultations/872\\_876\\_mhz/update/](http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/update/)

## Impact on the 915 – 917 MHz band

- A6.29 The Ministry of Defence (MOD) is in the process of clearing all military users from the 915-917 MHz band. MOD intends to consult with other government departments on the future use of 870 – 872 MHz and 915 – 917 MHz with the intention of transferring management responsibility to another government department or release of the spectrum to Ofcom. CEPT is expected to make a decision on the future use of this spectrum in 2013/14, most likely allocating it to short range devices on a licence exempt basis. The use of the spectrum above 925 MHz can be considered by any future user of the spectrum within this band.
- A6.30 There is a single wind profiler radar in the UK located near Camborne in Cornwall that operated on 915 MHz. Within this band, radiolocation is a secondary service as allocated in the United Kingdom Frequency Allocation Table 2010 (UKFAT 2010); this means that it can not expect protection from services operating under a primary allocation such as mobile applications.
- A6.31 The wind profiler works in the vertical plane, with a highly directional beam, we understand that it has a one-way half power half-width of the order of 5 degrees<sup>35</sup>.
- A6.32 The antennas of the wind profiler are screened in the horizontal direction. Figure 7 below shows a picture of the 915 MHz wind profiler at Camborne.



**Figure 7: Wind Profile Radar near Camborne**

- A6.33 The nearest base stations to the wind profiler, as taken from our Sitefinder website, where base station information is submitted on a voluntary basis, are listed below in Table 6. The nearest base stations are approximately 1km away and are not as far as we are aware currently using their maximum allowable transmit power.

<sup>35</sup> [http://mst.nerc.ac.uk/beam\\_form.html](http://mst.nerc.ac.uk/beam_form.html)



Approximate distance away from wind profiler	Frequency band	Current e.i.r.p., dBW	Current maximum licensed power, dBW
1 km	900 MHz	26.2	32
1 km	2100 MHz	17.89	35
1 km	1800 MHz	28.5	32
2 km	900 MHz	26	32
2 km	2100 MHz	28.9	35
2km	1800 MHz	27.4	32
2km	2100 MHz	29.4	35

**Table 6: Base stations from our Sitefinder website near the Wind Profile Radar near Camborne**

A6.34 The Figure 8 below shows an extract from Google maps showing the position of the wind profile radar near Camborne.



**Figure 8: Location of wind profiler taken from Google maps**

A6.35 Although detailed technical analysis has not been done, it is unlikely that this wind profiler is at significant risk of interference from an increase in the licence power from the mobile systems above 925 MHz given its distance from the nearest base stations and the horizontal screening provided.



## Impact on the 917 – 921 MHz band

- A6.36 This band is to be released by Ofcom; a potential future use is for low power licence exempt systems. Any potential new users of the 917 – 921 MHz band should take into account the likely impact of use of the spectrum above 925 MHz (including the proposed power increase if adopted).
- A6.37 Ofcom has conducted some high level technical analysis to assess the separation distance that could be needed to protect SRD use. The results are shown in Table 7. Due to the assumptions used the separation distances are conservative, it is likely that the actual separation distances required are likely to be lower.
- A6.38 The analysis assumes the protection given to SRDs is -137 dBW / 25kHz (-107 dBm / 25 kHz) based on the receiver sensitivity of the most sensitive SRD equipment measured in a report prepared for Ofcom in October 2011 entitled “Investigation on the receiver characteristics of SRD equipment in the 863 – 870 MHz band.”<sup>36</sup> The out-of-band emissions for the UMTS base station are based on ETSI EN 301 908 - 11 and ETSI EN 301 908 - 2 for the UMTS UE. Propagation models used are the Extended Hata model for the suburban environment for the base stations to SRD and Extended Hata SRD model for the UE to the SRD<sup>37</sup>.

UMTS 900 system	Frequency of SRD device	e.i.r.p. of the UMTS system	Out-of-band levels from UMTS system	Estimated separation required to SRD
UE handset	875.9875 MHz	-6 dBW	-43.4 dBW / 25 kHz	225m
Base station	920.9875 MHz	32 dBW	-43.5 dBW / 25 kHz	200m
Base station  Assuming a 3 dB power increase in out-of-band emissions from a more directional antenna is being used, with a gain of 19dBi.	920.9875 MHz	35 dBW	-40.5 dBW / 25 kHz	240m

**Table 7: Estimated separation distance required for potential SRD use of 872 – 876 MHz and 917 – 921 MHz and UMTS 900 use.**

- A6.39 The analysis in Table 7 shows that a similar separation distance is required for future SRD use of the band 917 – 921 MHz if it is nearby in frequency to a UMTS 900 UE handset and UMTS 900 base station. However it is statistically more likely that an SRD will be closer to the UMTS 900 UE handset, therefore the risk of “harmful” interference to SRD is low, and remains lower than the (already low) risk of harmful interference from a handset. The potential impact of an increase in the out-of-band emissions from the UMTS 900 base station is not likely to increase significantly the risk of interference to any SRDs use in this band in the future.

<sup>36</sup> <http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/SRD-Study.pdf>

<sup>37</sup> <http://tractool.seamcat.org/wiki/Manual/PropagationModels/ExtendedHata>

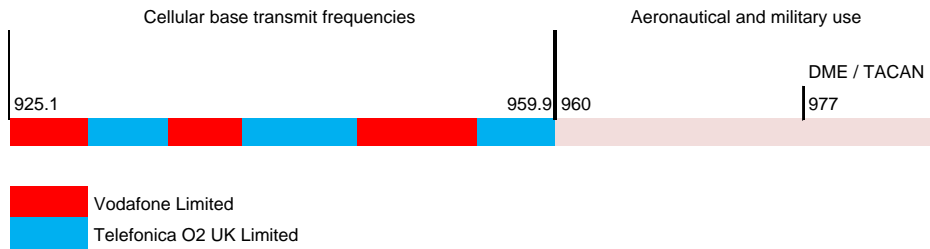
## Impact on the 921 – 925 MHz band

- A6.40 The 921 – 925 MHz band is used for Global System for Mobiles - Railway (GSM-R), the wireless communications standard for railway communication. GSM-R is a communication element containing both voice signalling and control data between trains and line controllers.
- A6.41 We have an existing Notice of Co-ordination Procedure required for UMTS deployment under the Public Wireless Network Licences covering the 900 MHz band, dated 26 January 2012<sup>38</sup>. It is required for UMTS 900 deployment to allow the co-existence of UMTS and GSM-R in the adjacent bands. It provides thresholds at the GSM-R receiver from UMTS 900 base stations that if breached requires the UMTS 900 operator to coordinate with the GSM-R operator prior to bringing the base station into operation or making other changes to the base station that could lead to a breach. These thresholds will remain at the existing levels to protect the GSM-R operator.
- A6.42 If an operator wished to increase the e.i.r.p. from any of its UMTS 900 base stations, it would still need to adhere to the same threshold levels to protect the GSM-R receiver, so the protection offered by the co-ordination notice will not be affected by a change in the UMTS 900 licensed maximum e.i.r.p..
- A6.43 Each base station that the UMTS 900 operator deploys has to be considered against this threshold to protect GSM-R receivers. If an operator plans to increase the e.i.r.p. from an existing base station, this increase will need to be assessed again against the requirements of the co-ordination notice to see if it breaches the threshold.
- A6.44 We plan to revise the existing Notice of Co-ordination Procedure if the proposals in this consultation document to add LTE and WiMAX to the 900 MHz band licences are adopted. We intend that the current coordination thresholds applicable to UMTS 900 will also apply to LTE and WiMAX in the revised notice.
- A6.45 Under a revised co-ordination procedure, if an operator plans to deploy LTE or WiMAX base stations operating in the 900 MHz band, again they will still need to adhere to the same threshold levels to protect the GSM-R receiver, so the protection offered by the co-ordination procedure will not be affected by a change to LTE or WiMAX.

## Impact above the 925 – 960 MHz band

- A6.46 This section of the annex, considers the impact of an increase in licensed power to the neighbouring uses of the spectrum above 960 MHz.
- A6.47 Figure 9 below shows the use of the spectrum above the 900 MHz band base transmit frequencies.

<sup>38</sup> [http://stakeholders.ofcom.org.uk/binaries/consultations/900-1800mhz-wireless-telegraphy/statement/GSMR\\_operators.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/900-1800mhz-wireless-telegraphy/statement/GSMR_operators.pdf)



**Figure 9: Band plan of spectrum above the 900 MHz band base transmit frequencies**

- A6.48 The 960 – 1215 MHz band is assigned to both the Civil Aviation Authority (CAA) and the MOD. All aeronautical assignments in this band are undertaken by the CAA. Other MOD communications systems operate with the agreement of CAA.
- A6.49 Paragraphs A6.53 to A6.60 describe aeronautical use of the band. Some aeronautical use of the band is not introduced as we consider that there is sufficient guard band separation to the mobile cellular use.
- A6.50 Paragraphs A6.61 to A6.82 contain key conclusions and supporting material for existing studies that have been carried out with CEPT study groups looking at adjacent use of cellular systems to the aeronautical use.
- A6.51 Paragraphs A6.83 to A6.86 describe military use of the band.
- A6.52 Paragraphs A6.87 to A6.101 contain key conclusions and supporting material for existing studies that have been carried out with CEPT study groups looking at adjacent use of cellular systems to the military use.

### **Aeronautical use of the 960 – 1215 MHz band**

- A6.53 Distance Measuring Equipment (DME) and tactical air navigation system (TACAN) systems currently use the aeronautical band above 960 MHz. There is some other use of the aeronautical band<sup>39</sup> but these are not discussed in detail here as we consider that there is sufficient frequency separation to the mobile cellular use in the 900 MHz band.
- A6.54 DME provides a slant range distance measurement between an aircraft and a ground based DME transponder (the aircraft systems initiates interrogations of the known DME transponder installations that should be in view or nearby). It is used for aircraft departure or arrival procedures at airports/airfields and also for general navigation purposes. The DME system can be used in conjunction with a VHF omni directional radio range (VOR) bearing measurement to enable an aircraft to obtain a position fix. It could also be used independently as a simple ranging fix. It is also often used together with the instrument landing system (ILS) localiser or glide-path signals on the final approach to an airport. An aircraft's on-board flight management system can also use the distance measurements from several DMEs in a triangulation process to get the position of the aircraft. DME systems are installed on international transport category aircraft, some but not all general aviation aircraft and also on other aircraft types such as helicopters.

<sup>39</sup>Other uses of 960 – 1215 band include Secondary Surveillance Radar (SSR), Universal Access Transceiver (UAT) and Automatic Dependent Surveillance – Broadcast (ADS - B).

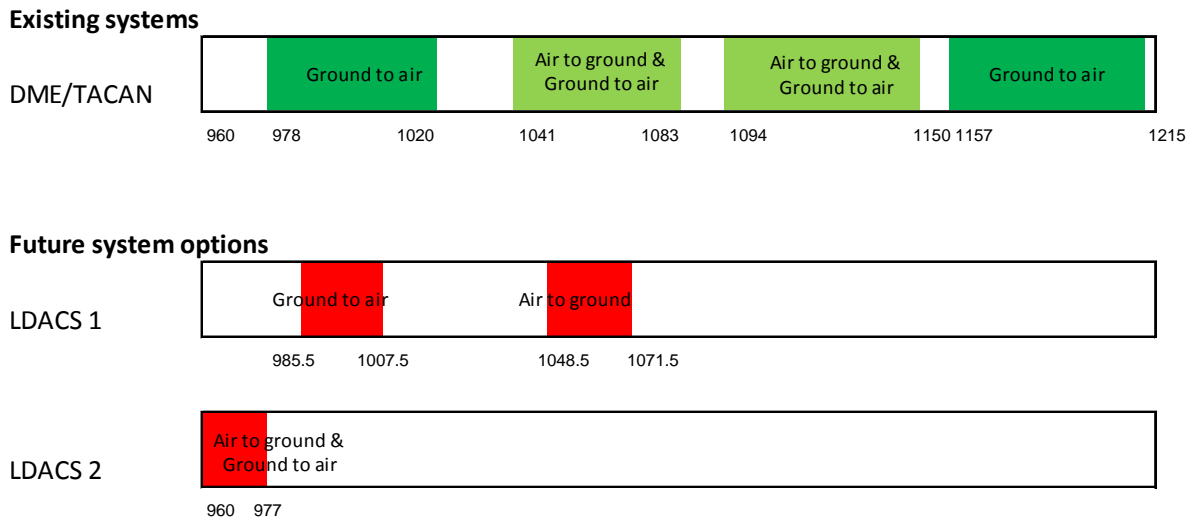
- A6.55 The tactical air navigation system (TACAN) system is used for military aircraft. We understand that it is a more accurate version of the VOR / DME system. It gives distances and bearings.
- A6.56 The frequency range for the DME and TACAN systems is 960 – 1215 MHz. The sub-bands indicated in the spectrum plot: 978 – 1020 MHz, 1041 – 1083 MHz, 1094 – 1150 MHz and 1157 – 1213 MHz, taken from the International Civil Aviation Organisation (ICAO) channel plan<sup>40</sup>. This is shown in the Figure 10 below under existing systems.
- A6.57 This means that internationally travelling aircraft will be using TACAN / DME systems that are above 978 MHz.
- A6.58 In the other parts of the spectrum, including the 960 – 977 MHz sub-band, national allotments exist. At the moment the 960 – 977 MHz sub-band is not used for civil aeronautical purposes within the United Kingdom<sup>41</sup>. It is also not used for civil maritime use.
- A6.59 The International Civil Aviation Organisation working paper on coexistence of Future Communication System (FCS) and TACAN systems<sup>42</sup>, December 2009 states that: “For the next decades a significant increase in the number of flights is foreseen that would require a significantly larger capacity for air traffic control communications than the current systems can provide. Also there are objectives to make air traffic safer, more efficient and more environmental friendly. The current systems for air traffic control communications is currently at the limits of its capacity and can not support further developments and objectives.”
- A6.60 At this moment there are two candidate technologies: L-band Datalink Aeronautical Communication System 1 (LDACS 1) and L-band Datalink Aeronautical Communication System 2 (LDACS 2) each with a specific spectrum requirement, as depicted in Figure 10 below under the heading future system options.

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<sup>40</sup> Annex 10 to the Convention on International Civil Aviation, Aeronautical Telecommunications, Volume 1 Radio Navigation Aids, ICAO, 2006

<sup>41</sup> According to the Aeronautical Information Publication updated 13/12/12, [http://www.nats-uk.ead-it.com/public/index.php%3Foption=com\\_content&task=blogcategory&id=6&Itemid=13.html](http://www.nats-uk.ead-it.com/public/index.php%3Foption=com_content&task=blogcategory&id=6&Itemid=13.html) . The Aeronautical Charts & Data function has now transferred to NATS who, under licence from the CAA, control the scheduled production of maps and charts for both the Visual Flight Rules (VFR) series and the Aeronautical Information Publication (AIP).

<sup>42</sup> International Civil Aviation Organization Working Paper, ACP-WGF21/WP-07, Working paper on coexistence of FCS and TACAN systems, AERONAUTICAL COMMUNICATIONS PANEL (ACP) NINETEENTH MEETING OF WORKING GROUP F, Bangkok, Thailand 10 – 18 December 2009



**Figure 10: Band plan for existing and future aeronautical systems considered in this Annex.**

### Existing technical analysis

- A6.61 The CEPT Report 42, “Compatibility between UMTS and existing and planned aeronautical systems above 960 MHz”, and ECC Report 96, “Compatibility between UMTS 900 / 1800 and systems operating in adjacent bands” have considered adjacency issues with UMTS 900. The CEPT Report 41, “Compatibility between LTE and WiMAX operating within the bands 880 – 915 MHz / 925 – 960 MHz and 1710 – 1785 MHz / 1805 – 1880 MHz (900 / 1800 MHz bands) and systems operating in adjacent bands” has looked at adjacency issues with LTE / WiMAX 900 MHz FDD systems. These reports analyse the potential impact of out-of-band emissions into the adjacent aeronautical systems. They consider the impact on existing DME / TACAN systems and on the potential future systems in the band LDACS 1 and LDACS 2.
- A6.62 The conclusions of these reports are summarised below, together with additional supporting information that we consider to be helpful.

### Key Conclusions of the ECC Report 96, dated 2007

- A6.63 The ECC Report 96<sup>43</sup>, “Compatibility between UMTS 900 / 1800 and systems operating in adjacent bands” has looked at adjacency issues of DME and TACAN systems with UMTS 900. The key conclusions from this report are listed below in paragraphs A6.64 and A6.65.
- A6.64 The use of TACAN / DME below 970 MHz would require additional protection so that the compatibility in adjacent band with UMTS 900 can be ensured.
- A6.65 The potential interference from UMTS 900 to aeronautical DME operating at frequencies above 972 MHz does not represent any difficulty. The frequency range 960 – 972 MHz is not currently used for aeronautical DME, but is planned in the near future. Some additional margins may be required for protection of aeronautical DME operating frequencies between 960 and 972 MHz. The report suggests a regulatory solution should be examined.

<sup>43</sup> <http://www.erodocdb.dk/doks/doccategoryECC.aspx?doccatid=4>

### Key Conclusions of CEPT Report 42, dated 2010

- A6.66 The CEPT Report 42, "Compatibility between UMTS and existing and planned aeronautical systems above 960 MHz"<sup>44</sup> has looked at adjacency issues of DME and LDACS systems with UMTS 900. The key conclusions from this report are listed below in paragraphs A6.67 and A6.70.
- A6.67 No interference is expected from UMTS base stations to DME airborne receivers is expected above 972 MHz. Below 972 MHz some interference in the order of 3 or 4 dB, may occur at low altitudes for the mixed-urban environments.
- A6.68 LDACS airborne receivers are no more sensitive to interference than DME.
- A6.69 UMTS base station transmissions may cause interference to a future use of LDACS TDD ground station (LDACS 2) if it is selected in the band 960 – 977 MHz, in the order of 17 – 25 dB, depending on the distance from the ground station to the nearest base station. It considers that future design of LDACS ground systems should consider potential interference from UMTS base stations.
- A6.70 Additionally the report indicates that there could be a risk of interference from LDACS 2 systems to UMTS UEs.

### Summary of relevant support information from CEPT Report 42

- A6.71 The study considered aggregate adjacent channel interference to DME / LDACS from multiple base stations that were visible to the aircraft at different flying heights. This analysis considered an assumed antenna pattern for both the DME / LDACS system and the UMTS base stations.
- A6.72 The study uses a power from the transmitter of 43 dBm (13 dBW), with a sector antenna gain of 18 dBi, giving and base station maximum e.i.r.p. of 61 dBm (31 dBW), with a power control reduction of 3.5 dB on average.
- A6.73 Below 972 MHz some interference in the order of 3 or 4 dB, may occur at low altitudes for the mixed-urban case. Below are the results of two separate studies undertaken in the CEPT Report 42. The Table 8 compares the results of the two studies against the protection criteria in each case.

	Rural				Mixed-urban			
	962MHz		967MHz		962MHz		967MHz	
<b>RESULTS OF THE TWO STUDIES</b>								
Simulation/Altitude	200m	1500m	200m	1500m	200m	700m	200m	700m
Study n°1 (dBm)	-97	-102	-100	-105	-93.5	-96	-96.5	-99
Study n°2 (dBm)	-94	-101	-96	-104	-91	-95	-94	-98
Delta between studies 1 and 2 (dB)	3	1	4	1	2.5	1	2.5	1
<b>COMPARISON BETWEEN THE TWO STUDIES AND THE PROTECTION CRITERION</b>								
Criterion	-94	-102	-97	-105	-94	-99	-97	-102
Delta between study 1 and the criterion	-3	0	-3	0	+0.5	+3	+0.5	+3
Delta between study 2 and the criterion	0	+1	+1	+1	+3	+4	+3	+4

<sup>44</sup> <http://www.erodocdb.dk/doks/doccategory.aspx?doccatid=16>

**Table 8: The results from the two studies looking at adjacent channel interference to DME / LDACS from multiple base stations**

- A6.74 Some difference between studies 1 and 2, up to 4 dB, can be explained by different network configurations.
- A6.75 The suppression of unwanted emissions of a UMTS base station is better than the ETSI specification indicates, due to the duplex filter. This additional suppression of interference starts at an offset of a few MHz from the 960 MHz border, and should provide additional protection for scenarios considered here at roughly 965 MHz and above.
- A6.76 Reception bandwidths of 1 MHz have been assumed in the study. However, the DME Minimum Operational Performance Standards (MOPS) specify that 90% of the transmitted power is contained in a 500 KHz bandwidth. The requirement for the receiving characteristics (the interrogator pulse rise time shall not exceed 1.2  $\mu$ s and shall not be less than 0.8  $\mu$ s) implies a receiving bandwidth of around 1 MHz. However, if the receiving bandwidth of the DME is lower than 1 MHz (e.g. 0.5 MHz), then the interference will be decreased by  $10 \log (1 / 0.5)$  dB.
- A6.77 The apportionment is proposed to model that several sources of interferences may occur simultaneously on the DME devices. However, the pre-requisite is that the interferences are contributing in the same order. Otherwise, if one source of interference is predominant and the others are negligible, then the apportionment factor has no longer to be taken into account. An apportionment factor (of 3 dB  $\leq$  966.5 MHz and 6 dB  $>$  966.5 MHz) has been included in the calculations. If the UMTS represent the major source of interference, then these values may be too conservative especially for the low altitudes of the aircraft. This would result in interference requirements 3 – 6 dB more relaxed than assumed here.
- A6.78 Three additional margins have been used in the links budgets used in the analysis within the report:
- The propagation model describing the link from the ground station to the airborne receiver contains an additional 7.6 dB margin in comparison with free space propagation (to model the reception of the signal 95% of the time to consider propagation variations);
  - The apportionment for UMTS interfering with DME / LDACS is either 3 or 6 dB. This is to take into account that there may be other interference sources, such as MIDS;
  - A safety margin due to safety-of-life is a further 6 dB.

The character of the phenomena that these margins have been introduced to cover is transitory and rare, and it is thus very unlikely that they will all be needed at the same time.

#### Key Conclusions from CEPT Report 41, dated 2010

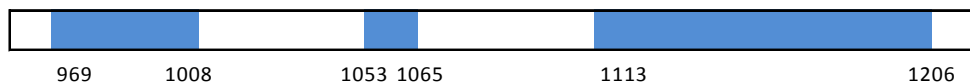
- A6.79 The CEPT Report 41, "Compatibility between LTE and WiMAX operating within the bands 880 - 915 MHz / 925 - 960 MHz and 1710 - 1785 MHz / 1805 - 1880 MHz (900 / 1800 MHz bands) and systems operating in adjacent bands" has looked at adjacency issues of DME and LDACS systems with LTE FDD and WiMAX FDD systems. The key conclusions from this report are listed below in paragraphs A6.80 and A6.82.



- A6.80 The LTE and WiMAX base station masks for the 900 MHz bands are aligned with the UMTS 900 mask for all the LTE / WiMAX channelization bandwidth available and are expected to have similar characteristics in terms of average power. Similarly, the protection criteria of LTE and WiMAX terminals is aligned with that of UMTS, and hence the conclusions regarding interference between UMTS and DME / LDACS should be applicable to the scenarios involving LTE / WiMAX on one side and DME / LDACS on the other side, for the same signal bandwidth.
- A6.81 When considering LTE / WiMAX with higher carrier bandwidth (> 5 MHz), the compatibility results should be improved. With a large number of interferers with lower bandwidths (< 5 MHz), the aggregate interference from LTE would increase. However, it is not expected that LTE will be deployed with lower bandwidth. Bandwidth different from 5 MHz for LTE / WiMAX has not been addressed in detail.
- A6.82 Introducing LTE and WiMAX into the 900 band should not cause any additional impact on adjacent services.

### Other Military use of the 960 – 1215 MHz band

- A6.83 Although military use of this band is with agreement of the Civil Aviation Authority (CAA), there is a North Atlantic Treaty Organization (NATO) system that uses this band. It needs to make sure that it does not cause interference to CAA systems. These systems will also need to avoid causing interference to any new future aeronautical operations, which could cause some limitations to their use.
- A6.84 The Joint Tactical Information Distribution System (JTIDS), also referred to as Multifunctional Information Distribution system (MIDS) or Link 16 is a NATO system used to support data and voice communications needs in the air and missile defence community. It is used for command and control, navigation, positioning information and identification.
- A6.85 The MIDS system can be placed on ground based base stations and repeaters, aircraft, ships, or other types of military vehicles. It is a system used in military operations and for training exercises.
- A6.86 The normal mode of operation for this Time division multiple access (TDMA) system is to pseudorandom hop over 51 frequencies in the 969 – 1008 MHz, 1053 – 1065 MHz and 1113 – 1206 MHz bands, as depicted in Figure 11.



**Figure 11: Band plan of MIDS use**

#### Existing technical analysis

- A6.87 The ECC Report 96<sup>45</sup>, “Compatibility between UMTS 900 / 1800 and systems operating in adjacent bands” have undertaken looking at adjacency issues with UMTS 900. The CEPT Report 41, “Compatibility between LTE and WiMAX operating within the bands 880 - 915 MHz / 925 - 960 MHz and 1710 - 1785 MHz / 1805 - 1880 MHz (900 / 1800 MHz bands) and systems operating in adjacent bands”. These

<sup>45</sup> <http://www.erodocdb.dk/doks/doccategoryECC.aspx?doccatid=4>



reports analyse the potential impact of out-of-band emissions and blocking into the MIDS systems.

A6.88 The conclusions of these reports are summarised below, together with additional supporting information that we consider to be helpful.

**Key Conclusions from ECC Report 96, dated March 2007**

A6.89 The ECC Report 96, “Compatibility between UMTS 900 / 1800 and systems operating in adjacent bands” has looked at adjacency issues with UMTS 900 and MIDS systems. The key conclusions from this report are listed below in paragraph A6.90 and A6.95

A6.90 The report initially looked at the risk of blocking to the MIDS receiver (saturation level of the MIDS receiver is -10 dBm). The geometry modelled in the report was for a UMTS 900 base station of 45m high and a MIDS receiver at 16m high.

A6.91 The maximum value of the UMTS signal from a macro cell pointing at the MIDS system at an e.i.r.p. of 58 dBm was -21 dBm at a distance of 200 – 280 m away. This is not a concern as it is 11 dB below the level -10 dBm to protect the receiver from saturation.

A6.92 The ECC Report 96 then looked at the risk of out-of-band emissions to the MIDS receiver. The noise level threshold of -104 dBm / 5 MHz received in-band from out-of-band and spurious emissions. The maximum signal level out-of-band levels, are also at a separation distance between systems of 200 – 280 m. The out-of-band power levels for the MIDS channels at the separation distance of 200 – 280 m are reproduced in the Table 9 below.

Frequency band	Out-of-band signal level from UMTS 900	For number of MIDS channels	Above the threshold, dB
960 – 969 MHz	-71 dBm / 5 MHz	1	33
969 – 999 MHz	-83 dBm / 5 MHz	10	21
999 – 1206 MHz	-87 dBm / 5 MHz	40	17

**Table 9: The out-of-band power levels for the MIDS channels from the UMTS 900 base stations**

A6.93 The threshold -104 dBm / 5 MHz is breached for all 51 channels by at least 17dB.

A6.94 The ECC Report 96 states that the MIDS system is able to tolerate the first 11 channels being interfered with. The MIDS receiver jam threshold is between 11 and 51 channels being interfered.

A6.95 The out-of-band levels of a single UMTS 900 base station was investigated at the time. The out-of-band levels were actually lower than the out-of-band limits by more than 17 dB. So it would give sufficient protection to the MIDS receiver at the worse case distance of 200 – 280 m for at least 40 of the 51 channels, which would mean that the MIDS receiver would still be able to operate.

### Additional analysis based on ECC Report 96

A6.96 Based on the analysis given in paragraph A6.91, if the e.i.r.p. was increased to 65 dBm, as proposed in this Consultation, instead of the 58 dBm used in ECC Report 96; there would still be a 4 dB margin of protection to the MIDS system to avoid saturation of its receiver.

### Key Conclusions from CEPT Report 41, dated November 2010

A6.97 The CEPT Report 41, "Compatibility between LTE and WiMAX operating within the bands 880 – 915 MHz / 925 – 960 MHz and 1710 – 1785 MHz / 1805 – 1880 MHz (900 / 1800 MHz bands) and systems operating in adjacent bands" has looked at adjacency issues with LTE FDD and WiMAX FDD systems with MIDS systems. The key conclusions from this report are listed below in paragraph A6.95 and A6.97.

A6.98 The report has the same conclusions as ECC Report 96 for investigating the affect of blocking and out-of-band emissions.

A6.99 The out-of-band power levels for the MIDS channels at the separation distance of 200 - 280 m are reproduced in the Table 10 below. (The Table 10 below the same results as reproduced in Table 9 from ECC Report 96.)

Frequency band	Maximum signal level	For number of MIDS channels	Above threshold, dB
960 – 969 MHz	-71 dBm / 5 MHz	1	33
969 – 999 MHz	-83 dBm / 5 MHz	10	21
999 – 1206 MHz	-87 dBm / 5 MHz	40	17

**Table 10: The out-of-band power levels for the MIDS channels from the LTE and WiMAX base stations**

A6.100 Information put forward by some manufacturers about the performance of a typical LTE / WiMAX 900 base station shows that the practical level of unwanted emission provides isolation considerably higher than that required (17 dB). Indeed, the interference criteria would be met already at 980 MHz or even lower. With this typical base station performance, there would be sufficient protection to the MIDS receiver at the worse case distance of 200 – 280 m for at least 40 of the 51 channels, which would mean that the MIDS receiver would still be able to operate.

A6.101 Introducing LTE and WiMAX into the 900 band should not cause any additional impact on adjacent services.

### **Provisional Conclusions**

A6.102 The provisional conclusions of this analysis are as follows:

- we believe that there is unlikely to be a significant increase in the interference environment experienced by existing systems operating in neighbouring spectrum bands if we allow the requested 3 dB increase in the maximum permitted base station transmit power for UMTS systems licensed for use in the 925.1 -959.9 MHz band (65 dBm e.i.r.p. per carrier);
- we also believe that there is unlikely to be a significant increase in the interference environment experienced by existing systems operating in neighbouring spectrum

bands if we allow LTE and WiMAX technologies to operate in the 900 MHz band at an equivalent maximum permitted base station transmit power (65 dBm e.i.r.p. per 5 MHz).

A6.103 Therefore, subject to considering responses to this consultation, we propose the following maximum permitted e.i.r.p. for UMTS, LTE and WiMAX in the 900MHz band.

<b>Technology</b>	<b>Proposed maximum in-band e.i.r.p.</b>
UMTS	35 dBW per 3.84 MHz carrier
LTE FDD (all proposed bandwidths)	35 dBW per 5 MHz
WiMAX FDD (all proposed bandwidths)	35 dBW per 5 MHz

**Table 11: Proposed maximum permitted e.i.r.p. for UMTS, LTE and WiMAX**

## Annex 7

# Consultation Questions

*Question 1: do you agree with the proposal to vary Vodafone's 900 MHz, 1800 MHz and 2100 MHz licences and H3G's 2100 MHz licence so as to permit those frequencies to be used to deploy 4G technologies?*

*Question 2: do you agree with the proposal to vary Telefónica's 900 MHz, 1800 MHz and 2100 MHz licences and EE's 2100 MHz licence so as to permit those frequencies to be used to deploy 4G technologies where we receive formal requests to do so?*

*Question 3: do you agree with the proposal to vary the 900 MHz licences to increase the maximum power limit for UMTS by 3dB from 62 dBm e.i.r.p. per carrier to 65 dBm e.i.r.p. per carrier?*

*Question 4: do you agree with the changes proposed in section 5?*