



**Auction of spectrum:
1452 - 1492 MHz**
INFORMATION MEMORANDUM UPDATE

Publication date:

13 March 2008

Contents

Section		Page
1	Background	1
2	Updated information	3
Annex		Page
1	Draft licence for a high power network	8
2	Draft licence for low power network	21
3	Draft high power licence for 1479.5-1492 MHz	33
4	Draft low power licence for 1479.5-1492 MHz	46

Section 1

Background

- 1.1 This document sets out changes made to the information contained in the Information Memorandum for the award of Wireless Telegraphy Act licences in the 1452-1492 MHz band.
- 1.2 On 7 December 2007 the Office of Communications (“Ofcom”) published an Information Memorandum (“the Memorandum”)¹ that provided information for those parties considering bidding for a licence under the Wireless Telegraphy Act 2006 to establish or use stations for wireless telegraphy or install or use apparatus for wireless telegraphy in the 1452-1492 MHz band (“the spectrum band”) in the United Kingdom.
- 1.3 At the same time we also published two further documents. They were:
 - The Statement² setting out our policy decisions; and
 - Notice³ of our proposal to make regulations in connection with the award of 1452-1492 MHz.
- 1.4 In particular, the Memorandum:
 - described the characteristics of the spectrum bands for which Licences are to be awarded, and the way in which they will be packaged;
 - summarised the principal terms of the licences that will be issued following completion of the award process;
 - summarised the steps that persons need to take in order to qualify and take part in the award process;
 - summarised the rules and timetable for the award process; and
 - contained draft Licences.
- 1.5 Since publication of the Memorandum a number of changes have been made to the information under each of these bullets. Section 2 of this document provides updated information. Annexes 1, 2, 3 and 4 have revised draft Licences.
- 1.6 The notice at the front of the Memorandum (headed “Important Notice”) applies to this update as it applies to the Memorandum.
- 1.7 We are making other information relevant to this award available alongside this document. This is as follows:
 - An explanatory note to accompany Schedule 6 of The Wireless Telegraph (Licence Award) Regulations 2008 (the “Award Regulations”). This note is available at:
http://www.ofcom.org.uk/radiocomms/spectrumawards/liveawards/award_1452/note.pdf ; and

¹ See http://www.ofcom.org.uk/radiocomms/spectrumawards/liveawards/award_1452/1452im/

² See http://www.ofcom.org.uk/consult/condocs/1452_1492/statement/

³ See <http://www.ofcom.org.uk/consult/condocs/1452regs/>

- A statement setting out our decisions in relation to the statutory instruments we need to make in connection with the award of wireless telegraphy licences for the use of the spectrum band. This document is available at:
<http://www.ofcom.org.uk/radiocomms/spectrumawards/liveawards/award1452/im.pdf>

1.8 The relevant section of our website for information on our spectrum award programme and the award of 1452-1492 MHz is
www.ofcom.org.uk/radiocomms/spectrumawards/.

Section 2

Updated and additional information

2.1 The updated and additional information for the Information Memorandum is as below with reference to paragraphs of the Information Memorandum where relevant.

The award process

2.2 In paragraph 4.15 of the Information Memorandum the Application Form is described as being set out at Schedule 1 of the Award Regulations with the Application Warranty being set out in Schedule 2 and the Additional Member Warranty being set out in Schedule 3. In order to simplify the documents that applicants have to submit, the Application Form and the Application Warranty have been combined in Schedule 1 and so the Additional Member Warranty is now set out in Schedule 2.

2.3 In paragraphs 4.42 and 4.43 of the Information Memorandum we discuss what will happen if the Lot Selection Menu is incomplete or defective and if a bidder fails to return a completed Lot Selection Menu or pay the relevant Licence Fee. We have removed paragraphs 11(5), (6), (7) and (8) in order to simplify the regulations so these paragraphs no longer apply.

2.4 In paragraph 4.109 of the Information Memorandum we discuss the information that we will make available to winning bidders. We have changed paragraph 44 of the Award Regulations to make it clear that we will notify the outcome of the award to all bidders at the end of the auction stage, although at that point we will only notify winning bidders of their winning price. Specifically at the end of the auction stage we will inform all bidders of:

- the Lot(s) comprised in all Winning Bidders' Winning Auction Stage Bid;
- the Licence Condition assigned to those Lots;
- any Unallocated Lots assigned to the Winning Bidders and
- the Winning Prices..

2.5 All bidders should note that they are expected not to share any of this information with third parties before we announce the results of the auction.

2.6 In paragraphs 4.114 and 4.115 of the Information Memorandum we describe the completion of the Award Process. We have changed paragraph 48 of the Award Regulations so that it no longer restricts the publication of the outcome of the award process to after the grant of the licences and the payment of refunds to winning bidders.

2.7 We intend to publish additional details of the bids that have been made during the primary bid rounds. We will not publish details of the individual bids that have been made, but after the bidding for a business day has ended we may publish all, or some, of:

- the latest round prices for each lot;
- the total demand for each lot; and

- the total demand for each licence condition chosen for each lot.

2.8 In addition we have made some minor editorial changes to improve the clarity of the Award Regulations

Technical licence conditions

2.9 In the table in paragraph 1.3 and in paragraphs 3.20 to 3.21 we discuss the high and low power licence conditions as they apply to 1452 to 1479.5 MHz. In order to make it clearer how the auction rules will apply to 1479.5 to 1492 MHz and to ease co-ordination between the holders of blocks LO, LP and LQ, we have published two new draft licences for 1479.5 to 1492 MHz. The key changes from the draft licence that we published previously are in paragraphs 7 and 8 of Schedule 1 in each case.

2.10 A high power licence that includes block LQ will limit the density of transmitters using frequencies in the range 1479.5 MHz to 1482.9 MHz, excluding indoor transmitters with an EIRP no greater than 2 Watts per 1.7 MHz, to no more than 150 transmitters in any 50km x 50km square centred on the intersection of 1km OS grid lines within the licensed area. There will be no limit on the density of transmitters using frequencies solely in the range 1482.9 MHz to 1492 MHz.

2.11 A low power licence that includes block LQ will limit the mean operational EIRP of any transmitter using frequencies in the range 1479.5 MHz to 1482.9 MHz to not exceed 6kW within a single 1.7MHz channel. There will be no limit in the mean operational EIRP of any transmitter solely using frequencies in the range 1482.9 MHz to 1492 MHz.

2.12 Following the award of the licences we will be happy to consider changes to the limits in the licence that includes block LQ that are compatible with the relevant agreed engineering code of practice.

2.13 In Annex 1 of the Information Memorandum we set out copies of the draft licences for this spectrum. In paragraph 3 of Schedule 2 to each of those licences we have confirmed that we will use the Infoterra clutter database. This was chosen as we believe that, compared to the other clutter databases under consideration, the Infoterra clutter database provides some benefits.

- firstly, the clutter categories used by Infoterra were more easily mapped to the ITU categories; and
- secondly, Infoterra use the category "Open" for large areas of open land such as golf courses which we felt was a more suitable title than that used by some of the other databases under consideration.

2.14 The licences are granted to establish, install and use radio transmitting and receiving stations and/or radio apparatus described in the licence subject to the terms of the licence. For the avoidance of doubt they do not guarantee exclusive use of this spectrum. In the future we may issue additional licences to allow the use of all, or part, of the Spectrum Band.

2.15 In addition to the changes above we have corrected some of the numbering in the licences that were annexed to the Information Memorandum that was published in December and made some other minor editorial changes to help to improve clarity. Copies of the revised draft licences are included in Annexes 1 to 4 of this document.

Other spectrum awards

- 2.16 In paragraph 5.4 we stated that we intended to hold the award of the 10-40 GHz bands in early 2008. This award has now been completed with the outcome published on our website⁴.
- 2.17 In paragraph 5.4 we also discussed the award of the 2500-2690MHz and 2010-2025MHz. On 19 December 2007 we published a consultation⁵ on the auction rules, procedures and draft regulations for this award. The consultation closed on 1 February 2008 and included the indicative timetable in the table below noting that the timetable is dependent on a number of considerations which could turn out to be different from current expectations.

Indicative timeline to the proposed award

1 February 2008	Closing date for responses to this Consultation Document
February/March 2008	Decisions on the award. Subject to those decisions, Ofcom will publish a Statement, Information Memorandum and draft regulations Start of statutory consultation period on draft regulations Mock auction(s) with interested parties
March/April 2008	End of statutory consultation on draft regulations Making of regulations Publication of a statement on the final regulations
April/May 2008	Start of the award process with application date
July 2008	First bidding round (if there is more than one bidder)

- 2.18 In paragraphs 5.5 and 5.6 we discussed the Digital Dividend review. A statement⁶ on this was published on 13 December 2007 and included the following indicative timetables for the three digital dividend awards. These are subject to factors outside our control and may therefore change during the course of the rest of the Digital Dividend Review.

⁴ See <http://www.ofcom.org.uk/radiocomms/spectrumawards/liveawards/1040award/notices/results.pdf>

⁵ See <http://www.ofcom.org.uk/consult/condocs/2ghzrules/>

⁶ See <http://www.ofcom.org.uk/consult/condocs/ddr/statement/>

Timetable for awarding a package of interleaved spectrum with PMSE obligations to a band manager by beauty contest

Spring 2008	Consultation on award design
Summer 2008	Consultation closes
Autumn 2008	Invitations to tender
Late 2008	Award

Timetable for awarding geographic packages of interleaved spectrum suitable for local television

Spring 2008	Consultation on award design
Summer 2008	Consultation closes
Autumn 2008	Information memorandum and draft regulations
Late 2008	Awards in Border, Granada, West Country and Wales
Summer 2009	Remaining awards

Timetable for awarding cleared spectrum, channel 36 and interleaved channels 61 and 62

Spring 2008	Consultation on detailed award design
Summer 2008	Consultation closes
Late 2008	Information memorandum and draft regulations
Summer 2009	Award

2.19 Annexes to this report were published on 21 December 2007 and are available at <http://www.ofcom.org.uk/consult/condocs/ddr/statement/ddrannex.pdf>.

Follow up to the Independent Audit of Spectrum Holdings

2.20 In paragraph 5.10 we discussed the consultation document "Spectrum Framework Review: the Public Sector". A statement was published relating to this consultation on 31 January 2008 and is available from our website⁷.

London 2012 Olympic Games and Paralympic Games and 2014 Commonwealth Games

2.21 In paragraphs 5.11 to 5.20 we provided information regarding the London 2012 Olympic Games and Paralympic Games and the 2014 Commonwealth Games. We now understand that the Commonwealth Games will be the Glasgow 2014 Commonwealth Games. Additionally, we can update the information in paragraphs 5.11 and 5.12 respectively, as follows:

- On 6 July 2005, London was chosen to host the games of the XXX Olympiad (the "Games"), which will take place between 27 July and 9 September 2012. The Olympic Park will be built on a 500-acre site in the Lower Lea Valley, while Wembley Stadium, the All England Lawn Tennis and Croquet Club, Lord's Cricket Ground, Greenwich Park, Regent's Park, Hyde Park and Horse Guards Parade will also host events in London. The Eton College Rowing Centre at Dorney Lake, Weymouth Bay and Portland Harbour and five other football grounds- Hampden Park, the Millennium Stadium, Old Trafford, St James' Park and Villa Park- currently make up the remaining venues.

⁷ See <http://www.ofcom.org.uk/consult/condocs/sfrps/statement/>

- As well as the Games themselves, test events will take place at Weymouth and Portland in 2010 and at this and other venues during 2011 and into 2012.

Ultra-Wide Band

- 2.22 In order to implement changes required by Commission Decision 2007/131/EC⁸ on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community, in July 2007 we made the Wireless Telegraphy (Ultra-Wideband Equipment)(Exemption) Regulations 2007 (No. 2084) to exempt the use of spectrum by equipment using ultra-wide band (UWB) technologies. UWB is a generic term for technologies typically characterised by the emission of very low power radiation spread over a very large radio bandwidth.
- 2.23 In summary, the provisions in the regulations described in paragraph 2.21 applicable to the 1452-1492 MHz band are as follows:
- The equipment only radiates transmissions at frequencies up to and including 3.4 GHz or at frequencies above 4.8 GHz. The emissions limit for frequencies below and up to and including 1.6 GHz is
 - i) a maximum mean EIRP density no greater than -90.0 dBm/MHz; and
 - ii) a maximum peak EIRP no greater than -50.0 dBm or the equivalent transmission level.
- 2.24 There are two further, conditions, namely that UWB equipment must::
- be used indoors or, where it is not used indoors, not be attached to any infrastructure, installation or outdoor antenna that is fixed or to any motor vehicle or railway vehicle; and
 - not cause harmful interference to any wireless telegraphy.

Other Ofcom consultations

- 2.25 In paragraph 5.21 we discussed the consultation document “Licence-Exemption Framework Review”. A statement has been published relating to this and is available at http://www.ofcom.org.uk/consult/condocs/lefr/lefr_statement/.

General conditions of entitlement

- 2.26 In paragraph 5.39 of the Information Memorandum we discussed a number of consultations relating to General Conditions. The statements relating to some of these have been published and are available from the Ofcom website. For example:
- A statement on the regulation of VoIP services can be found at <http://www.ofcom.org.uk/consult/condocs/voip/voipstatement/>; and
 - A statement on telephone number portability for consumers switching suppliers can be found at <http://www.ofcom.org.uk/consult/condocs/gc18review/statement/>.

⁸ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:055:0033:0036:EN:PDF>

Annex 1

Draft licence for a high power network

DRAFT LICENCE

Wireless Telegraphy Act 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 14xx.xxx to 14xx.xxx MHz Band

Licence no: **[xxxxxxx]**

Date: **[date]**

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

[company name]

Company Reg No: [xxxxxxxx]

(the "Licensee")

[address 1]

[address 2]

[address 3]

[postcode]

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in Schedule 1 (the "Radio Equipment") subject to the terms, set out below.

Licence Term

2. This Licence shall continue in force until revoked by Ofcom in accordance with Paragraph 3 below or surrendered by the Licensee.

Licence Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the "Act"), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:
 - (a) at the request of, or with the consent of, the Licensee;
 - (b) in accordance with paragraph 8 of this Licence;
 - (c) if there has been a breach of a term of the Licence;
 - (d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of Regulations made by Ofcom under the powers conferred by section 30(1) and (3) of the Act⁹;
 - (e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the Wireless Telegraphy (Licence Award) Regulations 2008 (the "Regulations");
 - (f) in accordance with Paragraph 8(5) of Schedule 1 to the Act;
 - (g) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 156 of the Communications Act 2003; or
 - (h) for reasons related to the management of the radio spectrum, provided that in such case:
 - (i) this power to revoke may only be exercised after at least five (5) year's notice is given in writing to the Licensee; and
 - (ii) such notice must expire after fifteen (15) years from the date of this Licence.
4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

⁹ These are regulations on spectrum trading.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act¹⁰.
6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee's name and address from that recorded in the Licence.

Fees

7. The licence fee in respect of this Licence is [£xxxxxx], which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.
8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.
9. The Licensee shall also pay interest to Ofcom on any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 32(2) of the Act from the date such amount falls due until the date of payment, calculated with reference to the Bank of England base rate from time to time. In accordance with section 15 of the Act any such amount and any such interest is recoverable by Ofcom.
10. If the Licence is surrendered or revoked, no refund, whether in whole or in part of any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation [57] of the Regulations).

Radio Equipment Use

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

¹⁰ See Ofcom's website for the latest position on spectrum trading and the types of trade which are permitted.

Access and Inspection

13. The Licensee shall permit a person authorised by Ofcom:

- (a) to have access to the Radio Equipment; and
- (b) to inspect this Licence and to inspect, examine and test the Radio Equipment,

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

Modification, Restriction and Closedown

14. A person authorised by Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:

- (a) a breach of a term of the Licence has occurred; and/or
- (b) the use of the Radio Equipment is causing or contributing to undue interference to the use of other authorised radio equipment.

15. Ofcom may require any of the radio stations or radio apparatus that comprise the Radio Equipment to be modified or restricted in use, or temporarily closed down either immediately or on the expiry of such period as may be specified in the event of a national or local state of emergency being declared. Ofcom may only exercise this power after a written notice is served on the Licensee or a general notice applicable to holders of a named class of Licence is published.

Geographical Boundaries

16. This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

Interpretation

17. In this Licence:

- (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of stations and installation and use of apparatus for wireless telegraphy as specified in section 8 of the Act; and
- (b) the expressions "undue interference", "station for wireless telegraphy" and "apparatus for wireless telegraphy" shall be construed in accordance with section 115 of the Act.

18. The schedules to this Licence form part of this Licence together with any subsequent schedules which Ofcom may issue as a variation to this Licence at a later date.
19. The Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

Issued by Ofcom

Signed by

For the Office of Communications

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxx MHz Band**

1. **Description of Radio Equipment Licensed**

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. **Interface Requirements for the Radio Equipment use**

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068¹¹ for Spectrum Access in the Band 1452 – 1492 MHz

3. **Special Conditions relating to the Operation of the Radio Equipment**

(a) During the period that this Licence remains in force and for six (6) months thereafter, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of:

(i) the following details relating to the Radio Equipment:

a) postal address;

b) National Grid Reference (to one hundred (100) metres resolution);

c) antenna height (above ground level) and type, bearing east of true north; and

d) radio frequencies used by the Radio Equipment; and

(ii) a statement of the number of subscribing customers;

(iii) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

and the Licensee must produce these records if requested by a person authorised by Ofcom.

¹¹ Available from the Ofcom website at <http://www.ofcom.org.uk>

- (b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.
- (c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.
- (d) The Licensee must also submit to Ofcom in such manner and at such times, all information relating to the establishment, installation or use of the Radio Equipment, whether stored in hard copy or electronic form, as reasonably requested for the purposes of verifying compliance with this Licence or for statistical purposes.
- (e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

- (a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).
- (b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.
- (c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:
 - (i) Efficient frequency use of the radio spectrum;
 - (ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;
 - (iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;
 - (iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

- (d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.
- (e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom

shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

- (f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.
- (g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must be provided to Ofcom as soon as is practical. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is operated in compliance with such cross-border coordination and sharing procedures as may be notified to the Licensee by Ofcom.

6. Permitted Frequency Bands

Subject to the Out-of-Block Emissions permitted under Paragraph 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

- (i) 14xx.xxx MHz – 14xx.xx MHz

7. Maximum permissible EIRP

No limit.

8. Maximum permissible transmitter density

The number of transmitters, excluding indoor transmitters with an EIRP not greater than than 2 Watts per 1.7 MHz, in any 50km x 50km square centred on the intersection of 1km OS grid lines within the licensed area must not exceed 150.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed -48 dBW/m²/MHz at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. Permissible Out-of -Block aggregate PFD

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from relevant block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level (dBW/m ² /MHz)
0.0 to 0.2 MHz	-77
0.2 to 0.4 MHz	-101
0.4 to 0.6 MHz	-110
0.6 to 0.8 MHz	-119
0.8 to 1.0 MHz	-127
1.0 to 4.2 MHz	-128

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

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

The lower block edge being 14xx.xxx MHz

The upper block edge being 14xx.xxx MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km², 4 km², 25 km², 100 km², 400 km², 2500 km² or 10000 km², which includes at least ten transmitters.

All test points that occur above a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

- (a) "EIRP" means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- (b) "ERP" means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.
- (c) "dBm" means the power level in decibels (logarithmic scale) referenced against 1 milliWatt (i.e. a value of 0 dBm is 1mW);
- (d) "dBW" means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBw is 1 W).
- (e) "Out-of-Block Emissions" means radio frequency emissions generated by the Radio Equipment and radiated into the frequency bands adjacent (in terms of frequency) to the Licensee's Permitted Frequency Bands.
- (f) "Base station" means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.
- (g) "Mobile station" means a radio transmitter intended to be used while in motion or during halts at unspecified locations.
- (h) "PFD" means power-flux density and is a measure of the power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units $\text{dBW/m}^2/\text{MHz}$.
- (i) "aggregate PFD" means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.
- (j) "Notified Licensees" means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxx MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey “Panorama DTM” 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by Infoterra shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	Dense urban	Dense Urban	30
2	Urban	Urban	20
3	Industrial	Suburban	10
4	Suburban	Suburban	10
5	Village	Suburban	10
6	Parks/recreation	Open	10
7	Open	Open	10
8	Open in urban	Urban	20
9	Forest	Open	10
10	Water	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in

Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

- a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.
- b) **Summation of signals from transmitters.** The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).
- c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

- d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.
- e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability
- f) **P.1546 time variability.** Field strengths will be predicted for a 50% time variability.
- g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.
- h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10
- i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation 27a of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation 27b shall be used to determine the correction for receiving/mobile height.
- j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.
- k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.

- l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation 6 of P.1546, Annex 5 will be used to determine $h1$ in all cases. In using this equation the actual value of path length d will be used, including cases when d is less than 1 km.
- m) **Transmit antenna gain.** The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. **Operational details of transmitting stations**

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP not greater than 2 Watts per 1.7 MHz. These details may include:

- (a) the National Grid Reference to ten (10) metres resolution of each transmitting site;
- (b) the height above ground level of each transmitting antenna to an accuracy of 1 metre;
- (c) the azimuth of each transmitting antenna on each site;
- (d) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);
- (e) the down-tilt (physical and electrical) of each transmitting antenna;
- (f) Class of Emission of the radiated signal;
- (g) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and
- (h) the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna.

Annex 2

Draft licence for low power network

DRAFT LICENCE

Wireless Telegraphy Act 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 14xx.xxx to 14xx.xxx MHz Band

Licence no: [xxxxxxx]

Date: [date]

2. The Office of Communications (Ofcom) grants this licence (the "Licence") to

[company name]

Company Reg No: [xxxxxxxx]

(the "Licensee")

[address 1]

[address 2]

[address 3]

[postcode]

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in Schedule 1 (the "Radio Equipment") subject to the terms, set out below.

Licence Term

3. This Licence shall continue in force until revoked by Ofcom in accordance with Paragraph 3 below or surrendered by the Licensee.

Licence Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the “Act”), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:
- (a) at the request of, or with the consent of, the Licensee;
 - (b) in accordance with paragraph 8 of this Licence;
 - (c) if there has been a breach of a term of the Licence;
 - (d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of Regulations made by Ofcom under the powers conferred by section 30(1) and (3) of the Act¹²;
 - (e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the Wireless Telegraphy (Licence Award) Regulations 2008 (the “Regulations”);
 - (f) in accordance with Paragraph 8(5) of Schedule 1 to the Act;
 - (g) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 156 of the Communications Act 2003; or
 - (h) for reasons related to the management of the radio spectrum, provided that in such case:
 - (i) this power to revoke may only be exercised after at least five (5) year’s notice is given in writing to the Licensee; and
 - (ii) such notice must expire after fifteen (15) years from the date of this Licence.
4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act¹³.
6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee’s name and address from that recorded in the Licence.

¹² These are regulations on spectrum trading.

¹³ See Ofcom’s website for the latest position on spectrum trading and the types of trade which are permitted.

Fees

7. The licence fee in respect of this Licence is [£xxxxxxx], which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.
8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.
9. The Licensee shall also pay interest to Ofcom on any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 32(2) of the Act from the date such amount falls due until the date of payment, calculated with reference to the Bank of England base rate from time to time. In accordance with section 15 of the Act any such amount and any such interest is recoverable by Ofcom.
10. If the Licence is surrendered or revoked, no refund, whether in whole or in part of any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation 57 of the Regulations).

Radio Equipment Use

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

Access and Inspection

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

Modification, Restriction and Closedown

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

Geographical Boundaries

16. This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

Interpretation

17. In this Licence:
 - (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of stations and installation and use of apparatus for wireless telegraphy as specified in section 8 of the Act; and
 - (b) the expressions "undue interference", "station for wireless telegraphy" and "apparatus for wireless telegraphy" shall be construed in accordance with section 115 of the Act.
18. The schedules to this Licence form part of this Licence together with any subsequent schedules which Ofcom may issue as a variation to this Licence at a later date.
19. The Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

Issued by Ofcom

Signed by

For the Office of Communications

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxxMHz Band**

1. **Description of Radio Equipment Licensed**

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. **Interface Requirements for the Radio Equipment use**

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068¹⁴ for Spectrum Access in the Band 1452 – 1492 MHz

3. **Special Conditions relating to the Operation of the Radio Equipment**

(a) During the period that this Licence remains in force and for six (6) months thereafter, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of:

(i) the following details relating to the Radio Equipment:

a) postal address;

b) National Grid Reference (to one hundred (100) metres resolution);

c) antenna height (above ground level) and type, bearing east of true north; and

d) radio frequencies used by the Radio Equipment; and

(iv) a statement of the number of subscribing customers;

(v) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

¹⁴ Available from the Ofcom website at <http://www.ofcom.org.uk>

and the Licensee must produce these records if requested by a person authorised by Ofcom.

- (b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.
- (c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.
- (d) The Licensee must also submit to Ofcom in such manner and at such times, all information relating to the establishment, installation or use of the Radio Equipment, whether stored in hard copy or electronic form, as reasonably requested for the purposes of verifying compliance with this Licence or for statistical purposes.
- (e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

- (a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).
- (b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.
- (c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:
 - (i) Efficient frequency use of the radio spectrum;
 - (ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;
 - (iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;
 - (iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

- (d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.
- (e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as

required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

- (f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.
- (g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must be provided to Ofcom as soon as is practical. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is operated in compliance with such cross-border coordination and sharing procedures as may be notified to the Licensee by Ofcom.

6. Permitted Frequency Bands

Subject to the Out-of-Block Emissions permitted under Paragraph 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

- (i) 14xx.xxx MHz – 14xx.xxx MHz

7. Maximum permissible EIRP

The mean operational EIRP of any transmitter deployed in the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed 6kW within a single 1.7MHz channel.

8. Maximum permissible transmitter density

No limit.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed -48 dBW/m²/MHz at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. Permissible Out-of -Block aggregate PFD

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from relevant block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level (dBW/m ² /MHz)
0.0 to 0.2 MHz	-77
0.2 to 0.4 MHz	-101
0.4 to 0.6 MHz	-110
0.6 to 0.8 MHz	-119
0.8 to 1.0 MHz	-127
1.0 to 4.2 MHz	-128

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

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

The lower block edge being 14xx.xxx MHz

The upper block edge being 14xx.xxx MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km², 4 km², 25 km², 100 km², 400 km², 2500 km² or 10000 km², which includes at least ten transmitters.

All test points that occur over a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

- (a) "EIRP" means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- (b) "ERP" means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.
- (c) "dBm" means the power level in decibels (logarithmic scale) referenced against 1 milliWatt (i.e. a value of 0 dBm is 1mW);
- (d) "dBW" means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBw is 1 W).
- (e) "Out-of-Block Emissions" means radio frequency emissions generated by the Radio Equipment and radiated into the frequency bands adjacent (in terms of frequency) to the Licensee's Permitted Frequency Bands.
- (f) "Base station" means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.
- (g) "Mobile station" means a radio transmitter intended to be used while in motion or during halts at unspecified locations.
- (h) "PFD" means power-flux density and is a measure of the power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units dBW/m²/MHz.
- (i) "aggregate PFD" means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.
- (j) "Notified Licensees" means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 14xx.xxx to 14xx.xxx MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey “Panorama DTM” 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by Infoterra shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	Dense urban	Dense Urban	30
2	Urban	Urban	20
3	Industrial	Suburban	10
4	Suburban	Suburban	10
5	Village	Suburban	10
6	Parks/recreation	Open	10
7	Open	Open	10
8	Open in urban	Urban	20
9	Forest	Open	10
10	Water	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

- a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.
- b) **Summation of signals from transmitters.** The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).
- c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

- d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.
- e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability
- f) **P.1546 time variability.** Field strengths will be predicted for a 50% time variability.
- g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.
- h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10
- i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation 27a of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation 27b shall be used to determine the correction for receiving/mobile height.
- j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

- k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.
- l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation 6 of P.1546, Annex 5 will be used to determine $h1$ in all cases. In using this equation the actual value of path length d will be used, including cases when d is less than 1 km.
- m) **Transmit antenna gain.** The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. Operational details of transmitting stations

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP not greater than 2 Watts per 1.7 MHz. These details may include:

- (a) the National Grid Reference to one ten (10) metres resolution of each transmitting site;
- (b) the height above ground level of each transmitting antenna to an accuracy of 1 metre;
- (c) the azimuth of each transmitting antenna on each site;
- (d) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);
- (e) the down-tilt (physical and electrical) of each transmitting antenna;
- (f) Class of Emission of the radiated signal;
- (g) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and
- (h) the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna.

Annex 3

Draft high power licence for 1479.5-1492 MHz

DRAFT LICENCE

Wireless Telegraphy Act 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 1479.500 to 1492.000 MHz Band

Licence no: [xxxxxx]

Date: [date]

3. The Office of Communications (Ofcom) grants this licence (the "Licence") to

[company name]

Company Reg No: [xxxxxxxx]

(the "Licensee")

[address 1]

[address 2]

[address 3]

[postcode]

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in Schedule 1 (the "Radio Equipment") subject to the terms, set out below.

Licence Term

4. This Licence shall continue in force until revoked by Ofcom in accordance with Paragraph 3 below or surrendered by the Licensee.

Licence Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the “Act”), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:
 - (a) at the request of, or with the consent of, the Licensee;
 - (b) in accordance with paragraph 8 of this Licence;
 - (c) if there has been a breach of a term of the Licence;
 - (d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of Regulations made by Ofcom under the powers conferred by section 30(1) and (3) of the Act¹⁵;
 - (e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the Wireless Telegraphy (Licence Award) Regulations 2008 (the “Regulations”);
 - (f) in accordance with Paragraph 8(5) of Schedule 1 to the Act;
 - (g) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 156 of the Communications Act 2003; or
 - (h) for reasons related to the management of the radio spectrum, provided that in such case:
 - (i) this power to revoke may only be exercised after at least five (5) year’s notice is given in writing to the Licensee; and
 - (ii) such notice must expire after fifteen (15) years from the date of this Licence.
4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act¹⁶.
6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee’s name and address from that recorded in the Licence.

¹⁵ These are regulations on spectrum trading.

¹⁶ See Ofcom’s website for the latest position on spectrum trading and the types of trade which are permitted.

Fees

7. The licence fee in respect of this Licence is [£xxxxxx], which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.
8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.
9. The Licensee shall also pay interest to Ofcom on any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 32(2) of the Act from the date such amount falls due until the date of payment, calculated with reference to the Bank of England base rate from time to time. In accordance with section 15 of the Act any such amount and any such interest is recoverable by Ofcom.
10. If the Licence is surrendered or revoked, no refund, whether in whole or in part of any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation 57 of the Regulations).

Radio Equipment Use

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

Access and Inspection

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

Modification, Restriction and Closedown

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

Geographical Boundaries

16. This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

Interpretation

17. In this Licence:
 - (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of stations and installation and use of apparatus for wireless telegraphy as specified in section 8 of the Act; and
 - (b) the expressions "undue interference", "station for wireless telegraphy" and "apparatus for wireless telegraphy" shall be construed in accordance with section 115 of the Act.
18. The schedules to this Licence form part of this Licence together with any subsequent schedules which Ofcom may issue as a variation to this Licence at a later date.
19. The Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

Issued by Ofcom

Signed by

For the Office of Communications

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 1479.500 to 1492.000 MHz Band**

1. **Description of Radio Equipment Licensed**

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. **Interface Requirements for the Radio Equipment use**

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068¹⁷ for Spectrum Access in the Band 1452 – 1492 MHz

3. **Special Conditions relating to the Operation of the Radio Equipment**

- (a) During the period that this Licence remains in force and for six (6) months thereafter, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of:
- (i) the following details relating to the Radio Equipment:
 - a) postal address;
 - b) National Grid Reference (to one hundred (100) metres resolution);
 - c) antenna height (above ground level) and type, bearing east of true north; and
 - d) radio frequencies used by the Radio Equipment; and
 - (ii) a statement of the number of subscribing customers;
 - (iii) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

¹⁷ Available from the Ofcom website at <http://www.ofcom.org.uk>

and the Licensee must produce these records if requested by a person authorised by Ofcom.

- (b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.
- (c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.
- (d) The Licensee must also submit to Ofcom in such manner and at such times, all information relating to the establishment, installation or use of the Radio Equipment, whether stored in hard copy or electronic form, as reasonably requested for the purposes of verifying compliance with this Licence or for statistical purposes.
- (e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

- (a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).
- (b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.
- (c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:
 - (i) Efficient frequency use of the radio spectrum;
 - (ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;
 - (iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;
 - (iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

- (d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.
- (e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as

required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

- (f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.
- (g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must be provided to Ofcom as soon as is practical. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is operated in compliance with such cross-border coordination and sharing procedures as may be notified to the Licensee by Ofcom.

6. Permitted Frequency Bands

Subject to the Out-of-Block Emissions permitted under Paragraph 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

- (i) 1479.500 to 1492.000 MHz

7. Maximum permissible EIRP

No limit.

8. Maximum permissible transmitter density

The number of transmitters using frequencies in the range 1479.500 MHz to 1482.900 MHz in any 50km x 50km square centred on the intersection of 1km OS grid lines within the licensed area, excluding indoor transmitters with an EIRP not greater than 2 Watts per 1.7 MHz, must not exceed 150.

There is no limit on the density of transmitters using frequencies solely in the range 1482.900 MHz to 1492.000 MHz.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed $-96.7 \text{ dBW/m}^2/\text{MHz}$ at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. **Permissible Out-of -Block aggregate PFD**

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level ($\text{dBW/m}^2/\text{MHz}$)
6.250 to 6.000 MHz	-121
6.000 to 5.400 MHz	-120
5.400 to 5.000 MHz	-119
5.000 to 4.600 MHz	-118
4.600 to 4.200 MHz	-117
4.200 to 3.800 MHz	-116
3.800 to 3.400 MHz	-115
3.400 to 3.000 MHz	-114
3.000 to 2.800 MHz	-113
2.800 to 2.600 MHz	-112
2.600 to 2.200 MHz	-111
2.200 to 2.000 MHz	-110
2.000 to 1.800 MHz	-109
1.800 to 1.600 MHz	-108
1.600 to 1.400 MHz	-107
1.400 to 1.200 MHz	-106
1.200 to 1.000 MHz	-105
1.000 to 0.800 MHz	-104
0.800 to 0.600 MHz	-102
0.600 to 0.400 MHz	-101
0.400 to 0.200 MHz	-99
0.200 to 0.000 MHz	-97

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

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

The lower block edge being 1479.500 MHz

The upper block edge being 1492.000 MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km², 4 km², 25 km², 100 km², 400 km², 2500 km² or 10000 km², which includes at least ten transmitters.

All test points that occur over a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

- (a) "EIRP" means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- (b) "ERP" means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.
- (c) "dBm" means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1mW);
- (d) "dBW" means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBW is 1 W).
- (e) "Out-of-Block Emissions" means radio frequency emissions generated by the Radio Equipment and radiated into the frequency bands adjacent (in terms of frequency) to the Licensee's Permitted Frequency Bands.
- (f) "Base station" means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.

(g) “Mobile station” means a radio transmitter intended to be used while in motion or during halts at unspecified locations.

(h) “PFD” means power-flux density and is a measure of the power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units dBW/m²/MHz.

(i) “aggregate PFD” means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.

(j) “Notified Licensees” means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 1479.500 to 1492.000 MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey “Panorama DTM” 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by Infoterra shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	Dense urban	Dense Urban	30
2	Urban	Urban	20
3	Industrial	Suburban	10
4	Suburban	Suburban	10
5	Village	Suburban	10
6	Parks/recreation	Open	10
7	Open	Open	10
8	Open in urban	Urban	20
9	Forest	Open	10
10	Water	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

- a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.
- b) **Summation of signals from transmitters.** The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).
- c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

- d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.
- e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability
- f) **P.1546 time variability.** Field strengths will be predicted for a 50% time variability.
- g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.
- h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10
- i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation 27a of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation 27b shall be used to determine the correction for receiving/mobile height.
- j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

- k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.
- l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation 6 of P.1546, Annex 5 will be used to determine $h1$ in all cases. In using this equation the actual value of path length d will be used, including cases when d is less than 1 km.
- m) **Transmit antenna gain.** The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. Operational details of transmitting stations

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP not greater than 2 Watts per 1.7 MHz. These details may include:

- (a) the National Grid Reference to ten (10) metres resolution of each transmitting site;
- (b) the height above ground level of each transmitting antenna to an accuracy of 1 metre;
- (c) the azimuth of each transmitting antenna on each site;
- (d) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);
- (e) the down-tilt (physical and electrical) of each transmitting antenna;
- (f) Class of Emission of the radiated signal;
- (g) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and
- (h) the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna

Annex 4

Draft low power licence for 1479.5-1492 MHz

DRAFT LICENCE

Wireless Telegraphy Act 2006

Office of Communications (Ofcom)

SPECTRUM ACCESS LICENCE 1479.500 to 1492.000 MHz Band

Licence no: [xxxxxx]

Date: [date]

4. The Office of Communications (Ofcom) grants this licence (the "Licence") to

[company name]

Company Reg No: [xxxxxxxx]

(the "Licensee")

[address 1]

[address 2]

[address 3]

[postcode]

to establish, install and use radio transmitting and receiving stations and/or radio apparatus as described in Schedule 1 (the "Radio Equipment") subject to the terms, set out below.

Licence Term

5. This Licence shall continue in force until revoked by Ofcom in accordance with Paragraph 3 below or surrendered by the Licensee.

Licence Variation and Revocation

3. Pursuant to paragraph 8 of Schedule 1 to the Wireless Telegraphy Act 2006 (the “Act”), Ofcom may not revoke this Licence under Paragraph 6 of Schedule 1 to the Act except:
- (a) at the request of, or with the consent of, the Licensee;
 - (b) in accordance with paragraph 8 of this Licence;
 - (c) if there has been a breach of a term of the Licence;
 - (d) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of Regulations made by Ofcom under the powers conferred by section 30(1) and (3) of the Act¹⁸;
 - (e) if the Licensee has been found to the reasonable satisfaction of Ofcom to have been involved in any act, or omission of any act, constituting a material breach of the Wireless Telegraphy (Licence Award) Regulations 2008 (the “Regulations”);
 - (f) in accordance with Paragraph 8(5) of Schedule 1 to the Act;
 - (g) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purposes of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 156 of the Communications Act 2003; or
 - (h) for reasons related to the management of the radio spectrum, provided that in such case:
 - (i) this power to revoke may only be exercised after at least five (5) year’s notice is given in writing to the Licensee; and
 - (ii) such notice must expire after fifteen (15) years from the date of this Licence.
4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Paragraphs 6 and 7 of Schedule 1 to the Act.

Changes

5. This Licence is not transferable. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30(1) and (3) of the Act¹⁹.
6. The Licensee must give prior notice to Ofcom in writing of any proposed change to the Licensee’s name and address from that recorded in the Licence.

¹⁸ These are regulations on spectrum trading.

¹⁹ See Ofcom’s website for the latest position on spectrum trading and the types of trade which are permitted.

Fees

7. The licence fee in respect of this Licence is [£xxxxxx], which for the avoidance of doubt is exclusive of any VAT which may ultimately be payable.
8. On or after the expiry of fifteen (15) years from the date this Licence was granted, the Licensee shall pay to Ofcom such sum(s) as may be provided for in regulations made by Ofcom under sections 12 and 13(2) of the Act, failing which Ofcom may revoke this Licence.
9. The Licensee shall also pay interest to Ofcom on any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 32(2) of the Act from the date such amount falls due until the date of payment, calculated with reference to the Bank of England base rate from time to time. In accordance with section 15 of the Act any such amount and any such interest is recoverable by Ofcom.
10. If the Licence is surrendered or revoked, no refund, whether in whole or in part of any amount which is due under the terms of this Licence or provided for in any Regulations made by Ofcom under sections 12 and 13(2) of the Act will be made, except at the absolute discretion of Ofcom (in accordance with regulation 57 of the Regulations).

Radio Equipment Use

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

Access and Inspection

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

Modification, Restriction and Closedown

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

Geographical Boundaries

16. This Licence authorises the Licensee to establish, install and use the Radio Equipment only in the United Kingdom.

Interpretation

17. In this Licence:
- (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of stations and installation and use of apparatus for wireless telegraphy as specified in section 8 of the Act; and
 - (b) the expressions "undue interference", "station for wireless telegraphy" and "apparatus for wireless telegraphy" shall be construed in accordance with section 115 of the Act.
18. The schedules to this Licence form part of this Licence together with any subsequent schedules which Ofcom may issue as a variation to this Licence at a later date.
19. The Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

Issued by Ofcom

Signed by

For the Office of Communications

DRAFT SCHEDULE

SCHEDULE 1 TO LICENCE NUMBER: [xxxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 1479.500 to 1492.000 MHz Band**

1. **Description of Radio Equipment Licensed**

In this Licence, the Radio Equipment means any radio transmitting and receiving stations and/or any radio apparatus.

2. **Interface Requirements for the Radio Equipment use**

Use of the radio equipment shall be in accordance with the following Interface Requirement:

IR 2068²⁰ for Spectrum Access in the Band 1452 – 1492 MHz

3. **Special Conditions relating to the Operation of the Radio Equipment**

(a) During the period that this Licence remains in force and for six (6) months thereafter, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of:

(iv) the following details relating to the Radio Equipment:

a) postal address;

b) National Grid Reference (to one hundred (100) metres resolution);

c) antenna height (above ground level) and type, bearing east of true north; and

d) radio frequencies used by the Radio Equipment; and

(v) a statement of the number of subscribing customers;

(vi) the operational details of base station sites required in Schedule 2 Paragraph 5 required to establish compliance in any particular area;

²⁰ Available from the Ofcom website at <http://www.ofcom.org.uk>

and the Licensee must produce these records if requested by a person authorised by Ofcom.

- (b) The Licensee shall inform Ofcom of the address of the premises at which this Licence and the information detailed at sub-paragraph 3(a) above shall be kept.
- (c) The Licensee must submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom shall notify to the Licensee.
- (d) The Licensee must also submit to Ofcom in such manner and at such times, all information relating to the establishment, installation or use of the Radio Equipment, whether stored in hard copy or electronic form, as reasonably requested for the purposes of verifying compliance with this Licence or for statistical purposes.
- (e) The Licensee must ensure that the Radio Equipment is established and installed only for terrestrial use.

4. Code of Practice on Engineering Coordination

- (a) The Licensee shall use best endeavours to agree within six months of the date of first issue of this Licence, with the Notified Licensees, engineering coordination principles (to be set out in an industry Code of Practice on Engineering Coordination).
- (b) The objective of the Code of Practice on Engineering Coordination shall be to secure the efficient use of the radio spectrum such that the establishment, installation and use of Radio Equipment will allow other services, whether similar, competing or otherwise, (including those offered by the Notified Licensees) to be established without undue interference.
- (c) In developing the Code of Practice on Engineering Coordination the Licensee and the Notified Licensees shall at a minimum consider principles relating to:
 - (i) Efficient frequency use of the radio spectrum;
 - (ii) Limiting transmission power to that which is no greater than necessary to effectively provide service;
 - (iii) Selection of sites and siting radio equipment in a manner that will minimise the probability of interference arising;
 - (iv) Arrangements for communicating information between Notified Licensees to facilitate engineering coordination.

The Code of Practice on Engineering Coordination, when agreed, shall be provided to Ofcom.

- (d) The Licensee shall use its best endeavours to adhere to the agreed Code of Practice when establishing and using stations for wireless telegraphy and installing and using apparatus for wireless telegraphy.
- (e) If a Code of Practice on Engineering Coordination containing such engineering coordination principles is not agreed within six months as

required by sub-paragraph (a), or, where at any time the objective described in sub-paragraph (b) is in Ofcom's sole opinion not being secured, Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

- (f) Any breach of the principles in a Code of Practice on Engineering Coordination imposed by Ofcom under sub-paragraph (e) above shall constitute a breach of this Licence.
- (g) The Licensee and the Notified Licensees may agree changes to the Code of Practice on Engineering Coordination which was provided to Ofcom under sub-paragraph (c). When agreed, such a revised Code of Practice must be provided to Ofcom as soon as is practical. Where at any time the objective described in sub-paragraph (b) is not being secured by the revised Code of Practice Ofcom shall require that the Licensee and the Notified Licensees shall adhere to the terms of a Code of Practice containing such principles as Ofcom in its sole discretion deems necessary for the achievement of the objective.

5. Cross-border coordination

The Licensee must ensure that the Radio Equipment is operated in compliance with such cross-border coordination and sharing procedures as may be notified to the Licensee by Ofcom.

6. Permitted Frequency Bands

Subject to the Out-of-Block Emissions permitted under Paragraph 10, the Radio Equipment must only transmit and/or receive on the following frequency bands (the "Permitted Frequency Bands"):

- (i) **1479.500 to 1492.000 MHz**

7. Maximum permissible EIRP

The mean operational EIRP of any transmitter using any frequency in the range 1479.500 MHz to 1482.900 MHz shall not exceed 6kW within a single 1.7MHz channel.

There is no limit on the mean operational EIRP of any transmitter that solely uses frequencies in the range 1482.900 MHz to 1492.000 MHz.

8. Maximum permissible transmitter density

No limit.

9. Maximum permissible aggregate PFD

The maximum aggregate PFD in the Permitted Frequency Band(s) specified in paragraph 6(i) shall not exceed $-96.7 \text{ dBW/m}^2/\text{MHz}$ at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The maximum aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

10. **Permissible Out-of -Block aggregate PFD**

The maximum aggregate PFD outside the Permitted Frequency Band(s) specified in Paragraph 6(i) shall not exceed:

Offset from block edge ΔF	Maximum aggregate PFD
	At a receive antenna height of 1.5 m above ground level ($\text{dBW/m}^2/\text{MHz}$)
6.250 to 6.000 MHz	-121
6.000 to 5.400 MHz	-120
5.400 to 5.000 MHz	-119
5.000 to 4.600 MHz	-118
4.600 to 4.200 MHz	-117
4.200 to 3.800 MHz	-116
3.800 to 3.400 MHz	-115
3.400 to 3.000 MHz	-114
3.000 to 2.800 MHz	-113
2.800 to 2.600 MHz	-112
2.600 to 2.200 MHz	-111
2.200 to 2.000 MHz	-110
2.000 to 1.800 MHz	-109
1.800 to 1.600 MHz	-108
1.600 to 1.400 MHz	-107
1.400 to 1.200 MHz	-106
1.200 to 1.000 MHz	-105
1.000 to 0.800 MHz	-104
0.800 to 0.600 MHz	-102
0.600 to 0.400 MHz	-101
0.400 to 0.200 MHz	-99
0.200 to 0.000 MHz	-97

at a height of 1.5m above ground level at more than 95% of locations within a test area as defined in Paragraph 12.

The permissible out-of-block aggregate PFD is due to transmissions by equipment located in the above test area and which is licensed to operate in the Permitted Frequency Band(s) as specified in Paragraph 6(i).

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

The lower block edge being 1479.500 MHz

The upper block edge being 1492.000 MHz

11. Compliance with PFD conditions

For the purpose of establishing compliance with the PFD conditions set out in Paragraphs 9 and 10 a methodology based on radio-frequency propagation modelling shall be used. This methodology is set out in Schedule 2 to this licence.

12. Definition of a test area

The test area is a square area including at least ten transmitters. Its location is defined by the (4-figure) National Grid Reference of the bottom left corner. The appropriate test area is the smallest of the following areas, 1 km², 4 km², 25 km², 100 km², 400 km², 2500 km² or 10000 km², which includes at least ten transmitters.

All test points that occur over a water feature (e.g. sea, lake or river) will be ignored. PFD levels at these points will not contribute to establishing compliance.

13. Interpretation

In this Schedule:

- (a) "EIRP" means the equivalent isotropically radiated power. This is the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain);
- (b) "ERP" means the effective radiated power. This is the power fed to the antenna multiplied by the maximum gain of the antenna with respect to a half-wave dipole.
- (c) "dBm" means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1mW);
- (d) "dBW" means the power level in decibels (logarithmic scale) referenced against 1 Watt (i.e. a value of 0 dBW is 1 W).
- (e) "Out-of-Block Emissions" means radio frequency emissions generated by the Radio Equipment and radiated into the frequency bands adjacent (in terms of frequency) to the Licensee's Permitted Frequency Bands.
- (f) "Base station" means a radio transmitter not intended to be used while in motion to provide a communications service, typically used in mobile or broadcasting radio systems.

(g) “Mobile station” means a radio transmitter intended to be used while in motion or during halts at unspecified locations.

(h) “PFD” means power-flux density and is a measure of the power received per unit area per unit frequency. For the purposes of this licence it is expressed in the following units dBW/m²/MHz.

(i) “aggregate PFD” means the combined PFD caused by all transmitters authorised by this licence within the test area defined in Schedule 1, Paragraph 12.

(j) “Notified Licensees” means the holders of wireless telegraphy licences (which relate to the frequency band 1452 – 1492 MHz) which are notified to the Licensee by Ofcom.

DRAFT SCHEDULE

SCHEDULE 2 TO LICENCE NUMBER: [xxxxxx]

Schedule Date: [date]

Licence Category: **Spectrum Access Licence 1479.500 to 1492.000 MHz Band**

1. Radio-frequency propagation model

For the purpose of radio-frequency propagation modelling ITU-R Recommendation P.1546-3 (P.1546) shall be used.

2. Terrain data

Ordnance Survey “Panorama DTM” 50 m resolution digital terrain map data shall be used.

3. Clutter data

The 50 m resolution clutter database produced by Infoterra shall be used.

This database identifies 10 different clutter categories. For the purposes of incorporation into P.1546 these categories are mapped to the categories noted in P.1546, namely: urban, dense urban, suburban, sea, open. The mapping that will be used is shown in Table A1.

Code	Clutter Database Category	P.1546 category	Reference Antenna Height (m)
1	Dense urban	Dense Urban	30
2	Urban	Urban	20
3	Industrial	Suburban	10
4	Suburban	Suburban	10
5	Village	Suburban	10
6	Parks/recreation	Open	10
7	Open	Open	10
8	Open in urban	Urban	20
9	Forest	Open	10
10	Water	Sea	10

Table A1. Mapping of clutter categories

4. Calculation methodology

To verify compliance, field strength values will be calculated using any suitable radio-frequency software planning tool implementing the radio-frequency propagation model and terrain and clutter data sets described in Paragraphs 1, 2 and 3.

Compliance to the licence terms is established if the aggregate field strength values predicted by the radio-frequency software planning tool are no greater than those given in Schedule 1 Paragraphs 9 and 10 for the specified percentage of locations (pixels) within the test area.

Detailed specification of the methodology is given below:

- a) **Pixel Size.** The test area defined in Schedule 1, Paragraph 12 will be divided into square pixels of size 50m by 50m.
- b) **Summation of signals from transmitters.** The aggregate field strength at a pixel will be defined to be the summation of the predicted field strengths for each outdoor transmitter (expressed in linear units) on an r.m.s. basis (linear addition of power density).
- c) **Excluded pixels.** Aggregate field strength will not be calculated for pixels which contain a transmitter. Pixels containing a transmitter will not be considered in determining compliance. Pixels which are of P.1546 clutter type 'Sea' will not be considered in determining compliance.

The term "adjacent to sea" as described in P.1546, Annex 5, Section 9 is interpreted as "located over the sea". These pixels will therefore not be considered in determining compliance.

- d) **Path profile extraction.** Both terrain height and clutter height will be assumed to be constant over the area of a pixel. No interpolation of heights will be undertaken. The path profile will be extracted using the Bresenham algorithm. Ofcom will publish an example of modelling compliance for a reference network against which licence holders can verify their own compliance modelling software.
- e) **P.1546 location variability.** Field strengths will be predicted for a 50% location variability
- f) **P.1546 time variability.** Field strengths will be predicted for a 50% time variability.
- g) **P.1546 field-strength predictions for distances less than 1 km.** For path lengths of less than 1 km, the method described in P.1546, Annex 5, Section 14 will be used.
- h) **Receiving/mobile antenna height.** Field strengths will be calculated at the height specified in Schedule 1 Paragraphs 9 and 10
- i) **P.1546 correction for receiving/mobile antenna height.** For pixels which are classified as P.1546 categories "dense urban", "urban" or "suburban environment", equation 27a of P.1546 shall be used to determine the correction for receiving/mobile antenna height. For pixels which are classified as P.1546 categories "open" or "sea", equation 27b shall be used to determine the correction for receiving/mobile height.
- j) **Terrain Clearance Angle.** Terrain Clearance Angle correction as described in P.1546, Annex 5, Section 11 will be used.

- k) **P.1546 Correction for short urban/suburban paths.** (P.1546, Annex 5, Section 10,). No correction for short urban/suburban paths will be applied.
- l) **P.1546 Land paths shorter than 15 km.** For paths less than 15 km in length, as described in P.1546, Appendix 5, Section 3.1, equation 6 of P.1546, Annex 5 will be used to determine $h1$ in all cases. In using this equation the actual value of path length d will be used, including cases when d is less than 1 km.
- m) **Transmit antenna gain.** The transmit EIRP assumed will be that in the direction of the reference receiver at the clutter height

5. Operational details of transmitting stations

The operational details of all transmitting stations within the area for which compliance is to be established will be entered into the radio-frequency software planning tool, excluding indoor transmitting stations with an EIRP not greater than 2 Watts per 1.7 MHz. These details may include:

- (i) the National Grid Reference to ten (10) metres resolution of each transmitting site;
- (j) the height above ground level of each transmitting antenna to an accuracy of 1 metre;
- (k) the azimuth of each transmitting antenna on each site;
- (l) the horizontal and vertical profile of each transmitting antenna on each site (without taking into account any down-tilt);
- (m) the down-tilt (physical and electrical) of each transmitting antenna;
- (n) Class of Emission of the radiated signal;
- (o) the mean operational EIRP per MHz over the permitted frequency bands given in Schedule 1 Paragraph 6, averaged over a specified 3 minute interval; and
- (p) the out-of-block emission profile in EIRP per MHz to a maximum of 4 MHz either side of the permitted frequency bands given in Schedule 1 Paragraph 6 of each transmitting antenna