

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

SPECTRUM ACCESS 3.5 GHz

This licence replaces licence number 1111442, issued by Ofcom on 11 January 2018

Licence no.: **1197663**
Date of issue: **25 June 2019**
Fee Payment Date: **31 July** (annually)

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

UK Broadband Limited
(Company Registration number: 04713634)
("the Licensee")
Star House
20 Grenfell Road
Maidenhead
Berkshire SL6 1EH

to establish, install and use wireless telegraphy stations and/or wireless telegraphy apparatus as described in the schedule to this Licence (together "the Radio Equipment") subject to the terms set out below.

Licence term

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

Licence variation and revocation

3. Pursuant to schedule 1, paragraph 8 of the Wireless Telegraphy Act 2006 (the “Act”), Ofcom may not revoke this Licence under schedule 1, paragraph 6 of the Act except:
- (a) at the request, or with the consent, of the Licensee;
 - (b) if there has been a breach of any of the terms of this Licence;
 - (c) in accordance with schedule 1 paragraph 8(5) of the Act;
 - (d) if it appears to Ofcom to be necessary or expedient to revoke the Licence for the purpose of complying with a direction by the Secretary of State given to Ofcom under section 5 of the Act or section 5 of the Communications Act 2003;
 - (e) if, in connection with the transfer or proposed transfer of rights and obligations arising by virtue of the Licence, there has been a breach of any provision of regulations made by Ofcom under the powers conferred by section 30 of the Act¹;
 - (f) for reasons related to the management of the radio spectrum, provided that in such case the power to revoke may only be exercised after at least five years’ notice is given in writing; or

¹ These are regulations on spectrum trading.

(g) 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 breach of any award regulations associated with the frequencies permitted in this licence (“the Regulations”).

4. Ofcom may only revoke or vary this Licence by notification in writing to the Licensee and in accordance with Schedule 1, paragraphs 6, 6A and 7 of the Act.

Transfer

5. This Licence may not be transferred. The transfer of rights and obligations arising by virtue of this Licence may however be authorised in accordance with regulations made by Ofcom under powers conferred by section 30 of the Act².

Changes to the Licensee Details

6. The Licensee shall give prior notice to Ofcom in writing of any proposed change to the Licensee’s name and address as recorded in paragraph 1 of this Licence.

Fees

7. The Licensee shall each year pay to Ofcom the relevant fee as provided under section 12 of the Act and regulations made thereunder on or before the fee payment date shown above, or on or before such dates as shall be notified in writing to the Licensee.

8. The Licensee shall also pay interest to Ofcom on any amount which is due to Ofcom under the terms of this Licence or provided for in any regulations made by Ofcom under sections 12 or 13(2) of the Act from the date such amount falls due until the date of payment, at the then applicable Bank of England base rate. In accordance with section 15 of the Act any such amount and any such interest is recoverable by Ofcom.

9. If the Licence is surrendered, revoked or varied, no refund, whether in whole or in part, of any amount which is due under the terms of this Licence, payable in accordance with the Regulations, 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.

Radio equipment use

10. The Licensee shall ensure that the Radio Equipment is established, installed and used only in accordance with the provisions specified in the schedule to this Licence. Any proposal to amend any detail specified in any of the schedule to this Licence must be agreed with Ofcom in advance and implemented only after this Licence has been varied or reissued accordingly.

11. The Licensee shall ensure that the Radio Equipment is operated in compliance with the terms of this Licence and is used only by persons who have been authorised in writing by the Licensee to do so and that such persons are made aware of, and of the requirement to comply with, the terms of this Licence.

² See Ofcom’s website for the latest position on spectrum trading and the types of trade which are permitted.

Access and inspection

12. 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

13. Any person authorised by Ofcom may require the Radio Equipment or any part thereof, to be modified or restricted in use, or temporarily or permanently closed down immediately if in the opinion of the person authorised by Ofcom:
- (a) a breach of a term of the Licence has occurred; and/or
 - (b) the use of the Radio Equipment is, or may be, causing or contributing to undue interference to the use of other authorised radio equipment.
14. Ofcom may require any of 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 has been served on the Licensee or a general notice applicable to holders of a named class of licence has been published.

Geographical boundaries

15. Subject to the requirements of any coordination procedures notified to the Licensee pursuant to Schedule 1 to this Licence, and excluding the areas set out in paragraph 17 of this Licence, the Licensee is authorised to establish, install and use the Radio Equipment in the United Kingdom. (The Licensee is not authorised to establish, install and use the Radio Equipment in the Channel Islands or the Isle of Man).
16. The areas excluded from this licence are the territorial sea and any inland waters adjacent to the territorial sea, but in the case of streams, rivers or other watercourses which form part of such inland waters they are only excluded where such stream, river or watercourse is more than 2km wide.

Interpretation

17. In this Licence:

- (a) the establishment, installation and use of the Radio Equipment shall be interpreted as establishment and use of wireless telegraphy stations and installation and use of wireless telegraphy apparatus as specified in section 8(1) of the Act;
- (b) the expression “interference” shall have the meaning given by section 115 of the Act;
- (c) the expressions “wireless telegraphy station” and “wireless telegraphy apparatus” shall have the meanings given by section 117 of the Act;
- (d) the expression “territorial sea” shall be determined in accordance with the Territorial Sea Act 1987;
- (e) the expression “inland waters” shall have the meaning given by section 221(1) of the Water Resources Act 1991;
- (f) the schedule forms part of this Licence together with any subsequent schedule(s) which Ofcom may issue as a variation to this Licence at a later date; and
- (g) the Interpretation Act 1978 shall apply to this Licence as it applies to an Act of Parliament.

Issued by Ofcom

Office of Communications

SCHEDULE 1 TO LICENCE NUMBER: 1197663

Schedule Date: 25 June 2019

Licence Category: Spectrum Access 3.5 GHz

Description of Radio Equipment

1. References in this schedule to the Radio Equipment are references to any wireless telegraphy station or wireless telegraphy apparatus that is established, installed and/or used under this schedule.

Interface Requirements for the Radio Equipment

2. Use of the Radio Equipment shall be in accordance with the following Interface Requirement:

IR 2097: Terrestrial systems capable of providing electronic communications services in the 3.4 to 3.8 GHz band.

Special conditions relating to the Radio Equipment

3.
 - a) Subject to paragraph 3(b) of this schedule, during the period that this Licence remains in force, unless consent has otherwise been given by Ofcom, the Licensee shall compile and maintain accurate written records of the following details relating to the Radio Equipment:
 - i) postal address (including post code);
 - ii) National Grid Reference, to at least 10m resolution;
 - iii) antenna height (above ground level), type, and boresight bearing east of true north (if applicable);
 - iv) radio frequencies which the Radio Equipment uses; and
 - v) Transmitted power expressed in dBm / 5 MHz EIRP per cell for non-AAS Radio Equipment; and
 - vi) Transmitted power expressed in dBm / 5 MHz TRP per cell for AAS Radio Equipment.

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

- b) The conditions relating to the keeping of records contained in sub-paragraphs 3(a)(i), (ii) and (iii) of this schedule shall not apply in respect of femtocell equipment and smart/intelligent low power repeater equipment.
- c) The conditions relating to the keeping of records contained in paragraph 3(a) of this schedule shall not apply in respect of licence exempt radio equipment.
- d) The Licensee shall submit to Ofcom copies of the records detailed in sub-paragraph 3(a) above at such intervals as Ofcom may notify to the Licensee.

- e) The Licensee shall submit to Ofcom in such manner and within such period as specified by Ofcom, such other information in relation to the Radio Equipment, or any wireless telegraphy station or wireless telegraphy apparatus which the Licensee is planning to use, as Ofcom may from time to time request. Such information may include, but is not limited to, information in relation to the radio frequency, transmitted power and date of first use for wireless telegraphy stations or wireless telegraphy apparatus to be established, installed or used within such timeframe and in such areas as Ofcom may reasonably request.

Coordination at frequency and geographical boundaries

4. The Licensee shall ensure that the Radio Equipment is operated in compliance with such coordination procedures as may be notified to the Licensee by Ofcom from time to time.

International cross-border coordination

5. The Licensee shall 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 from time to time.

Cooperation between Licensees

6. In addition to complying with the specific transmission terms, conditions and limitations set out in this Licence, the Licensee must liaise and co-operate with other holders of licences in the 3410 MHz – 3800 MHz band (if necessary adjusting transmission power and other technical parameters of transmission) in such a way that harmful interference is not caused by one network deployment to that of another Licensee within the band.

Permitted Frequency Blocks

7. The Radio Equipment may only transmit within the following frequency bands (the “Permitted Frequency Blocks”):

3480 - 3500 MHz
3580 - 3600 MHz

Maximum power within the Permitted Frequency Blocks

8. Subject to any more restrictive limitations imposed by the coordination requirements notified by Ofcom in accordance with paragraphs 4 and 5 of this schedule, the power transmitted in the Permitted Frequency Blocks shall not exceed:

Radio Equipment	Maximum mean power
non-AAS base station ^[a]	65 dBm / 5 MHz EIRP per cell
AAS base station ^[a]	44 dBm / 5 MHz TRP per cell
Mobile or nomadic terminal station ^[b]	28 dBm TRP
Fixed or installed terminal station ^[b]	35 dBm / 5 MHz EIRP

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

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

Maximum power of base stations outside the Permitted Frequency Blocks

9. When transmitting, the Licensee must either transmit in accordance with the condition in paragraph (a) or in accordance with the condition in paragraph (b) –
- a) The condition referred to is that the Licensee must transmit within the limits of the Permissive Transmission Mask and, if doing so, the Licensee must also transmit within the limits of transmission Frame Structure A.
 - b) The condition referred to is that the Licensee must transmit within the limits of the Restrictive Transmission Mask, and, if doing so, it must also transmit and within the limits of transmission Frame Structure B.

10. The Permissive Transmission Mask means that –

for transmissions on the downlink frequencies, the maximum mean EIRP or TRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks, but within 3410 – 3800 MHz, shall not exceed the following transitional and baseline requirements:

	Non-AAS dBm / 5 MHz EIRP per antenna	AAS dBm / 5 MHz TRP per cell	
-5 to 0 MHz offset from lower block edge 0 to 5 MHz offset from upper block edge	Min(PMax – 40, 21)	Min(PMax' – 40, 16)	
-10 to -5 MHz offset from lower block edge 5 to 10 MHz offset from upper block edge	Min(PMax – 43, 15)	Min(PMax' – 43, 12)	
Out of block baseline power limit (BS) < -10 MHz offset from lower block edge > 10 MHz offset from upper block edge	Min(PMax – 43, 13)	Min(PMax' – 43, 1)	

11. The Restrictive Transmission Mask means that –

for transmissions on the downlink frequencies, the EIRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks, but within 3410 – 3800 MHz, shall not exceed the following baseline:

	non-AAS dBm / 5 MHz EIRP per cell*	AAS dBm / 5 MHz TRP per cell
Out of block baseline power limit (BS)	- 34	-43

12. Frame Structure A (also known as the “Preferred Frame Structure”) means that:
- a) transmissions from the Licensee’s base stations have a frame structure as shown in Figure 1. Timeslots (or subframes) 0, 2 to 5 and 7 to 9 must be allocated to Downlink (D) or Uplink (U) transmissions as indicated or may be left with no transmissions;
 - b) the Licensee must ensure that the special subframe (S) in timeslots 1 and 6 have a structure that is compatible with TD-LTE special subframe configuration 6, also known as 9:3:2 (DwPTS: GP: UpPTS). For the avoidance of doubt, a special subframe structure is compatible where there are no uplink transmissions within the downlink pilot timeslot (DwPTS) or guard period (GP) and no downlink transmissions within the uplink pilot timeslot (UpPTS) or guard period (GP);
 - c) timeslots must have a duration of 1 millisecond;
 - d) the Licensee shall ensure that frames start at a common reference time so that all licensees’ frames are aligned and transmissions synchronised;

Note: TD-LTE frame configuration 2 (3:1) is compatible with this frame structure, as are some 5G NR frame configurations. Other technologies are permitted provided that the requirements of 12(a) to 12(d) are met.

13. Frame Structure B (also known as the “Compatible Frame Structure”) means that:
- a) transmissions from the Licensee’s base stations must have a frame structure as shown in Figure 2. Timeslots (or subframes) 0 and 2 must be allocated to Downlink (D), or Uplink (U) transmissions as indicated;
 - b) the Licensee must ensure that the special subframe (S) in timeslot 1 has a structure that is compatible with TD-LTE special subframe configuration 6, also known as 9:3:2 (DwPTS: GP: UpPTS). For the avoidance of doubt, a special subframe structure is compatible where there are no uplink transmissions within the downlink pilot timeslot (DwPTS) or guard period (GP) and no downlink transmissions within the uplink pilot timeslot (UpPTS) or guard period (GP);
 - c) timeslots must have a duration of 1 millisecond;
 - d) the Licensee shall ensure that frames start at a common reference time so that all licensees’ frames are aligned and transmissions synchronised;
 - e) timeslots with no transmission indicated may have no transmission or must be determined as a Downlink, Uplink or Special subframe as necessary in order to ensure compliance with paragraph 13(c) and 13(f);
 - f) the Licensee must cooperate to minimise harmful sub-frame overlaps if different technologies are used. On rare occasions this may require the frame alignment or guard period to be slightly offset;
 - g) for the avoidance of doubt all-downlink frame structures such as Supplementary Downlink (SDL) are not permitted.

Note: all current TD-LTE frame configurations are compatible with this frame structure, as are some 5G NR frame configurations. Other technologies are permitted provided that the requirements of 13(a) to 13(d) are met.

Figure 1: Frame Structure A

DL/UL ratio	Subframe number									
	0	1	2	3	4	5	6	7	8	9
3:1	D	S	U	D	D	D	S	U	D	D

Figure 2: Frame Structure B

DL/UL ratio	Subframe number									
	0	1	2	3	4	5	6	7	8	9
Any	D	S	U							

14. Irrespective of whether the Restrictive Transmission Mask or the Permissive Transmission Mask is being used, the EIRP or TRP emanating from the Radio Equipment transmissions at any frequency outside the Permitted Frequency Blocks shall not exceed the following additional band edge requirements:

	Non-AAS <i>dBm / MHz_[a] EIRP per antenna</i>	AAS <i>dBm / MHz_[a] TRP per cell</i>
Below 3390 MHz	-50	-52

[a] We note this level is defined in the Commission Decision 2019/235/EC as per MHz rather than per 5 MHz

	Non-AAS <i>dBm / 5 MHz EIRP per antenna</i>	AAS <i>dBm / 5 MHz TRP per cell</i>
3390 – 3400 MHz	Min(PMax – 43, 13)	Min(PMax' – 43, 1)
3400 – 3405 MHz	Min(PMax – 43, 15)	Min(PMax' – 43, 12)
3405 – 3410 MHz	Min(PMax – 40, 21)	Min(PMax' – 40, 16)
3800 – 3805 MHz	Min(PMax – 40, 21)	Min(PMax' – 40, 16)
3805 – 3810 MHz	Min(PMax – 43, 15)	Min(PMax' – 43, 12)
3810 – 3840 MHz	Min(PMax – 43, 13)	Min(PMax' – 43, 1)
Above 3840 MHz	-2	-14

Small Cells

15. The Licensee is required to comply with the Permissive Transmission Mask as set out in paragraph 10 of this schedule but is not required to comply with the frame structure requirements set out in paragraphs 12 or 13 above, for:
- Indoor Domestic Small Cells; or
 - Indoor Non-domestic Small Cells, except where another licensee demonstrates that they are suffering harmful interference as a result.

If another licensee demonstrates that they are suffering harmful interference as a result of an Indoor Non-domestic Small Cell, the Indoor Non-domestic Small Cell must comply with the requirements set out in paragraphs 9 and 12 above, where Frame Structure A is used or those requirements set out in both paragraphs 9 and 13 above where Frame Structure B is used.

Interpretation of terms in this schedule

16. In this schedule:

- a) “5G NR” means 5G New Radio and refers to the air interface that has been developed by 3GPP for fifth generation (5G) mobile radio networks. This air interface defines how 5G base stations and user devices both transmit and receive radio signals using spectrum;
- b) “AAS” means active antenna system. An AAS is a base station and antenna system where the amplitude and / or phase between antenna elements is continually adjusted resulting in an antenna pattern that varies in response to short term changes in the radio environment. This is not intended to include long term beam shaping such as fixed electrical down tilt. In AAS base stations the antenna system is integrated as part of the base station system or product;
- c) “dBm” means the power level in decibels (logarithmic scale) referenced against 1 milliwatt (i.e. a value of 0 dBm is 1 milliwatt);
- d) “Downlink” means transmissions from a base station to a terminal station (handset);
- e) “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), measured during the “on” part of the transmission;
- f) “femtocell” means a base station which operates at a power not exceeding 24 dBm EIRP per carrier, and which is or will be used only by and under the control of the Licensee, following the establishment of a telecommunications link between the femtocell and a network of the Licensee;
- g) “Fixed or installed” means used or installed at specific fixed points;
- h) “Indoor” means a location inside a building or place in which the shielding will typically provide the necessary attenuation to protect wireless telegraphy against harmful interference;
- i) “Indoor Domestic Small Cell” means a base station with an EIRP of less than or equal to 24dBm per 20 MHz carrier that is located within a residential property;
- j) “Indoor Non-domestic Small Cell” means a base station with an EIRP of less than or equal to 24dBm per 20 MHz carrier that is located indoors but not within a residential property;
- k) “IR” means a United Kingdom Radio Interface Requirement notified by Ofcom in accordance with Article 8 of Directive 2014/53/EU of the European Parliament and of the Council on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment (known as the Radio Equipment Directive);
- l) “lower block edge” means, in relation to each Permitted Frequency Block, the lowest frequency in that Permitted Frequency Block;
- m) “mobile or nomadic” means intended to be used while in motion or during halts at unspecified points;

- n) “non-AAS” means a piece of Radio Equipment which is not an AAS;
- o) “per antenna” means per radiating unit/component (irrespective of the number of radiating elements that make up that unit/component);
- p) “per cell” means per specific piece of Radio Equipment. For a multi-sector base station, per cell refers to each one of the individual sectors irrespective of the number of transmit antennas;
- q) “Permitted Frequency Blocks” has the meaning given to it in paragraph 7 of this Schedule;
- r) “PMax” is the maximum mean power for the base station in question if it is using a non-AAS. This is measured as EIRP per carrier and determined on a per antenna basis;
- s) “PMax” is the maximum mean power for the base station in question if it is using an AAS. This is measured as TRP per carrier and determined on a per cell basis;
- t) “smart/intelligent low power repeater” means a repeater which operates with power not exceeding 24 dBm EIRP per carrier, which may be established by customers of the Licensee who have written agreements with the Licensee and:
- The Licensee has ultimate control of the repeater, i.e. each individual repeater can be disabled remotely by the Licensee;
 - The repeater operates only on the Licensee’s frequencies and with their valid Public Land Mobile Network Identifier;
 - Must not cause undue interference to other spectrum users; and
 - The repeater only transmits on the uplink timeslot when actively carrying a call (voice, video or data) or signalling from serviced handsets.
- u) “TDD” means the application of time-division multiplexing to separate uplink and downlink signals;
- v) “TD-LTE” means the TDD variant of LTE (Long Term Evolution or 4G technology);
- w) “TRP” means the total radiated power. This is the integral of the power transmitted in different directions over the entire radiation sphere, measured during the on part of the transmission;
- x) “Uplink” means transmissions from a terminal station (handset) to a base station; and
- y) “upper block edge” means, in relation to each Permitted Frequency Block, the highest frequency in that Permitted Frequency Block.