



Consultation and information
on technical licence conditions for
800 MHz and 2.6 GHz spectrum
and related matters

Consultation

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Contents

Section		Page
1	Executive summary	1
2	Introduction	2
3	Band Plan and adjacencies for the 800 MHz band	6
4	Technical licence conditions for the 800 MHz band	9
5	Band plan and adjacencies for the 2.6 GHz band	12
6	Technical licence conditions for the 2.6 GHz band	16
7	Low-power shared access in paired 2.6 GHz spectrum	20
8	Terminal stations	31
9	Next steps	33
Annex		Page
1	Responding to this consultation	34
2	Ofcom's consultation principles	36
3	Consultation response cover sheet	37
4	Consultation questions	39
5	Impact Assessment	41
6	Proposed changes to the 900 MHz and 1800 MHz licences	43
7	Glossary of abbreviations	45

Section 1

Executive summary

- 1.1 The Ofcom consultation¹ on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues was published on 22 March 2011 (the March 2011 Consultation). It set out, for information, our thinking at the time on the technical licence conditions that would apply in the two bands that were to be awarded. It also indicated that we would consult further when we were in a position to set out detailed proposals for the technical conditions that should apply to 800 MHz and 2.6 GHz licences.
- 1.2 In this consultation we set out our proposals for technical licence conditions for the 800 MHz and 2.6 GHz spectrum, including further details on low power shared access in the 2.6 GHz band. We provide further information on necessary measures to manage interference to adjacent spectrum usage including radar systems above 2.7 GHz and short range devices and emergency services above 800 MHz, though our work in these areas remains ongoing.
- 1.3 We also set out proposals for the technical measures necessary to implement Commission Decision 2011/251/EU² amending Decision 2009/766/EC on 900 MHz and 1800 MHz to permit the deployment of LTE and WiMAX technology in these bands.
- 1.4 This consultation does not cover specific additional technical restrictions that may be needed for co-existence of new services in the 800 MHz band with adjacent DTT use in bands below 790 MHz. Co-existence with DTT is the subject of the separate Ofcom consultation³ 'Coexistence of new services in the 800 MHz band with DTT' that is being published in parallel with this document.

¹ <http://stakeholders.ofcom.org.uk/consultations/combined-award/>

² <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:106:0009:0010:EN:PDF>

³ <http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/>

Section 2

Introduction

Background

- 2.1 The Ofcom consultation⁴ on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues was published on 22 March 2011 (the March 2011 Consultation). It set out, for information, our thinking at the time on the technical licence conditions that would apply in the two bands that were to be awarded. It also indicated that we would consult further when we were in a position to set out detailed proposals for the technical conditions that should apply to 800 MHz and 2.6 GHz licences.
- 2.2 In this consultation we set out our proposals for technical licence conditions for the 800 MHz and 2.6 GHz spectrum, including further details on low power shared access in the 2.6 GHz band. We provide further information on necessary measures to manage interference to adjacent spectrum usage including radar systems above 2.7 GHz and short range devices and emergency services above 800 MHz, though our work in these areas remains ongoing.
- 2.3 We also set out proposals for the technical measures necessary to implement Commission Decision 2011/251/EU⁵ amending Decision 2009/766/EC on 900 MHz and 1800 MHz to permit the deployment of LTE and WiMAX technology in these bands.

Scope of this consultation and information document

- 2.4 This document covers the following areas:
- Technical licence conditions for the 790 to 862 MHz band (the '800 MHz band')
 - Technical licence conditions for the 2500 to 2690 MHz band (the '2.6 GHz band')
 - Information for users of short range devices (SRDs) in adjacent spectrum above 863 MHz about the potential for interference from the use of the 800 MHz band
 - Information about the potential interference into the 800 MHz band from emergency services use of spectrum above 862 MHz
 - Information about coordination arrangements that will apply to blocks in the 2.6 GHz band before and after radar remediation work is completed
 - Conditions that would apply to low-power shared access within the 2.6 GHz band
 - Implementation of Commission Decision 2011/251/EU amending Decision 2009/766/EC, affecting the technical conditions in the 900 MHz and 1800 MHz licences
 - Exemption of user terminals

⁴ <http://stakeholders.ofcom.org.uk/consultations/combined-award/>

⁵ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:106:0009:0010:EN:PDF>

- 2.5 This consultation does not cover specific additional technical restrictions that may be needed for co-existence of new services in the 800 MHz band with adjacent DTT use in bands below 790 MHz. Co-existence with DTT is the subject of the separate Ofcom consultation⁶ 'Coexistence of new services in the 800 MHz band with DTT' that is being published in parallel with this document.

Structure of this document

- 2.6 The rest of this document is structured as follows:

- Section 3 addresses the 800 MHz band plan and adjacent spectrum, the relation with the parallel consultation on coexistence between new services in the 800MHz band and DTT services below 790 MHz, information about the risk of interference to short range devices above 863 MHz and emergency services use of spectrum above 862 MHz.
- Section 4 addresses the technical licence conditions for the 800 MHz band, and plans for an Interface Requirement.
- Section 5 addresses the 2.6 GHz band plan and adjacent spectrum, transitional arrangements during the period before certain radar remediation work is completed and long term conditions for protection of radars.
- Section 6 addresses the technical licence conditions for the 2.6 GHz band, and plans for an Interface Requirement.
- Section 7 addresses conditions for low power shared access in paired 2.6 GHz spectrum.
- Section 8 addresses the exemption of terminal stations.
- Section 9 sets out the next steps for this consultation and related indicative timings.

- 2.7 A detailed technical report from Real Wireless on Low Power Shared Access is published alongside this document. A detailed technical report from ERA Technology Ltd and Aegis Systems Ltd, 'Investigation on the Receiver Characteristics of SRD Equipment in the 863 to 870 MHz Band', which assess the potential for interference from LTE terminal stations in the 800 MHz band into SRDs is expected to be published within a week of this document. An impact assessment is set out in Annex 5.

European activities on 2.1 GHz spectrum

- 2.8 This document does not consult on any issues affecting the 2.1 GHz bands. In 2009 the European Commission issued a mandate to CEPT for studies to develop common and minimal (least restrictive) technical conditions for the 1900 to 1980 MHz, 2010 to 2025 MHz and 2110 to 2170 MHz spectrum. CEPT completed its work to address this mandate in July 2010 and published the results in CEPT Report 39⁷.

⁶ <http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/>

⁷ <http://www.ecodocdb.dk/Docs/doc98/official/Word/CEPTREP039.DOC>

- 2.9 Similar mandates to CEPT on technical conditions for the 800 MHz and 2.6 GHz spectrum led to Commission Decisions which incorporated the block edge masks. The European Commission has indicated an intention to bring forward draft proposals at the October meeting of the Radio Spectrum Committee for a Commission Decision implementing the technical conditions in CEPT Report 39.
- 2.10 The CEPT project team ECC PT1 which deals with International Mobile Telecommunications (IMT) is currently reviewing the ECC Decision on harmonised utilisation of the 2.1 GHz spectrum, with a view to adding the technical conditions from CEPT Report 39 as a new annex. The European Commission may make use of the results of the ECC PT1 activity during development of its draft Decision.

Spectrum at 900 MHz and 1800 MHz

- 2.11 In 2009 the European Commission issued a mandate to CEPT to study technical conditions for the introduction of new technologies in the 900 MHz and 1800 MHz bands, with the aim of adding those technologies to the list in the annex of Decision 2009/766/EC. The CEPT project team ECC PT1 studied the coexistence of both LTE and WiMAX with existing GSM and UMTS networks within the 900 MHz and 1800 MHz bands and with systems in adjacent spectrum. CEPT published the results in late 2010 in two CEPT Reports: CEPT Report 40⁸ sets out the frequency separation for coexistence between LTE/WiMAX and existing GSM or UMTS networks; CEPT Report 41⁹ provides analysis of the coexistence between LTE/WiMAX and systems in adjacent bands.
- 2.12 Following the publication of these CEPT Reports, the European Commission has adopted Decision 2011/251/EU¹⁰, amending Decision 2009/766/EC. This adds technical conditions for LTE and WiMAX into the annex to that Decision, which previously only contained UMTS. The amending Decision also sets a deadline of 31 December 2011 for Member States to implement the technical conditions to allow LTE and WiMAX in these bands.
- 2.13 In the March 2011 Consultation, we announced proposals to liberalise the use of mobile frequencies at 900 MHz, 1800 MHz for LTE and WiMAX (see paragraphs 2.21 and 5.88). The licences for 900 MHz and 1800 MHz will need to be amended in order to implement the technical conditions in the amended Commission Decision, which are expressed in terms of frequency separations between channel edges of systems in neighbouring frequency assignments. These requirements would be added to the relevant section in Schedule 1 to the licence.
- 2.14 The spectrum emission masks of UMTS, LTE and WiMAX base stations are aligned and we do not expect the implementation of the amended Commission Decision in the 900 MHz licences to have any impact in respect of services in adjacent bands (e.g. coordination requirements between MNOs and Network Rail).
- 2.15 For information about MOD use of spectrum within the 1800 MHz band, see paragraphs 2.10 to 2.13 of the Information Memorandum¹¹ for the auction of 1781.7-1785 MHz paired with 1876.7-1880 MHz.

⁸ <http://www.ecodocdb.dk/Docs/doc98/official/Word/CEPTREP040.DOC>

⁹ <http://www.ecodocdb.dk/Docs/doc98/official/Word/CEPTREP041.DOC>

¹⁰ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:106:0009:0010:EN:PDF>

¹¹ http://stakeholders.ofcom.org.uk/spectrum/spectrum-awards/completed-awards/award_1781/documents/im/

Proposed changes to the 900 MHz and 1800 MHz licences

- 2.16 We propose to implement the amended Commission Decision by making changes, as described in annex 6, to Schedule 1 of the 900 MHz and 1800 MHz licences.
- 2.17 For the avoidance of doubt, the present document should not be taken as a notice under schedule 1 of the Wireless Telegraphy Act 2006 to vary the 900 MHz and 1800 MHz licences. We intend however to publish such a notice in due course.

Interface requirements

- 2.18 The Radio Equipment and Telecommunications Terminal Equipment Directive (the “R&TTE Directive”) requires EU Member States to notify the radio interfaces that they have regulated to the Commission. Ofcom sets out the radio interfaces applicable in the United Kingdom in a set of UK radio interface requirements. New interface requirements are notified to the Commission and, following the receipt of comments and implementation of any necessary changes, are published on the Ofcom website.
- 2.19 Notifications of interface requirements received by the Commission are published on the Technical Regulations Information System (TRIS) website¹².
- 2.20 Our plans for interface requirements for the bands within the scope of this document are:
- to draft a UK radio interface requirement for the 800 MHz band, based on the template¹³ developed by CEPT ECC WGRA and Project Team SE42, and endorsed by ECC PT1;
 - to develop a new Interface Requirement for LTE and WiMAX in 900 MHz and 1800 MHz, which would sit alongside the existing IR 2014 and IR 2019;
 - to develop a new Interface Requirement for the 2.1 GHz band to sit alongside IR 2019, covering usage under the conditions in the Commission Decision, once this becomes available; and
 - to revise IR 2072 for the 2.6 GHz band, to align it with the technical conditions for the award of this spectrum, and include the technical conditions for low-power shared access in this band.
- 2.21 These new and revised interface requirements will be notified to the Commission at the earliest opportunity.

¹² <http://ec.europa.eu/enterprise/tris>

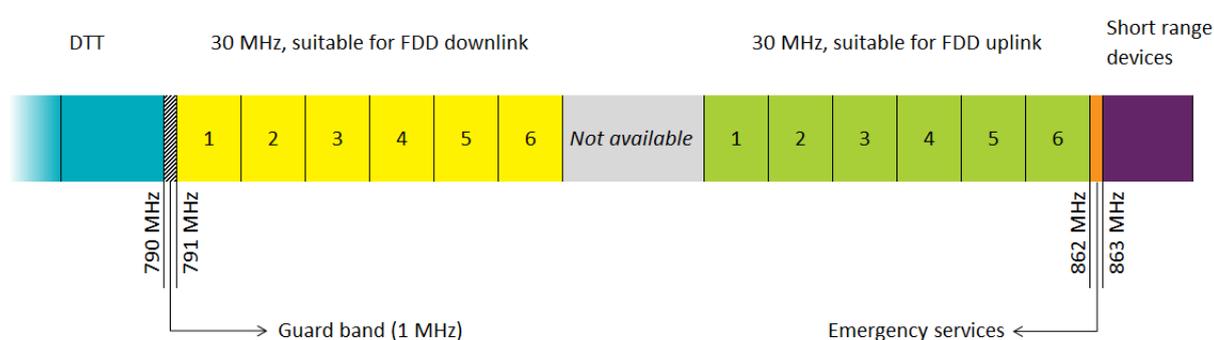
¹³ Document RA(10)94 in the 21st meeting of CEPT WGRA

Section 3

Band Plan and adjacencies for the 800 MHz band

- 3.1 The harmonised frequency arrangement for the 800 MHz band in Commission Decision 2010/267/EU is 2 x 30 MHz with a duplex gap of 11 MHz, based on a block size of 5 MHz, paired and with a guard band at 790-791 MHz. The Frequency Division Duplex (FDD) downlink starts at 791 MHz and FDD uplink starts at 832 MHz. This is illustrated by Figure 3.1 below.

Figure 3.1: The 800 MHz band and adjacent spectrum



DTT below 790 MHz

- 3.2 Alongside this consultation, Ofcom is separately consulting on our approach to the co-existence of new services in the 791 to 860 MHz band with adjacent DTT use in the bands below 790 MHz.
- 3.3 It is anticipated that specific additional technical restrictions may be needed for achieving the co-existence of new services in the 800 MHz band with adjacent DTT use. The technical licence conditions for the 800 MHz band given in section 4 do not take account of these additional restrictions. A discussion of these is contained in the consultation on coexistence of new services in the 800 MHz band with DTT.

Emergency Services in 862 to 863 MHz

- 3.4 The band 862 to 863 MHz is available to emergency services and a number of systems are in use throughout the UK. As reported in the March 2011 Consultation, studies indicate that future mobile terminal stations operating in the upper part of the 832 to 862 MHz uplink block may cause harmful interference to these services. We are also examining the management of potential interference from emergency services systems into mobile base stations at the top of the upper half of the 800 MHz band. We are currently liaising with the relevant Government departments and we anticipate that a mitigation plan will be put in place in time for the award, details of which will be provided in the information memorandum on the 800 MHz and 2.6 GHz award. At this stage, we do not anticipate that it will be necessary to impose permanent restrictions on the use of any portions of the 832 to 862 MHz uplink block to protect the emergency services systems.

Short range devices

- 3.5 A number of Short Range Devices (SRDs) operate in the EU harmonised frequency band between 863 and 870 MHz. The deployment of future mobile services in the 800 MHz band introduces a potential risk that these SRD applications may experience interference from terminal stations operating in the 832 to 862 MHz uplink block.
- 3.6 No licence is required to operate SRDs in the 863 to 870 MHz band and devices are deployed on a non-interference/non-protected basis, as defined by the European Commission¹⁴. The definition is reflected in the “Short range devices information sheet”¹⁵ published on the Ofcom website which states: *“If you receive interference from an authorised service that is operating within the terms of an appropriate licence or under licence exemption conditions, we cannot provide any protection; you or your SRD manufacturer must find a solution.”*
- 3.7 Nevertheless, in taking proposals on the award of the 800 MHz band forward, Ofcom has a general duty to consider the impact of its decisions on other spectrum users. We have therefore undertaken a preliminary technical analysis on the effect of the award on SRDs operating in the 863 to 870 MHz band.
- 3.8 There are a wide range of devices which use (or could use) the SRD band :
- The frequencies between 863 and 865 MHz are used mainly by audio devices including wireless headphones; assistive listening devices, such as amplified sound for the hard of hearing; and wireless microphones used in amateur situations such as schools and church halls (professional use of such equipment is licensed and deployed in other frequency bands).
 - The frequencies between 865 and 868 MHz are used mainly by so-called RFID devices i.e. the tracking and monitoring of cargo or stock in manufacturing or distribution industries.
 - The frequencies between 868 and 870 MHz are used mainly for telemetry devices (alarm and monitoring systems). These include commercial fire alarms, domestic intruder alarms, smart meters (for utilities), routine medical monitoring, and social alarms for the vulnerable (e.g. push button pendants worn by the elderly in sheltered accommodation).
- 3.9 The technical analysis commissioned by Ofcom¹⁶ was conducted first on anticipated worst-case scenarios and then using signals from a vendor’s test network and a terminal station¹⁷ emulator. In all cases, the level of anticipated interference was very dependent on what assumptions were made about the terminal station operation and the type of SRD. Such assumptions may not necessarily reflect accurately the true likelihood of interference. This is because LTE technology is in the very early stages of roll-out in Europe and actual operation may not reflect the simulation scenarios.

¹⁴ Commission Decision of 9 November 2006 on harmonisation of the radio spectrum for use by short-range devices (2006/771/EC) as amended (Article 3(1)). Recital 3 to the Commission Decision also provides “...radio-communications services..... have priority over short-range devices and are not required to ensure protection of particular types of short-range devices against interference.

¹⁵ <http://stakeholders.ofcom.org.uk/spectrum/spectrum-management/licence-exempt-radio-use/licence-exempt-devices/short-range-devices-information>

¹⁶ ERA Technology Ltd and Aegis Systems Ltd: Investigation on the receiver characteristics of SRD equipment in the 863 – 870 MHz band (published alongside this document)

¹⁷ 3GPP specifications use the term “user equipment”, or UE, for the terminal station

- 3.10 Using worst case assumptions, terminal stations can appear to be a source of potentially significant levels of interference, e.g. terminal stations operating relatively close to a SRD receiver, at near to maximum power and utilising a large number of resource blocks (amount of spectrum). Ofcom believes that circumstances where a terminal station is operating at full power and using all resource blocks are likely to be infrequent and very short lived. In tests under more likely circumstances, e.g. at larger distances, operating at lower power and using only a limited number of resource blocks, undue interference from terminal stations appears unlikely.
- 3.11 It therefore appears that users of SRD applications in the 863 to 870 MHz band are unlikely to suffer significantly more interference than already exists in this licence exempt band. Accordingly – and subject to the caveat below – we do not anticipate it will be necessary to impose licence restrictions on the use of any portions of the 832 to 862 MHz uplink block to protect SRDs.
- 3.12 However we recognise the need to give careful consideration to potential undue interference. In particular we intend to consider the case of social alarms further because users may on occasion rely on these types of devices to call for emergency assistance. We are currently carrying out a more detailed assessment of the potential for these devices to suffer interference, what actions may be necessary by Ofcom and others, and we are working with relevant stakeholders to explore appropriate solutions. We will provide details of our further findings in time for the information memorandum on the 800 MHz and 2.6 GHz award.
- 3.13 In all cases, there are a range of approaches to potential interference that could be adopted if SRD manufacturers and/or users are concerned. These could include migration to other frequency bands; changing the characteristics of signal transmission (such as ensuring social alarms use more robust signalling mechanisms); or providing advice or information.

Section 4

Technical licence conditions for the 800 MHz band

Technical licence conditions specified by Commission Decision 2010/267/EU

- 4.1 Commission Decision 2010/267/EU sets out the technical parameters that must apply to the use of the 800 MHz band for networks other than high-power broadcasting networks. The technical licence conditions that we propose to adopt are outlined below. They are fully consistent with those parameters.
- 4.2 The limit at any frequency is given by the highest (least stringent) value of (a) the baseline requirements, (b) the transition requirements, and (c) the in-block requirements (where appropriate).
- 4.3 The technical conditions are presented as upper limits on the mean equivalent isotropically radiated power (EIRP) or total radiated power (TRP)¹⁸ over an averaging time interval, and over a measurement frequency bandwidth. In the time domain, the EIRP or TRP is averaged over the active portions of signal bursts and corresponds to a single power control setting. In the frequency domain, the EIRP or TRP is determined over the measurement bandwidth specified in the tables. In general, and unless stated otherwise, the BEM levels correspond to the power radiated by the relevant device irrespective of the number of transmit antennas, except in the case of transition requirements for base stations, which are specified per antenna.
- 4.4 An in-block EIRP limit for base stations is not obligatory in Commission Decision 2010/267/EU. However, Member States may set limits and, unless otherwise justified, such limits would normally lie within the range 56dBm/(5 MHz) to 64dBm/(5 MHz). Our proposals for the in-block EIRP limit are in paragraphs 4.10 to 4.13.

Out-of-block limits for base stations

- 4.5 Out of block limits for base stations are set out in Tables 4.1 to 4.4.

Table 4.1: Baseline requirements — BS BEM out-of-block EIRP limits

Frequency range of out-of-block emissions	Maximum mean out-of-block EIRP	Measurement bandwidth
832 to 862 MHz (frequencies used for uplink)	-49.5 dBm	5 MHz

¹⁸ TRP is a measure of how much power the antenna actually radiates. The TRP is defined as the integral of the power transmitted in different directions over the entire radiation sphere.

Table 4.2: Transition requirements – base station out-of-block EIRP limits per antenna (for one to four antennas) over downlink frequencies (791 to 821 MHz)

Frequency range of out-of-block emissions	Maximum mean out-of-block EIRP	Measurement bandwidth
–10 to –5 MHz from lower block edge	18 dBm	5 MHz
–5 to 0 MHz from lower block edge	22 dBm	5 MHz
0 to +5 MHz from upper block edge	22 dBm	5 MHz
+5 to +10 MHz from upper block edge	18 dBm	5 MHz
Remaining downlink frequencies	11 dBm	1 MHz

Table 4.3: Transition requirements – base station out-of-block EIRP limits per antenna (for one to four antennas) over frequencies used as guard band

Frequency range of out-of-block emissions	Maximum mean out-of-block EIRP	Measurement Bandwidth
790 to 791 MHz	17.4 dBm	1 MHz
821 to 832 MHz	15 dBm	1 MHz

- 4.6 Commission Decision 2010/267/EU includes three sets of baseline requirements for frequencies below 790 MHz that can be applied per broadcasting channel and/or per region. In that decision the baseline requirements are designated as Case A for TV channels where broadcasting is protected, Case B for TV channels where broadcasting is subject to an intermediate level of protection and Case C for TV channels where broadcasting is not protected. The Commission Decision requires that Member States apply the baseline requirement of Case A in circumstances where digital terrestrial broadcasting channels are in use at the time of deployment of terrestrial systems capable of providing electronic communications services.
- 4.7 Member States are also required to take into account that Cases A and B reserve the option of bringing relevant broadcasting channels into use for digital terrestrial broadcasting at a future date, while Case C is appropriate where there are no plans to bring the relevant broadcasting channels into use. In order to retain the flexibility for DTT channels to be brought into use at a future date, we will apply Case A limits at all locations and for all DTT frequencies, regardless of whether those frequencies are in use at any given time in any given location.
- 4.8 We therefore propose that for all DTT frequencies out-of-block emissions be limited to the levels defined in Case A from all base stations. This means that the EIRP limits defined in Case A of Commission Decision 2010/267/EU will apply from 470 MHz to 790 MHz and will be applicable at all base stations. The limits in Table 4.4 are consistent with Case A defined in Commission Decision 2010/267/EU and the frequency range encompasses the full DTT spectrum.

Table 4.4: Baseline requirements – base station out-of-block EIRP limits over frequencies below 790 MHz

Frequency range of out-of-block emissions	Condition on base station in-block EIRP, P dBm/10 MHz	Maximum mean out-of-block EIRP	Measurement bandwidth
470 to 790 MHz	$P \geq 59$	0 dBm	8 MHz
	$36 \leq P < 59$	(P-59) dBm	8 MHz
	$P < 36$	-23 dBm	8 MHz

- 4.9 Please note, the out-of-block limits given in table 4.4 do not take account of any specific additional technical restrictions that may be needed for achieving the co-existence of new services in the 800 MHz band with adjacent DTT use. A discussion of these is contained in the consultation on coexistence of new services in the 800 MHz band with DTT.

Question 1: Do you have any comment on the proposal to apply the limits defined in Case A of Commission Decision 2010/267/EU for out-of-block emissions from base stations into all frequencies in the range 470 to 790 MHz, as set out in Table 4.4?

In-block limits for base stations

- 4.10 We propose an in-block limit for base stations as set out in Table 4.6.

Table 4.5: In-block requirements — base station in-block emission limit.

Maximum mean in-block power	61 dBm/(5MHz)
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- 4.11 The established practice for licences that we have issued in the 900 MHz, 1800 MHz and 2.1 GHz frequency bands is to include a maximum base station EIRP. For the 800 MHz band, including a 5 MHz measurement bandwidth will ensure that the in-block power density applies consistently to 5 MHz and 10 MHz uses of the spectrum.
- 4.12 As indicated above, Commission Decision 2010/267/EU does not require Member States to impose an in-band power limit but suggests that if one is applied it should normally be in the range 56 to 64 dBm/(5MHz) unless otherwise justified. We are proposing an in-band value of 61 dBm/(5MHz) which is within this range. A limit of 61 dBm/(5MHz) is consistent with the limit specified in Commission Decision 2008/477/EC for the 2.6 GHz band.
- 4.13 Please note, the in-block limits given in table 4.5 do not take account of any specific additional technical restrictions that may be needed for the co-existence of new services in the 800 MHz band with adjacent DTT use. A discussion of these is contained in the consultation on coexistence of new services in the 800 MHz band with DTT.

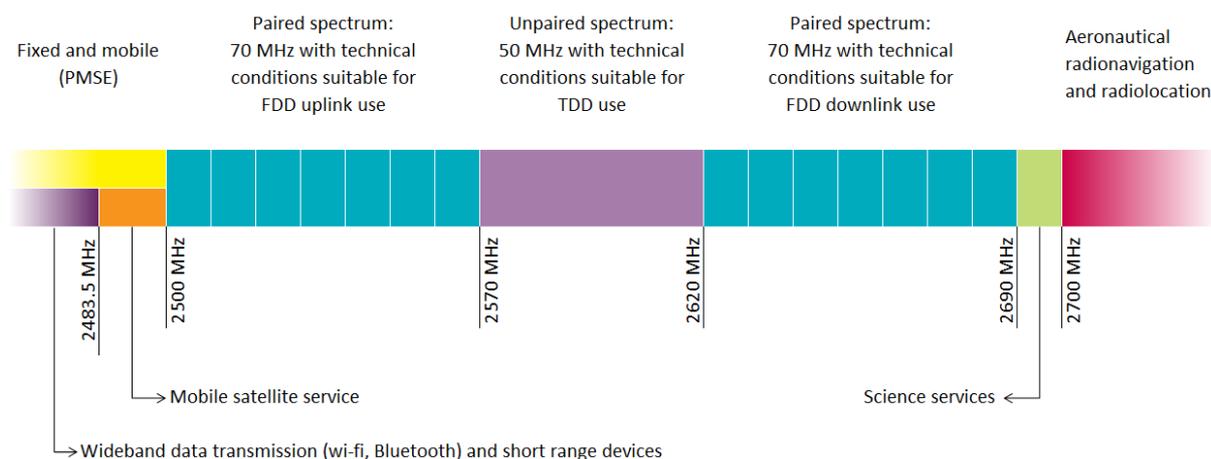
Question 2: Do you have any comment on the proposal to set an in-block emission limit of 61dBm/(5 MHz) for base stations in the 800 MHz band?

Section 5

Band plan and adjacencies for the 2.6 GHz band

5.1 Figure 5.1 below illustrates the UK band plan for 2.6 GHz and the usage in adjacent spectrum. The arrangement accords with the CEPT band-plan in ECC Decision (05)05¹⁹, which designates 2500 to 2570 MHz paired with 2620 to 2690 MHz for FDD use and 2570 to 2620 MHz for Time Division Duplex (TDD) use.

Figure 5.1: The 2.6 GHz band and adjacent spectrum



Services below 2500 MHz

- 5.2 Below 2500 MHz the spectrum is used by programme making and special events (PMSE) in the fixed and mobile service allocations at 2450 to 2500 MHz, wideband data transmission systems and short range devices (2400 to 2483.5 MHz), and mobile satellite (2483.5 to 2500 MHz). The UK Frequency Allocation Table²⁰ also contains secondary allocations to the radiolocation service and the radiodetermination-satellite service.
- 5.3 The April 2008 Information Memorandum²¹ for the award of 2500-2690 MHz and 2010-2025 MHz spectrum contained information on the use of the spectrum below 2500 MHz in paragraphs 2.18 to 2.24 and in paragraph 2.44. This information remains valid, except that the World Radiocommunication Conference will be held in 2012 and the work on consideration of the introduction of a Complementary Ground Component (CGC) of MSS in the band at 2483.5 to 2500 MHz has concluded with the publication of ECC Report 165. This report reached a general conclusion that the introduction of CGC in the 2483.5-2500 MHz band is not compatible with the systems in the same band such as radiodetermination-satellite service or PMSE where these systems are deployed, and would be very difficult with some systems deployed in the

¹⁹ <http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCDEC0505.PDF>

²⁰ <http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-policy-area/spectrum-management/ukfat2010.pdf>

²¹ <http://stakeholders.ofcom.org.uk/consultations/2ghzrules/statement/im/>

adjacent band such as the radionavigation satellite service or International Mobile Telecommunications (IMT).

Additional requirements on base station emissions for protection of radar above 2700 MHz

- 5.4 As indicated in the March 2011 Consultation and earlier information updates there is significant potential for in-band emissions from systems operating in the band 2500 to 2690 MHz to cause interference to aeronautical radionavigation radar, mainly used for air traffic control (ATC), operating in the bands above 2700 MHz. Ofcom has conducted extensive research into options for mitigating this interference by modifying affected radars. We are currently working with the radar operators, the Civil Aviation Authority, and Government to put in place a modification programme that will improve radars' resilience to emissions from outside their own band of operation. This should make them essentially immune to the in-band signals of base stations operating below 2690 MHz apart from those operating close to radar sites (within around 1 km where coordination with airports would ordinarily be expected).
- 5.5 In addition to being vulnerable to interference from outside of their own band, radars are susceptible to interference from unwanted base station emissions which fall within the radar band. This issue is addressed by the programme of radar modifications and will be managed by permanent coordination obligations. These are outlined below.

Interim coordination obligations

- 5.6 Whilst the modification programme is undertaken, Ofcom expects to impose interim coordination obligations on new licensees in the 2.6 GHz band to ensure the continued safe operation of aeronautical radar. These will require them to coordinate any base station whose in-band emissions would exceed a specific signal strength threshold at any radar site with the radar operator. We outlined the expected levels of necessary thresholds previously²². We have now undertaken work with the radar manufacturers to establish these levels with greater confidence and, once agreed and confirmed with relevant stakeholders, we intend to publish the details prior to the IM.
- 5.7 There are air traffic control radars across the UK, often close to major conurbations, and we estimate that the interim coordination obligations could initially affect as much as 43% of the UK land mass. A regional upgrade of the radars is planned, focusing on key areas such as London first. As and when radars are modified they will be removed from the interim coordination notice. The aim of the modification programme is that all susceptible radars in the vicinity of major conurbations will have been modified by the end of 2013, though this date cannot yet be confirmed.

Permanent coordination obligations

- 5.8 Both during and after the modification, radars operating above 2700 MHz will be susceptible to unwanted emissions falling within the radar band from base stations operating below 2690 MHz. In consequence it is likely that Ofcom will also impose a separate, permanent, requirement for base stations relatively close to radar sites to coordinate with the radar operators. Our initial thinking on how this requirement might be implemented is as follows:

²² http://stakeholders.ofcom.org.uk/binaries/spectrum/spectrum-awards/awards-in-preparation/757738/587_Information_Update_Coex1.pdf

- 2.6 GHz licensees will be required to coordinate with the radar operators any base station within a specified distance of a radar site (expected to have a value within the range of 10km to 15km) if the base station unwanted emissions, falling within the radar's operating bandwidth, exceed a specific signal strength threshold. The level of this threshold is still under consideration and we will publish details of this as soon as we are able. This would enable uncoordinated deployment within 10-15 km of a radar site for base stations whose unwanted emissions have been suppressed to a level below -45 dBm/MHz EIRP (the baseline requirements given in Table 6.1), to a lower level (for example -65 dBm/MHz EIRP) through filtering.
 - It will be the responsibility of the 2.6 GHz operators to establish whether they are likely to breach the coordination conditions using a methodology and propagation model specified by Ofcom (e.g. ITU-R P452 – 0.01% time) and coordinate the deployment of base stations when they are in breach of the conditions.
- 5.9 In addition to the coordination measures above, Ofcom is likely to impose an absolute coordination requirement on any 2.6 GHz base station within about 1km from any radar site. Any base station deployed within this zone will require coordination with the radar operators.
- 5.10 Further details of the coordination process will be provided in time for the information memorandum on the 800 MHz and 2.6 GHz award. We intend to hold workshops with affected stakeholders to develop in detail the required process.

Potential requirements relating to terminal stations

- 5.11 As well as being susceptible to interference from base stations, it is also possible that ATC radars could suffer interference from 2.6 GHz terminal stations which are very close to a radar site (less than 100 m or so). It may be that physical controls at an airport can adequately deal with this situation. However, there may be circumstances where this is not possible, for instance when there is uncontrolled public access close to a radar site. There may be a need for measures that would require a 2.6 GHz licensee to 'switch off' their 2.6 GHz terminal stations close to a radar or for terminal stations to be powered down if that radar is suffering harmful interference. Ofcom is currently considering whether this will be necessary and how the potential requirement might be implemented in 2.6 GHz licences. We will provide detail of this as soon as we can.

Maritime radars

- 5.12 In 2008 a report undertaken by Cobham Technical Services highlighted the possibility that future transmissions in the 3.4 GHz band and to a lesser extent transmissions in the 2.6 GHz band might cause interference to maritime radars operating in the S-band. Following publication of this report Ofcom and the MCA agreed that further work was required to deepen our understanding of this issue.
- 5.13 We have therefore carried out technical analysis²³ of the likely impact of 2.6 GHz transmissions on maritime radars operating above 2900 MHz and liaised with the maritime community regarding this issue. We have supplied this information to the MCA and the maritime stakeholder community. To date we have not received any evidence that interference into maritime radars from 2.6 GHz transmissions would impact on their operational use. We note that maritime radars are in use around the

²³ To be published shortly.

world in regions where 2.6GHz radio equipment is deployed. We therefore have no plans to impose additional restrictions on the use of the 2.6 GHz band to protect maritime radar operating in the bands above 2900 MHz.

Section 6

Technical licence conditions for the 2.6 GHz band

Technical licence conditions specified by Commission Decision 2008/477/EC

- 6.1 Commission Decision 2008/477/EC sets out the technical parameters that must apply to the use of the 2.6 GHz band. The technical licence conditions that we propose to adopt are outlined below. They are fully consistent with those parameters.
- 6.2 The technical conditions are presented as upper limits on the mean EIRP or TRP over an averaging time interval, and over a measurement frequency bandwidth. In the time domain, the EIRP or TRP is averaged over the active portions of signal bursts and corresponds to a single power control setting. In the frequency domain, the EIRP or TRP is determined over the measurement bandwidth specified in the tables.
- 6.3 Commission Decision 2008/477/EC places the Block Edge Masks (BEMs) for base stations in two categories: unrestricted blocks and restricted blocks. The parameters for the unrestricted blocks are clearly defined, but in cases where antennas are placed indoors or where the antenna height is below a certain height, a Member State may adopt an alternative BEM, which is clearly defined and referred to as the “alternative block edge mask”. The Commission Decision 2008/477/EC does not define the “certain height”.
- 6.4 The BEM for an unrestricted spectrum block is built up by combining the baseline requirements and the block specific requirements (in-block and out-of-block requirements).

Guidance in CEPT Report 19

- 6.5 It is noted that CEPT Report 19 provides additional clarification about the applicable frequency limits for the base station out of block baseline limit. According to Table A4.1 and footnote 29 of the CEPT Report, the +4dBm/MHz baseline limit is not applicable to frequencies above 2690 MHz.

Unrestricted block limits for base stations

- 6.6 The emission limits for an unrestricted spectrum block are built up by combining Tables 6.1, 6.2 and 6.3 in such a way that the limit for each frequency is given by the higher value out of the baseline requirements and the block specific requirements.
- 6.7 The frequency range in the second row of Table 6.1 extends beyond that in Commission Decision 2008/477/EC, since that Decision only deals with frequencies inside the 2.6 GHz band. The lower frequency limit of 2460 MHz is based on the edge of the out-of-band domain for the widest bandwidth systems envisaged for this band. The upper frequency limit is in place to ensure a consistent limit across the entire radar band.

Table 6.1: Baseline requirements – base station out-of-block EIRP limits

Frequency range of out-of-block emissions	Maximum mean out-of-block EIRP	Measurement bandwidth
Frequencies allocated to FDD down link and 5 MHz below and 10 MHz above the range of frequency blocks allocated to FDD down link.	4 dBm	1 MHz
Frequencies in the range 2460-3100 MHz not covered by the definition above.	-45 dBm	1 MHz

Table 6.2: Block specific requirements – unrestricted base station in-block EIRP limit

Frequency range of in-block emissions	Maximum mean in-block power
Paired downlink frequencies	61 dBm/(5 MHz) EIRP
Downlink use of standard unpaired frequencies	61 dBm/(5 MHz) EIRP

Table 6.3 Block specific requirements – base station out-of-block EIRP limits

Frequency range of out-of-block emissions	Maximum mean out-of-block EIRP	Measurement bandwidth
Start of band (2500 MHz) to -5 MHz from lower block edge	Baseline requirement level	
-5 MHz to -1 MHz from lower block edge	4 dBm	1 MHz
-1 MHz to -0.2 MHz from lower block edge	$+ 3 + 15(\Delta_F + 0.2)$ dBm	30 kHz
-0.2 MHz to 0 MHz from lower block edge	3 dBm	30 kHz
0 MHz to 0.2 MHz from upper block edge	3 dBm	30 kHz
0.2 MHz to 1 MHz from upper block edge	$+ 3 - 15(\Delta_F - 0.2)$ dBm	30 kHz
1 MHz to 5 MHz from upper block edge	4 dBm	1 MHz
5 MHz from upper block edge to end of band (2690 MHz)	Baseline requirement level	

Where: Δ_F is the frequency offset from the relevant block edge (in MHz)

Restricted block limits for base stations (unpaired frequencies)

- 6.8 To manage interference between paired and unpaired use, restricted blocks are required at 2570 to 2575 MHz and at 2615 to 2620 MHz. A 5 MHz restricted block will also be required between unpaired licensees in adjacent frequency blocks unless the 2570 to 2620 MHz spectrum were awarded as a single block.
- 6.9 The emission limits for a restricted spectrum block are built up by combining Tables 6.1 and 6.4 in such a way that the limit for each frequency is given by the higher value out of the baseline requirements and the block specific requirements.

Table 6.4: Block specific requirements – base station in-block EIRP limit for restricted unpaired frequencies

Frequency range of in-block emissions	Maximum mean in-block power
Downlink use of restricted unpaired frequencies	25 dBm/(5 MHz) EIRP

Alternative out-of-block limits for base stations with additional restrictions on antenna placement

- 6.10 In cases where base station antennas are placed indoors or where the antenna height is below a certain level alternative out-of-block emission limits may be used in line with Table 6.5 provided that the in-block power limit in Table 6.4 remains valid nationwide. Commission Decision 2008/477/EC requires that the out-of-block limits in Table 6.1 always apply at geographical borders to other Member States. We have agreed limits on emissions across the borders with France and Ireland and these are set out in Memoranda of Understanding. These Memoranda were published for information as annexes 3 and 4 of the April 2008 Information Memorandum²⁴ for the award of 2500-2690 MHz and 2010-2025 MHz spectrum and are still valid.
- 6.11 Our proposed conditions on use of the alternative out-of-block EIRP limits given in Table 6.5 relate to base station height and base station antenna location, both of which must be satisfied.
- 6.12 We propose that the alternative block edge mask could be used by TDD base stations in restricted blocks meeting the following conditions on base station antenna placement:
- i) antennas placed indoors at a separation greater than 70m from the nearest base station that uses the frequency block immediately below the restricted block; where the nearest such base station has an EIRP of 30dBm or lower, this separation may be reduced to 20m; or
 - ii) antennas placed outdoors at a height which is no greater than 12m above ground level and at a separation greater than 160m from the nearest base station that uses the frequency block immediately below the restricted block; where the nearest such base station has an EIRP of 30dBm or lower, this separation may be reduced to 40m.
- 6.13 Meeting these antenna placement conditions would require the two licensees either side of the 2570 MHz frequency boundary and any two TDD licensees in adjacent frequency blocks in the 2570 to 2620 MHz spectrum to share information about the locations and power class of their base stations in order to meet these antenna placement conditions.
- 6.14 Our conditions on antenna placement have been determined as a result of the recent study conducted by Real Wireless²⁵ in which various scenarios and equipment classes were modelled. The threshold for an acceptable level of uplink interference from a restricted TDD block to an adjacent FDD block was considered to be the same as that which would be received from a normal FDD uplink into an adjacent channel. This acceptable level of interference was found by 3GPP to result in no more than 10% throughput degradation for 95% of users²⁶.

²⁴ <http://stakeholders.ofcom.org.uk/consultations/2ghzrules/statement/im/>

²⁵ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

²⁶ <http://www.3gpp.org/ftp/Specs/html-info/36942.htm>

Table 6.5: Block specific requirements – alternative base station out-of-block EIRP limits for restricted block with additional restrictions on antenna placement

Frequency range of out-of-block emissions	Maximum mean out-of-block EIRP	Measurement bandwidth
Start of band (2500 MHz) to -5 MHz from lower block edge	-22 dBm	1 MHz
-5 MHz to -1 MHz from lower block edge	-18 dBm	1 MHz
-1 MHz to -0.2 MHz from lower block edge	$-19 + 15(\Delta_F + 0.2)$ dBm	30 kHz
-0.2 MHz to 0 MHz from lower block edge	-19 dBm	30 kHz
0 MHz to 0.2 MHz from upper block edge	-19 dBm	30 kHz
0.2 MHz to 1 MHz from upper block edge	$-19 - 15(\Delta_F - 0.2)$ dBm	30 kHz
1 MHz to 5 MHz from upper block edge	-18 dBm	1 MHz
5 MHz from upper block edge to end of band (2690 MHz)	-22 dBm	1 MHz

Where: Δ_F is the frequency offset from the relevant block edge (in MHz)

Question 3: Do you agree with the proposed conditions on antenna placement that would permit the use of the alternative block-edge mask for restricted unpaired blocks? If not, please explain your reasoning and your alternative proposals, bearing in mind the need to remain consistent with the framework provided in Commission Decision 2008/477/EC.

Question 4: Meeting the conditions on the use of the alternative block edge mask for restricted TDD blocks would require certain licensees to share information about the locations of their base stations. Do you agree with this proposed approach?

Section 7

Low-power shared access in paired 2.6 GHz spectrum

Introduction

- 7.1 Ofcom is consulting on the possibility of making available, whether through competition in the auction or explicit reservation, a block of paired 2.6 GHz spectrum for low-power shared access, in which each licensee would have 'shared' (non-exclusive) access to the spectrum.
- 7.2 Use of low-power access may be of potential benefit to operators who wish to deliver competitive services indoors or in localised outdoor environments using a variety of low-power cells (e.g. picocells and femtocells). Particular advantages of such deployments compared with macrocells include a high cell density, resulting in a high capacity density, and generally good signal quality. In addition, the indoor environment allows MIMO antenna technology to work well.
- 7.3 There are two scenarios under consideration for low-power shared access²⁷:
- 2 x 10 MHz or 2 x 20 MHz of spectrum dedicated to shared low-power access, in which spectrum is available for shared low-power access alone and not for standard power use. We refer to this option as "dedicated low-power shared access".
 - 2 x 20 MHz of spectrum, half of which is available for low-power shared access alone (2 x 10MHz) and the other half of which is shared with a standard-power licensee (2 x 10 MHz). We refer to this option as "hybrid low-power shared access".
- 7.4 Each scenario has particular technical considerations, and implementation would be through a combination of technical licence conditions and management of interference risk through use of an industry Code of Practice on Engineering Coordination.
- 7.5 In order to form a judgement on the scenarios under consideration we have drawn on work previously undertaken by Real Wireless and published by Ofcom²⁸ in which a number of typical low-power shared access deployment scenarios were considered, including residential, public spaces, campuses and business parks. The study addressed the options of dedicated low-power shared access, hybrid low-power shared access as well as a complete low-power underlay to the standard-power spectrum. The complete low-power underlay approach was shown to present considerable challenges not only in terms of protection to the overlapping standard-power operator, but also in terms of ensuring low-power operators could provide an

²⁷ Note that we are concerned here with the technical conditions for different scenarios for shared spectrum use, and not with the regulatory process by which any particular scenario might come to pass. We have as yet made no decision about whether, and if so how, 2.6GHz spectrum might be made available for shared low-power use.

²⁸ <http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/annexes/real-wireless-report.pdf>

adequate level of service in areas of overlapping deployment. Accordingly the low-power underlay is not considered further in this consultation.

- 7.6 Ofcom has commissioned a further technical study by Real Wireless²⁹ in which the hybrid option was given more detailed consideration. The study assessed the impact on standard-power networks operating within the vicinity of low-power networks, and what measures would need to be taken to mitigate the interference risks. Attention was also given to the number of licensees that can be accommodated in a low-power shared access block in areas of overlapping deployment. In addition, the optimal positioning of the low-power block was investigated under the assumption that spectrum emission limits outside the 2620 MHz to 2690 MHz band would be met by unmodified low-power access points with cost-effective installation measures.
- 7.7 The Real Wireless studies have generally assumed that LTE will be the technology adopted for low-power shared access. However, the intention will be for any low-power shared access licences to be technology neutral.

Consideration of dedicated and hybrid scenarios for low-power shared access

Dedicated low-power shared access

- 7.8 In this scenario a block of spectrum is dedicated to shared low-power access (this may be as a consequence of the result of the auction). The amount of spectrum concerned might be either 2 x 10 MHz or 2 x 20 MHz.
- 7.9 Compared with the hybrid low-power access option discussed below, the determination of the relevant technical licence conditions for this scenario is relatively straightforward.

2 x 10 MHz dedicated low-power shared access

- 7.10 If 2 x 10 MHz of the paired spectrum is dedicated to low-power shared access, the remaining 2 x 60 MHz of spectrum, not necessarily in a contiguous block, will be available for standard-power licensees.

2 x 20 MHz dedicated low-power shared access

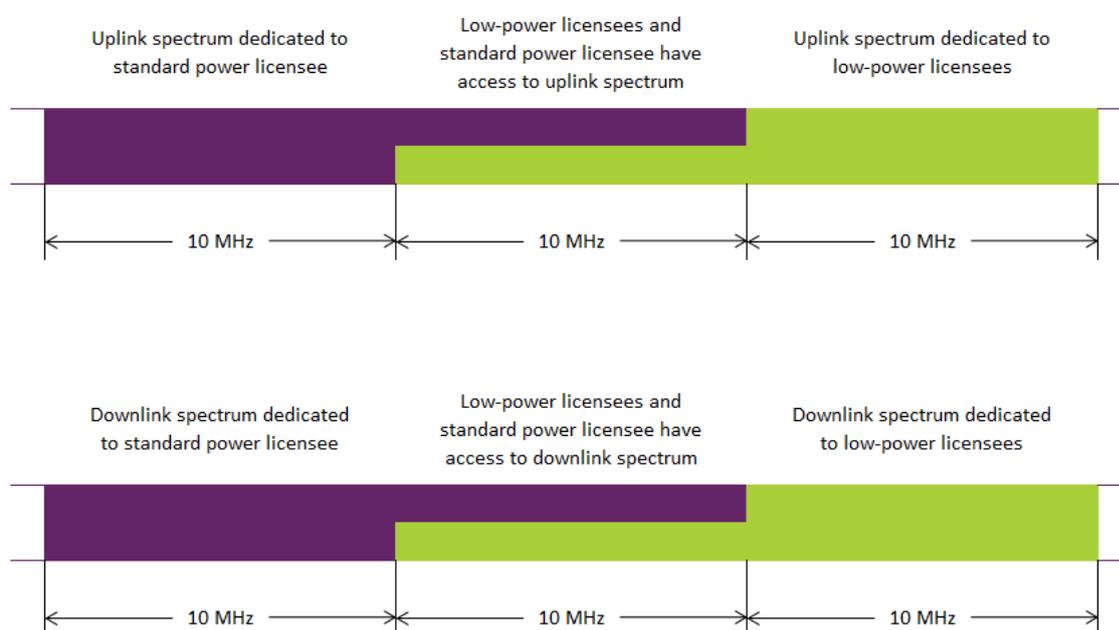
- 7.11 If 2 x 20 MHz of the paired spectrum is dedicated to low-power shared access, the remaining 2 x 50 MHz of spectrum, not necessarily in a contiguous block, will be available for standard-power licensees.
- 7.12 In comparison to use of 2 x 10 MHz dedicated low-power shared access, use of 2 x 20 MHz gives low-power operators the ability to use the higher bandwidth to maximise the benefits of small cells, with higher peak data rate services and likely consequent higher levels of user satisfaction. The higher bandwidth would also allow greater flexibility in terms of the dynamic scheduling required to manage interference from other sharers of the low-power block, thereby reducing the impact of sharing the block when several operators deploy in the same geographical area.

²⁹ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

Hybrid low-power shared access

- 7.13 An alternative option is to allow 2 x 20 MHz to be used for low-power shared access, but arrange the positioning such that half of this block (i.e. 2 x 10 MHz) overlaps, forming an underlay, with a standard-power block. For reasons discussed below we believe it will be important for the standard-power licensee also to have at least 2 x 20 MHz of 2.6 GHz paired spectrum in total i.e. at least 2 x 10 MHz in addition to the shared 2 x 10 MHz block.
- 7.14 The benefit of this option is that in the right circumstances, low-power shared access operators may have access to a full 20 MHz of spectrum. 2 x 60 MHz of standard-power spectrum, not necessarily contiguous, will still be available, albeit one of the licensees will be sharing some of their spectrum with low-power shared access operators.
- 7.15 In the event that the 10 MHz low-power underlay part becomes unusable, e.g. because its use would cause unacceptable interference to the overlapping standard-power licensee, the low-power operator still has the remaining (dedicated) 10 MHz as a fallback option meaning that low-power operators will still be able to provide wireless service. Likewise the standard-power licensee could fall back to operating its dedicated 10 MHz in cases where the situation is reversed.
- 7.16 Figure 7.3 shows the arrangement of hybrid low-power shared access with a low-power block partially underlaying a standard-power block.

Figure 7.3: 2 x 20 MHz hybrid low-power shared access



- 7.17 The recent Real Wireless study³⁰ addressed the technical feasibility of the hybrid low-power option and the steps that would be necessary to protect standard-power network performance. The focus was upon management of interference in the 10 MHz of spectrum used by both standard-power and low-power shared access networks. Concerns relate to low-power operation causing interference zones in standard-power coverage, particularly at the edge of low-power cells. Also,

³⁰ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

standard-power base station receivers may be desensitised by interference, thus reducing performance across the whole of the standard-power cell.

- 7.18 Ofcom has made no decision at this stage over whether the standard-power network or low-power networks should have priority in terms of one usage mode being required to protect the other from interference. However, in either case, the hybrid low-power shared access option requires appropriate technical licence conditions and clear guidelines on how to avoid interference to both data and control channels.
- 7.19 In the event that the standard-power network is given priority, there is likely to be an impact upon low-power shared access operation when in the same deployment areas as standard-power networks, and, in practice, the transmit powers of the low-power base stations and terminal stations may have to be constrained in order to limit the interference to standard-power networks.

Implementation of dedicated or hybrid options

- 7.20 Ofcom is still considering whether to implement the dedicated or hybrid options if we go ahead with the proposals for low-power shared access.

Question 5: We welcome comments on stakeholders' preference for the dedicated or hybrid options for low-power shared access as discussed above.

Placement of the low-power shared access block

- 7.21 Ofcom is still considering options for the placement of any low-power shared access block if we go ahead with the proposals to make spectrum available for this application.
- 7.22 For the purposes of this analysis we have assumed that low-power shared access operators are likely to want to be able to deploy readily available access points (i.e. standard units placed upon the European markets). The relatively stringent out-of-block emissions limits above 2700 MHz and below 2615 MHz (see section 6) may mean that additional filtering is required to reduce base station emissions to the required limits. The small form factor of low power access points implies that if low-power spectrum is placed at the top or bottom of the band, any additional filtering requirements could be difficult to achieve (given the limited frequency space within which the filter needs to roll-off). The level of difficulty in meeting the out-of-block limits will therefore be dependent upon the placement of the low-power block within the 2.6 GHz band.
- 7.23 The recent Real Wireless study³¹ examined the optimum frequency placement for low-power access units on the basis of reasonable assumptions about the performance of such low-power units, the associated antenna gain and any additional filtering it may be reasonable to include as a cost-effective installation measure. The unwanted emission levels investigated by the study were a) -65 dBm/MHz³² EIRP and b) -45 dBm/MHz EIRP above 2700 MHz and -45 dBm/MHz below 2615 MHz³³.

³¹ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

³² This level was chosen as it is indicative of a level likely to be needed for uncoordinated deployment of base stations at distances between about 1 km and about 10 to 15 km from a radar – see section 5.

³³ The -45 dBm levels above 2700 MHz and below 2615 MHz reflect the limits in section 6.

- 7.24 In accordance with these levels there are optimal positions within the 2.6 GHz paired spectrum for placement of the low-power block.
- 7.25 On the basis of taking “optimum placement” to mean no additional filtering is required, the optimum placements are given in Table 7.1. In some, in order to avoid additional filtering, the Real Wireless study indicates that an operator might need to restrict the maximum transmit power of their base stations to below 30 dBm: this is indicated in the fourth column.

Table 7.1 Optimal placement of the low-power block within the 2.6GHz band

Unwanted emission level above 2700 MHz	Low-power block bandwidth	Optimum channel centre frequency (MHz)	Maximum transmit power to avoid additional filtering
-65 dBm/MHz EIRP	10 MHz	2635	28dBm
	20 MHz	2650	25dBm
-45 dBm/MHz EIRP	10 MHz	2635 to 2675	30dBm
	20 MHz	2650 to 2660	30dBm

- 7.26 As already indicated, Ofcom has not decided where in the 2.6 GHz band any low-power shared access block might be placed. The optimum placements given in Table 7.1 are purely indicative and should not be taken to imply that frequency placements outside these ranges are ruled out.

Question 6: We welcome comments on the appropriate frequency placement for low-power spectrum blocks?

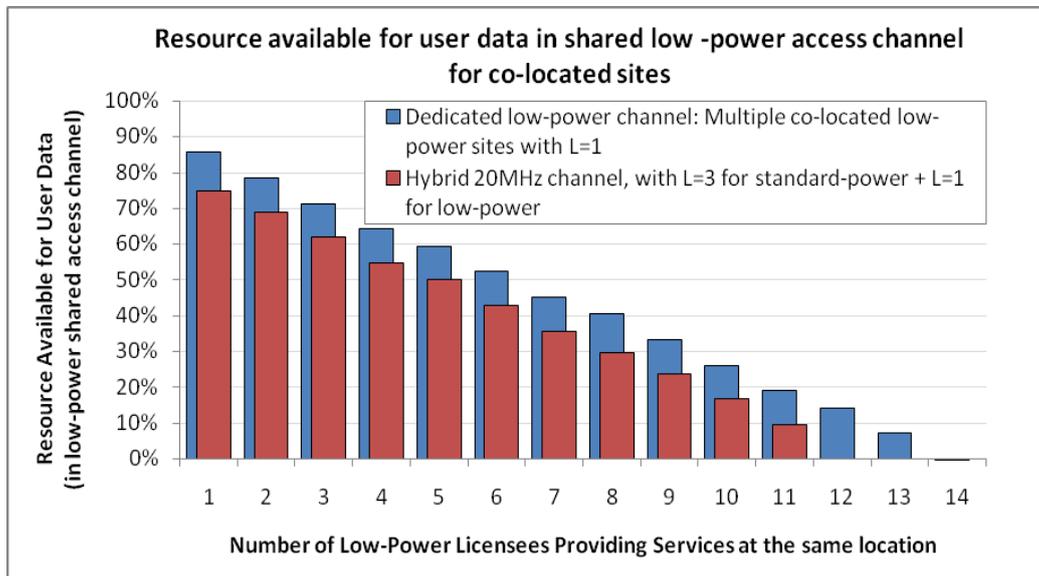
Number of low-power licences

- 7.27 Whilst we are not proposing in this consultation to limit the overall number of licences that may be awarded for low-power shared access on technical grounds, there may be technical reasons for a practical upper bound to the number of cells from different licensees that can operate with overlapping coverage. This has been explored in the recent Real Wireless study³⁴ with particular focus on a dedicated 10 MHz low-power access channel and a 20 MHz hybrid low-power access channel. Both standard-power and low-power shared access licensees were assumed to operate using LTE in this analysis.
- 7.28 The fundamental assumption underpinning this analysis is that multiple cells can operate on the same channel at the same location provided that the relevant control channels are not transmitted on the same (time, frequency) slots and that this can be achieved through control of the relative frame timing, carrier frequency position and bandwidth parameters. It was further assumed that the data channel power can be reduced to protect control channels in co-existing cells.
- 7.29 It is co-ordination of control channels that presents a fundamental limit for cells sharing spectrum in the same geographical area, meaning that the percentage of resources allocated to control channels increases with the number of co-existing low-power shared access licensees.

³⁴ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

7.30 Figure 7.2 shows the percentage of resource available for user data in the low-power shared access channel as the number of co-located low-power cells increases. The assumptions behind the calculations are given in the recent Real Wireless report³⁵.

Figure 7.2 Resource available for user data for co-located sites



7.31 There is clearly a point at which the overheads associated with multiple operators having concurrent access to the same channel become too great. The hybrid channel scheme also appears to result in a smaller percentage of resource available for user data. This is because the standard power cell is assumed to use more control channel overhead than any of the lower power cells as it is likely to be serving more users with its larger cell size.

7.32 In summary, there may be technical reasons that give a practical limit to the number of low-power shared access base stations from different operators that could operate in the same coverage area. However, that does not imply that the number of low-power shared access licences need to be limited to this number. For example, for residential access points where coverage is limited to individual homes it is very unlikely that there would be more than one operators' equipment per home. In other circumstances, roaming agreements and/or infrastructure sharing between low-power shared access operators could provide more efficient solutions to providing services in overlapping coverage areas than each operator installing their own base station. To be clear, Ofcom has not yet made a decision on the number of low-powered shared access licences that are likely to be made available. The technical limitations described above will be just one of a number of considerations that will be taken into account when making that decision.

Interference mitigation techniques

7.33 Use of a block of spectrum by concurrent licensees in close proximity to one another presents particular challenges through potentially high interference levels affecting neighbouring base stations and terminal stations. This could directly affect users' quality of service.

³⁵ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

- 7.34 Under the hybrid shared access mode, coexistence with an overlapping standard-power network in the same vicinity presents challenges, both in terms of low-power networks affecting the quality of service of standard-power service users and the standard-power networks impacting upon the low-power networks.
- 7.35 Ideally the interference between licensees could be managed through judicious placement of equipment. However deployment of low-power equipment may include installation by end-users. It is unrealistic to expect the majority of these users to appreciate the benefit of careful placement of equipment, and consequentially the outcome may be less than optimal.
- 7.36 In order to ensure that low-power shared access is feasible, a number of mitigation techniques can be used to ensure that interference to both data channels and control channels is limited. Mitigation ideally includes control of power, scheduling of resource allocation, and frequency and timing adjustments, all relying upon base stations and terminal stations being able to monitor their environment and respond to management commands from the network operator.
- 7.37 Modern mobile technologies, such as LTE, have the relevant monitoring and control functionality built into the standards. These mitigation measures could therefore be implemented in low-power networks, provided that the systems include this functionality.
- 7.38 Sharing of information between operators, for example base station locations, identities and transmit powers, as well as measurement reports, can also be of substantial benefit in optimising performance, though not all operators may want to participate in sharing of information and it may not be practical to share information about residential access points.
- 7.39 Other measures can also be used to protect the user experience, including roaming between networks or even radio access network sharing.
- 7.40 Monitoring of the radio environment can include base stations and terminal stations measuring the received power from potential “victim” base stations. The particular benefit of these measures is that they allow an estimate of the relevant received power or coupling losses to be made, thus allowing appropriate power control to be applied to the base stations (to protect the “victim” downlink) and to the terminal stations (to protect the “victim” uplink). In situations where power control alone is not sufficient to provide adequate protection, the shared portion of the spectrum in the hybrid access option can be avoided entirely or split between standard-power and low-power operators to avoid interference. Such measures could be the prime means of interference mitigation if the hybrid low-power shared access option is adopted.
- 7.41 In determination of the appropriate technical licence conditions for low-power shared access, we need to ensure that the restrictions are sufficient to provide adequate protection for other licensees in line with their type of licence (standard or shared), but not so restrictive as to stifle innovation and consequent efficient use of the spectrum.
- 7.42 Accordingly the proposed licence conditions only provide restrictions on transmit power and antenna placement. It is additionally proposed that low-power operators would be required to participate in an industry Code of Practice on Engineering Coordination, the key considerations of which are detailed in paragraphs 7.57 to 7.57 of this document. For the avoidance of doubt, the out-of-block limits in section 6 would still apply.

Technical licence conditions for low-power shared access

- 7.43 To manage interference risks we propose placing emission limits on the use of low-power shared access spectrum blocks. We also propose placing restrictions on the placement of outdoor base station antennas.
- 7.44 The proposed base station emission limits for a low-power shared access spectrum block are built up by combining Tables 6.1, 6.3 and 7.2 in such a way that the limit for each frequency is given by the higher value out of the baseline requirements and the block specific requirements.

Table 7.2: Block specific requirements – base station in-block EIRP limit for low-power shared access blocks for outdoor antenna placement

Frequency range of in-block emissions	Maximum mean in-block power
Downlink use of low-power shared access paired frequencies	30 dBm EIRP

- 7.45 A maximum mean in-block power limit of 30dBm EIRP has been proposed as this limits potential interference but is considered sufficient for provision of coverage in the majority of situations where low-power access may be deployed, including provision of indoor coverage from outdoor access points³⁶. This value is consistent with studies based on the assumption of a Local Area Base Station, as defined by 3GPP³⁷, with up to 6dB antenna gain.
- 7.46 In addition to the emission limits we also propose that base station antennas placed outdoors are at a height of no greater than 12m above ground level. We are not proposing to place a height restriction on the use of the low-power shared access block for base station antennas placed indoors.
- 7.47 Proposed in-block limits for low-power shared access terminal stations are set out in Table 7.3. This value aligns with that in ETSI EN 301 908-13³⁸. It is recognised that the value in EN 301 908 also includes limits to take account of tolerance and measurement uncertainty.

Table 7.3 In-block requirements for low-power shared access terminal stations in the 2.6 GHz band

Frequency range of in-block emissions	Maximum mean in-block power
Uplink use of low-power shared access paired frequencies	23 dBm EIRP

Question 7: Do you agree with our proposed technical licence conditions for low-power access?

Additional restrictions for hybrid low-power shared access

- 7.48 If the hybrid low-power access option is adopted, additional technical licence conditions will be needed to ensure that spectrum can be shared in a manner that

³⁶ See the Real Wireless study at <http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/annexes/real-wireless-report.pdf>

³⁷ <http://www.3gpp.org/ftp/Specs/html-info/36104.htm>

³⁸ Available at <http://pda.etsi.org>

minimises the interference risks between the overlapping standard-power and low-power shared access networks.

- 7.49 We are not in this consultation proposing the detail of these additional technical licence conditions as they are likely to depend on the specific technology choices licensees make and their ability to implement algorithms to control base station and terminal station powers based on detailed measurements of the base stations of neighbouring networks.
- 7.50 In cases where such measurement and control processes are either not adequate or not possible, we believe that additional technical licence conditions based on minimum separation distances between low-power and standard-power antenna placement will be required to ensure that service areas of each do not overlap.
- 7.51 It is likely that these minimum separation distances may need to be relatively large and be based upon:
- the transmit EIRP of the base station with relative higher priority (with a distinction between whether the transmit power is above or below, for example, 30 dBm EIRP);
 - whether the base station antenna with lower relative priority is a) indoors or b) outdoors and below a certain height.
- 7.52 For technologies such as LTE, that are sophisticated in their response to the radio environment, the standards having been developed to ensure optimal and adaptive use of spectrum even in the presence of interference, an alternative approach to the additional technical licence conditions is possible. The benefit of this would be that the standard-power and low-power shared assess service areas could, in many instances, overlap. This would be conditional upon low-power and standard-power systems using 'compatible' technologies and having mitigation measures in place based upon measurements and control of base station and terminal station transmit powers in accordance with clearly defined algorithms.
- 7.53 We have not decided on the relative priority for access to spectrum shared between standard-power networks and low-power networks, but use of sophisticated mitigation measures will allow not only maximal benefit in sharing with other users of the low-power shared access spectrum, but can also minimise the impact upon standard-power networks.
- 7.54 Real Wireless in their recent study³⁹ have analysed how interference mitigation could work if a hybrid low-power shared access option is adopted. It was assumed that the standard-power network would have priority for access to the shared spectrum, and an LTE technology-base for standard-power and low-power networks was adopted. The study proposed co-ordination rules for protection of standard-power uplink and standard-power downlink.
- 7.55 An illustration of the technical capabilities needed to allow the alternative additional technical licence conditions (i.e. not based on avoiding overlapping service areas by imposing relatively large separation distances) are provided below:
- the relevant base stations and terminal stations can measure the downlink power received from the base stations of the network to be protected;

³⁹ Available at: <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

- relevant base stations can perform power control in accordance with a defined algorithm; and
- the relevant terminal stations can be power controlled in accordance with a defined algorithm.

7.56 It is likely that the alternative additional technical licence conditions will need to, as a minimum, define:

- the specific base station and terminal station receive power measurements to be made;
- the frequency and accuracy required for these measurements; and
- the detailed base station and terminal station power control algorithms.

Question 8: We welcome comments from stakeholders on the additional restrictions and technical measures we have outlined for the management of interference under the hybrid approach, and the technical licence conditions that would be necessary to implement them.

Code of practice on engineering coordination for low-power shared access

7.57 Where more than one licensee wishes to provide services in an area of overlapping coverage, it is likely that they will need to co-ordinate their use of shared spectrum. Such engineering coordination could be facilitated by the development of an industry code of practice agreed by low-power licensees.

7.58 We therefore propose that licences for low-power shared access in 2.6 GHz should include amongst their conditions that:

- Licensees must use their best endeavours to agree with each other, within six months after the issue of the Licences, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination). The Code and any subsequent amendments to it must be notified to Ofcom in writing. The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that stations for wireless telegraphy and apparatus for wireless telegraphy shall be established or installed, sited, used and transmit in a manner that will allow services in the spectrum block, whether similar, competing or otherwise, to be employed in neighbouring locations (including locations on different floors on the same building).
- Licensees shall use their best endeavours to adhere to the Code of Practice on Engineering Coordination once it is agreed.

7.59 We propose that in developing the Code of Practice on Engineering Coordination the licensees will be required by the licences at a minimum to consider principles relating to:

- avoidance of interference by limiting transmission power to that which is no greater than necessary for service of customers;

- selection of sites in a manner that will minimise the probability of interference arising;
 - siting of equipment in a manner that will minimise the probability of interference arising; and
 - arrangements for communicating information between companies to facilitate engineering coordination.
- 7.60 The licensees would be required to use their best endeavours to adhere to the agreed Code of Practice on Engineering Coordination when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.
- 7.61 In the case that the hybrid approach to low-powered shared access is adopted, the overlapping standard-power licensees would not be required to participate in the development of the Code of Practice on Engineering Coordination; however they may choose to participate in development of those aspects of the Code for which mutual co-operation between the low-power shared access and standard-power licensees is beneficial to all parties.
- 7.62 We also propose that the low-power shared access licence give Ofcom the power to impose an engineering coordination procedure if necessary (e.g. where licensees either fail to agree the Code or where it is clear that the objective sought by the Code is not being achieved either through lack of cooperation or shortcomings in the Code itself).
- 7.63 As a matter of policy, Ofcom will not have a role in resolving individual engineering coordination disputes. Ofcom would only become involved where the objectives sought by the Code of Practice on Engineering Coordination are clearly not being secured. Such involvement would be limited to the imposition by Ofcom of a Code of Practice setting out a relevant engineering coordination procedure rather than the micro-management of individual coordination requests. Where a licensee fails to abide by a Code of Practice that has been imposed by Ofcom, this will be treated like any other breach of licence conditions and therefore it is possible that it could lead to Ofcom revoking the licensee's licence.

Question 9: Do you agree that a Code of Practice on Engineering Coordination, as outlined, is the appropriate approach to manage the coexistence between low-power licensees?

Section 8

Terminal stations

Introduction

- 8.1 This section describes the approach that we propose to take for the use of terminal stations operating in the 800 MHz and 2.6 GHz bands, as well as modifications to the conditions applying to the use of terminal stations in the 900 MHz and 1800 MHz bands. Our preferred approach for these spectrum bands is to bring forward regulations for the exemption of terminals from the requirement for individual licensing, provided that they comply with certain technical parameters. These parameters, which we set out below, are consistent with the usage studied during the development of CEPT Reports 19, 30, 40 and 41 covering these bands and with the power limits in Commission Decisions 2010/267/EU and 2008/477/EC.
- 8.2 Only those terminals that comply with the technical parameters in the exemption regulation could be operated without a Wireless Telegraphy Act 2006 licence.
- 8.3 We expect to consult on draft regulations on exemption of 800 MHz and 2.6 GHz terminals in summer 2012. The regulations should then be effective by the end of 2012.

Question 10: Do you agree that we should proceed with the approach that terminal stations complying with the relevant technical parameters be exempted from the requirement for individual licensing?

Technical conditions for terminal stations (800 MHz)

- 8.4 In-block limits for terminal stations (TS) are set out in Table 8.1.

Table 8.1: In-block requirements — TS BEM in-block emission limit over frequencies of FDD uplink in the 800 MHz band

Maximum mean in-block power	23 dBm
<p>This power limit is specified as EIRP for terminal stations designed to be fixed or installed and as total radiated power (TRP) for terminal stations designed to be mobile or nomadic. EIRP and TRP are equivalent for isotropic antennas. It is recognised that this value is subject to a tolerance of up to +2 dB, to take account of operation under extreme environmental conditions and production spread.</p> <p>TRP is a measure of how much power the antenna actually radiates. The TRP is defined as the integral of the power transmitted in different directions over the entire radiation sphere.</p>	

- 8.5 We recognise that there is an option provided in Commission Decision 2010/267/EU for Member States to relax the in-block limit for terminal stations in specific deployments provided that protection of other services, networks and applications is not compromised and cross-border obligations are fulfilled. We propose that licence exemption for the 800 MHz band should apply only to those terminals and installations complying with the in-block power limit in Table 8.1.

Technical conditions for terminal stations (2.6 GHz)

8.6 In-block limits for terminal stations (TS) are set out in Table 8.2.

Table 8.2: In-block requirements for terminal stations in the 2.6 GHz band

		Maximum mean in-block power
Mobile or nomadic terminal stations	Total radiated power	31 dBm/(5 MHz)
Fixed or installed terminal stations	EIRP	35 dBm/(5 MHz)
Terminal stations on low-power shared access networks	Total radiated power	23dBm

8.7 We propose that licence exemption for the 2.6 GHz band should apply only to those terminals and installations complying with the in-block power limits in Table 8.2.

Technical conditions for terminal stations (900 MHz and 1800 MHz)

8.8 In 2010 we consulted^{40,41} on plans to include the use of UMTS 900 MHz and UMTS 1800 MHz terminal equipment in proposed regulations to exempt devices from individual licensing. The consultation⁴² was concluded in October 2010 and the Wireless Telegraphy (Exemption and Amendment) Regulations 2010 were made by us on 14 October 2010, and came into force on 1 November 2010. There are no plans to change the status of 900 MHz and 1800 MHz terminal stations that are currently exempt from licensing.

8.9 With the advent of the Commission Decision amending Decision 2009/766/EC, we propose to implement the technical conditions for the exemption of LTE and WiMAX terminals in these bands. The amending Commission Decision defines these devices as

- i) LTE complying with LTE Standards, as published by ETSI, in particular EN 301 908-1, EN 301 908-13, EN 301 908-14, and EN 301 908-11
- ii) WiMAX complying with WiMAX Standards, as published by ETSI, in particular EN 301 908-1, EN 301 908-21 and EN 301 908-22

8.10 We will make proposals to add LTE and WiMAX for 900 MHz and 1800 MHz in a further amendment of the Wireless Telegraphy (Exemption and Amendment) Regulations in due course.

⁴⁰ <http://stakeholders.ofcom.org.uk/consultations/devices/>

⁴¹ <http://stakeholders.ofcom.org.uk/consultations/wireless-telegraphy-devices/>

⁴² <http://stakeholders.ofcom.org.uk/consultations/wireless-telegraphy-devices/statement>

Section 9

Next steps

- 9.1 This consultation is supplemental to the March 2011 Consultation and is focussed on technical matters. There are no significant matters of policy included in the proposals on which we are consulting. Therefore we have decided to run the consultation for a period of 8 weeks. The closing date is 11 August 2011.
- 9.2 We intend to include our final decisions on technical licence conditions in a Statement to be published alongside the Information Memorandum on the 800 MHz and 2.6 GHz award.

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 11 August 2011**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <https://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/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 steve.green@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.

Steve Green
3rd Floor
Riverside House
2A Southwark Bridge Road
London SE1 9HA

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.

- A1.5 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

- A1.6 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Steve Green on 020 7783 4384.

Confidentiality

- A1.7 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, 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.

- A1.8 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.
- A1.9 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

- A1.10 Ofcom intends to publish a statement, which will include decisions on technical licence conditions, alongside the Information Memorandum on the 800 MHz and 2.6 GHz award.
- A1.11 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

Ofcom's consultation processes

- A1.12 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.
- A1.13 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 . 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.
- A1.14 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

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.
- 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/.
- 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

Consultation questions

Sub heading

A4.1 We are inviting responses to the following questions set out throughout the sections of this consultations and welcome views from stakeholders on any other aspect of the proposed technical licence conditions which they would like to raise with us.

Technical licence conditions for the 800 MHz band

Question 1: Do you have any comment on the proposal to apply the limits defined in Case A of Commission Decision 2010/267/EU for out-of-block emissions from base stations into all frequencies in the range 470 to 790 MHz, as set out in Table 4.4?

Question 2: Do you have any comment on the proposal to set an in-block emission limit of 61dBm/(5 MHz) for base stations in the 800 MHz band?

Technical licence conditions for the 2.6 GHz band

Question 3: Do you agree with the proposed conditions on antenna placement that would permit the use of the alternative block-edge mask for restricted unpaired blocks? If not, please explain your reasoning and your alternative proposals, bearing in mind the need to remain consistent with the framework provided in Commission Decision 2008/477/EC.

Question 4: Meeting the conditions on the use of the alternative block edge mask for restricted TDD blocks would require certain licensees to share information about the locations of their base stations. Do you agree with this proposed approach?

Low-power shared access in paired 2.6 GHz spectrum

Question 5: We welcome comments on stakeholders' preference for the dedicated or hybrid options for low-power shared access as discussed above.

Question 6: We welcome comments on the appropriate frequency placement for low-power spectrum blocks.

Question 7: Do you agree with our proposed technical licence conditions for low-power access?

Question 8: We welcome comments from stakeholders on the additional restrictions and technical measures we have outlined for the management of interference under the hybrid approach, and the technical licence conditions that would be necessary to implement them.

Question 9: Do you agree that a Code of Practice on Engineering Coordination, as outlined, is the appropriate approach to manage the coexistence between low-power licensees?

Terminal stations

Question 10: Do you agree that we should proceed with the approach that terminal stations complying with the relevant technical parameters be exempted from the requirement for individual licensing?

Annex 5

Impact Assessment

A5.1 Ofcom has considered and assessed the likely impact of implementing its proposals throughout this consultation document, and therefore the document as a whole constitutes our impact assessment. This assessment is set out in particular in sections 2, 3, 4, 5, 6, 7 and 8 and annex 6.

A5.2 For ease of reference, we have set out in the table below a summary of the main proposals made in this consultation and details of where the impacts of those proposals are considered.

Consultation proposals	Impacts discussed in
Implementation of Commission Decision on 900/1800 MHz	
Modification to existing licences for 900 MHz and 1800 MHz	Section 2 and Annex 6
Technical conditions applicable to relinquished spectrum	Section 2 and Annex 6
Technical licence conditions for the 800 MHz band	
Users of adjacent spectrum: DTT, emergency services and short range devices (including social alarms)	Section 3
Technical conditions to be applied in 800 MHz licences	Section 4
Baseline requirements for protection of DTT frequencies	Section 4
In-block limits for base stations	Section 4
Technical licence conditions for the 2.6 GHz band	
Additional requirements on base station emissions for protection of radar above 2700 MHz	Section 5
Technical conditions to be applied in 2.6 GHz standard power licences	Section 6
Technical conditions to be applied to 2.6 GHz restricted TDD blocks	Section 6
Technical conditions applying to low-power shared access	Section 7
Dedicated spectrum or hybrid approach for low-power shared access	Section 7
Placement of low-power shared access spectrum blocks	Section 7

Number of low-power shared access licences	Section 7
Code of Practice on Engineering Coordination for low-power shared access	Section 7
Terminal stations	
Exemption of terminal stations from requirement for individual licensing	Section 8
Technical conditions for licence exemption of 800 MHz terminal stations	Section 8
Technical conditions for licence exemption of 2.6 GHz terminal stations	Section 8
Technical conditions for licence exemption of 900 MHz and 1800 MHz terminal stations	Section 8

Annex 6

Proposed changes to the 900 MHz and 1800 MHz licences

A6.1 We propose to implement Commission Decision 2011/251/EU amending Decision 2009/766/EC by making changes to paragraphs 3, 7, 9 and 10 in Schedule 1 of the 900 MHz and 1800 MHz licences. We do not plan to state an emission code for LTE or WiMAX equipment in paragraph 8 because the applicable code is dependent on licensee choices of technology and bandwidth.

Changes to paragraph 3: Approved Standards for the Radio Equipment

The Radio Equipment covered by this Licence shall comply with the appropriate Interface Requirement (IR 2014 – Public Wireless Networks and/or IR 2019 – Third Generation Mobile [and/or IR nnnn⁴³ – 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.

Changes to paragraph 7: RF Carrier Spacing

7. 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 bands; and
- the centre frequency of any of their UMTS carriers is 2.7 MHz or more inside any edge of their permitted frequency 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 bands;
- the channel edge of any of their LTE channels is 200 kHz or more inside any edge of their permitted frequency bands where a neighbouring licensee has deployed a GSM carrier or carriers (including GSM-R) in the immediately adjacent spectrum;
- the channel edge of any of their LTE channels does not extend beyond their permitted frequency bands where a neighbouring licensee has deployed a UMTS or LTE channel;
- the channel edge of any of their WiMAX channels is 200 kHz or more inside any edge of their permitted frequency bands where a neighbouring licensee has deployed a GSM carrier or carriers (including GSM-R) in the immediately adjacent spectrum; and

⁴³ Ofcom will assign a number on publication of this Interface Requirement

- the channel edge of any of their LTE channels does not extend beyond their permitted frequency bands where a neighbouring licensee has deployed a UMTS or LTE channel.

Changes to paragraph 9: Maximum Permissible e.i.r.p.

9. 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
The maximum e.i.r.p. for LTE is 31 dBW/(5 MHz)
The maximum e.i.r.p. for WiMAX is 31 dBW/(5 MHz)

Changes to paragraph 10: Interpretation

- 9.3 Add the following:

(k) “LTE system” means LTE complying with LTE Standards, as published by ETSI, in particular EN 301 908-1, EN 301 908-13, EN 301 908-14, and EN 301 908-11

(l) “WiMAX system” means WiMAX complying with WiMAX Standards, as published by ETSI, in particular EN 301 908-1, EN 301 908-21 and EN 301 908-22

Annex 7

Glossary of abbreviations

3GPP

The 3rd Generation Partnership Project. A collaboration between groups of telecommunications associations, to make a globally applicable third-generation (3G) mobile phone system specification within the scope of the International Mobile Telecommunications-2000 project of the International Telecommunication Union (ITU).

ATC

Air traffic control

BEM

Block Edge Mask

CEPT

European Conference of Postal and Telecommunication Administrations

CGC

Complementary Ground Component (of a mobile-satellite system)

dBm

decibels relative to one milliwatt; a logarithmic representation of radio frequency power

DTT

Digital Terrestrial Television

EIRP

Equivalent Isotropically Radiated Power

ETSI

European Telecommunications Standards Institute

EU

European Union

FDD

Frequency Division Duplex. A transmission method where the downlink/downstream path and uplink/upstream path are separated by frequency.

GHz

Gigahertz

GSM

Global System for Mobile Communications

GSM-R

Global System for Mobile Communications (GSM) on Railways

IMT

International Mobile Telecommunications

km

kilometre

LTE

Long Term Evolution

m

metre

MHz

Megahertz

MIMO

Multiple-input and multiple-output

MNO

Mobile network operator

MOD

Ministry of Defence

PMSE

Programme-making and special events

OFDM

Orthogonal Frequency Division Multiplexing

PMSE

Programme-making and special events

RFID

Radio frequency identification

R&TTE Directive

Directive 1999/5/EC of the European Parliament and of the Council on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity

RSC

Radio Spectrum Committee of the European Commission

SRD

Short range device

TDD

Time Division Duplex. A transmission method that uses the same channel for the uplink and downlink but separates them by time slots.

TS

Terminal stations

TRP

Total radiated power

UE

User equipment; alternative term for a terminal station

UMTS

Universal Mobile Telecommunications System

wi-fi

Commonly used to refer to wireless local area network (WLAN) technology, specifically that conforming to the IEEE 802.11 family of standards. Such systems typically use one or more access points connected to a wired Ethernet network which communicate with wireless network adapters in end devices such as PCs. It was originally developed to allow wireless extension of private LANs but is now also used as a general public access technology via access points known as "hotspots".

WiMAX

Worldwide interoperability for Microwave Access. The name given to wireless metropolitan area network (WMAN) technology, specifically that conforming to the IEEE 802.16 family of standards and certified by the WiMAX Forum.