

Spectrum for Unmanned Aircraft Systems (UAS)

Approach to authorising the use of radio equipment on
UAS

STATEMENT:

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1. Overview

Unmanned Aircraft Systems (UAS), more commonly known as drones, are aerial vehicles that do not carry a human operator, but instead are remotely piloted. This emerging technology could bring significant innovations to several industries, ultimately delivering benefits to consumers and citizens. To date, examples of this in the UK have included the use of drones to deliver medical supplies and mail to remote areas and use for search and rescue operations. Wireless communications, and hence the use of radio spectrum, are essential for the operation of drones including for control, sending back data/video and for various safety systems.

In the UK, the Civil Aviation Authority (CAA) is responsible for aviation safety and determining policy for the use of airspace. It regulates the use of UAS and sets rules for how and under what conditions UAS may be operated. As the spectrum regulator in the UK, Ofcom has the role of authorising the use of radiocommunications equipment.

Most drones today currently use spectrum designated for Wi-Fi or model aircraft which does not require a Wireless Telegraphy Act 2006 (the 'WT Act') licence, as these devices have been exempted from needing one by Ofcom. However, in recent years drone technology has advanced rapidly and the use of this licence exempt equipment does not provide the necessary range for some of the emerging use cases. These involve drones flying at higher altitudes and over longer distances, sometimes going beyond visual line of sight (BVLOS) of the operator.

Working with the CAA, Government, stakeholders and other administrations we have developed a UAS spectrum licensing framework. This will allow UAS operators to have access to different technologies, such as satellite and mobile, that could enable them to operate a wider range of services and over longer distances. As technology progresses, these devices are becoming increasingly automated and may one day become fully autonomous without the need for a remote pilot.

This statement sets out our decision to introduce this new UAS Operator Radio licence for drones, alongside the existing licence exemption framework for lower power use.

What we have decided – in brief

We have decided to introduce a new UAS Operator Radio licence to authorise the use of radio equipment on drones. The authorisation of this equipment is an enabler for drones to be operated beyond visual line of sight (BVLOS). The licence authorises a range of equipment that an operator may choose to use or be required to carry by the Civil Aviation Authority (CAA). The UAS Operator Radio licence will:

- Cover all drones a company or individual operates in the UK and territorial waters but does not cover international flights.
- Have an indefinite duration, subject to the payment of an annual licence fee of £75.
- Authorise a range of specific radio equipment that may be needed for future drone operations, including beacons and safety equipment that may be mandated by the CAA. The list of equipment will be kept under review and, subject to consultation, will be updated to reflect changes in technology or the overarching air safety framework.
- Permit the use of satellite and mobile technologies while requiring the specific agreement of the network operator(s). No transmission will be permitted in the 2.6 GHz band.

This licence does not replace the current licence exemption regime for low power 2.4 GHz and 5 GHz equipment which most drones on the market currently fall under.

This licence authorises spectrum use in accordance with the licence terms and conditions. Drone operators will continue to need to adhere to any air safety requirements and other regulations regarding the operation of their UAS set by the CAA, the UK's aviation regulator.

- 1.1 For many years Ofcom has authorised the use of spectrum used to control model aircraft and drones through our licence exemption regime, which means that users do not need a licence. Typically, these devices either use the 35 MHz frequency band (designated for airborne model control) or the 2.4 GHz and 5 GHz frequency bands (using Wi-Fi or other low power radio network technologies). Most of the drones which are currently on the market in the UK fall under these provisions so do not require a separate spectrum authorisation.
- 1.2 Technological developments have increased the operational range and altitude capabilities of UAS flights, sometimes going beyond visual line of sight (BVLOS). However, the radio equipment that most drones use today is not suitable for them to fly over these longer distances. This is due to power limitations of the licence exempt devices which means that they cannot provide the necessary range.
- 1.3 In [June 2022 we consulted on plans](#) to introduce a new spectrum licence for drone operators, especially those looking to fly BVLOS using mobile or satellite technologies. We proposed that our UAS Operator Radio licence would authorise the licensed operator, which could be an individual or company, to use a range of technologies on their drone fleet that are not currently permitted today. This access included the use of mobile and satellite terminals for control and transmission of data and safety equipment to enable the drone to avoid collisions and integrate safely into the UK's airspace.

- 1.4 We received 26 responses to the consultation. Most respondents agreed with our proposal to introduce a new licence, with just two respondents opposing this proposal. Several respondents provided feedback on specific aspects of our proposals, and we provide our response to these points in this statement.
- 1.5 Following careful review of responses, we have decided to proceed with our proposed approach and plan to accept applications for UAS Operator Radio licences from mid-January 2023. In light of the responses received we have made some amendments to the proposed licence terms and conditions. These changes mainly relate to the use of certain devices and their associated technical parameters.
- 1.6 This new licence does not replace the current licence exemption regime for low power 2.4 GHz and 5 GHz equipment which most drones on the market currently use today. Owners of these drones will not need to obtain one of these licences provided that the equipment meets the conditions for licence exempt use.

UAS Operator Radio Licence overview

- 1.7 The UAS Operator Radio licence:
- Covers all drones a company or individual operates in the UK¹ and territorial waters but does not cover international flights;
 - Will have an indefinite duration but subject to the payment of an annual licence fee of £75;
 - Authorises a range of specific radio equipment that may be needed for future drone operations, including beacons and safety equipment that may be mandated by the CAA; and
 - Permit the use of satellite and mobile technologies while requiring the specific agreement of the network operator(s). No transmission will be permitted in the 2.6 GHz band.
- 1.8 Standard terms and conditions for the licence are set out in our [Wireless Telegraphy Licence Conditions Booklet OfW 597](#).
- 1.9 When using satellite or mobile networks for connectivity the licensee must have permission from the relevant network operator to do so. Studies have shown that airborne drone operations can have an impact on a host mobile network, so it is for each operator to decide whether or not to allow airborne use on their network and under what conditions. For example, an operator might decide to restrict drone flights to certain locations.
- 1.10 Whilst this is ultimately a contractual matter between the mobile network operator (MNO) and their customers, we have included a provision in the UAS Operator Radio licence that requires the licensee to have specific written agreement from the MNO prior to using their network. We envisage this specific licence condition as a temporary safeguard measure to help reduce the risk of adverse impacts to MNO services and enable action to be taken in

¹ The licence does not provide authorisation in the Channel Islands and the Isle of Man. However, it could be extended to these areas in the future should the relevant island authorities wish to do so.

the event that these impacts occur. We plan to remove this clause in future once MNOs have had time to put in place mitigations to manage airborne use on their networks, for example via the introduction of new technology, inclusion of specific terms and conditions in contracts and raising awareness of these requirements with users of mobile services.

- 1.11 The conditions that an MNO may require before access is granted and any contractual agreements for using their network (including fees) are a commercial matter between the parties. Ofcom will not become involved in these matters or disputes regarding any refusal to provide permission to use the network. We urge all parties involved to work together and come up with an agreed process and set of requirements.
- 1.12 When using bands allocated to an MNO the licensee must ensure that the equipment does not use the 2.6 GHz band (2500-2690 MHz) in order to protect air traffic control (ATC) radars. We have not specified how licensees must do this as the solution could be solved via a hardware, software or network modification.
- 1.13 The licence also authorises the use of a range of safety related equipment including radars, beacons and altimeters. The list of radio equipment and frequencies contained in the licence will be kept under review and, subject to consultation, will be updated to include new technologies as they are adopted, or to implement changes introduced by the overarching air safety framework. As new mobile or satellite bands are introduced these will be included into the licence, an example of this is our [recent decision](#) to permit access to 14.25-14.5 GHz for satellite communications which we have now included into the licence.

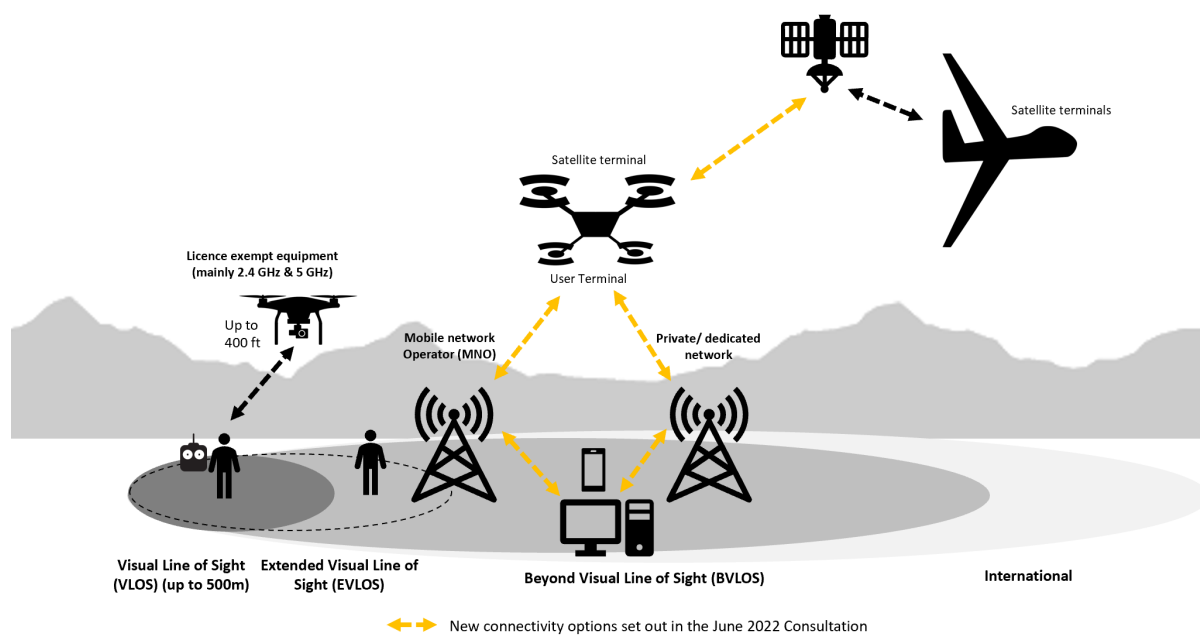
All UK drone use must comply with CAA regulations

- 1.14 The CAA regulates the safety of aviation, including aircraft, associated equipment, and airspace in the UK. The CAA also sets the rules governing how and where drones can be flown safely.
- 1.15 It should be noted that our UAS Operator Radio licence only authorises the use of radio equipment in regard to the authorisation under the WT Act. It does not provide any broader authorisation related to drone operations or supersede any aviation safety rules or requirements. Many of these are set by the [CAA](#) and could include requiring the operator to hold a Flight Radio Telephony Operators Licence (FRTOL) or being granted special permission to use certain equipment. There may also be specific CAA approvals required or restrictions placed on the use of some of the equipment listed in the UAS Operator Radio licence. Therefore, operators should ensure they have secured all relevant permissions prior to drone use.
- 1.16 Along with Government, the CAA is currently developing a long-term framework for UAS use and the integration of this into the overall UK airspace management regime. It is likely that the CAA will introduce further requirements relating to what radio equipment UAS must use to avoid collisions and operate safely into the UK's airspace. This is vital given the expectation that drones will be operated at greater distances/altitudes and with other users of the airspace. We continue to work closely with the CAA and Government on these issues and will ensure the regulatory regimes remain aligned.

2. Introduction

- 2.1 Unmanned Aircraft Systems (UAS), also referred to as Remotely Piloted Aerial Systems (RPAS) but more commonly known as drones, are aerial vehicles that do not carry a human operator, but instead are remotely piloted. As technology progresses, these devices are becoming increasingly automated, and may one day become fully autonomous without the need for a remote pilot.
- 2.2 In the UK, the Civil Aviation Authority (CAA) is responsible for the regulation of UAS and sets rules for how and under what conditions UAS may be operated. One of the key enablers for UAS is wireless communications. As the spectrum regulator in the UK, Ofcom also has a role in authorising radiocommunications equipment that can be used as part of a UAS.
- 2.3 Most drones today currently use spectrum designated for Wi-Fi or model aircraft which do not require a Wireless Telegraphy Act 2006 (the 'WT Act') licence, as these devices have been exempted from needing one by Ofcom. However, this regime is not suitable for some of the emerging use cases which would involve drones flying at higher altitudes and over longer ranges, sometimes going beyond visual line of sight (BVLOS). This is due to power limitations of the licence exempt devices that they use.
- 2.4 Ofcom has been working with the CAA and other stakeholders to review our framework for authorising equipment that can be used as part of a UAS, to help enable the development of this emerging industry.

Figure 1: Communication links for UAS command, control and payload



Our proposals

- 2.5 In our [June 2022 Consultation](#), we set out proposals to introduce a new spectrum licence for UAS operators. The proposed Unmanned Aircraft System (UAS) Operator Radio licence would authorise operators to use a range of technologies on their UAS/drone fleet that are not currently permitted today, including mobile and satellite terminals for control and transmission of data and video and safety equipment to enable the drone to avoid collisions and integrate safely into the UK's airspace.
- 2.6 We summarise some of the key points of our proposed approach below:
- The proposed licence would cover a range of equipment that an operator may choose to use or be required to carry by the Civil Aviation Authority (CAA).
 - If a licensee wishes to use a mobile technology that connects to a public mobile network they will need, before doing so, to obtain permission from the operator of the network they wish to use.
 - The licence would be subject to an annual fee of £75.
 - Our proposed licence would not replace the current licence exemption regime for low power 2.4 GHz and 5 GHz equipment which most drones on the market currently fall under today.
 - In addition to a licence to use radio equipment, operators will continue to need to adhere to any air safety requirements regarding the operation of their UAS set by the CAA, the UK's aviation regulator.

Table 1: June 2022 consultation proposed list of authorised equipment to be as part of a UAS

System	Frequency	Requirements
High Frequency (HF) Communications	2.85 to 22 MHz	
Very High Frequency (VHF) Navigation / Marker	108 to 117.575 MHz	
VHF Communications	117.975 to 137 MHz	Analogue voice communications with 8.33 kHz channelization, VHF Data Link Modes 2 & 4 with 25 kHz channelization. When operating on the emergency frequency (121.5 MHz), the auxiliary frequency for search and rescue operations (123.1 MHz) or the airport fire service frequency (121.6 MHz), the equipment may operate 25 kHz channel spacing on these frequencies.
Instrument Landing System	328.6 to 335.4 MHz	

System	Frequency	Requirements
Ultra-High Frequency (UHF) radio equipment	453.0125 to 462.4875 MHz	
Mobile Network User Terminal (UE)	703 to 733 MHz & 758 to 788 MHz (700 MHz band) 791 to 821 MHz & 832 to 862 MHz (800 MHz band) 880 to 915 MHz & 925 to 960 MHz (900 MHz band) 1710 to 1781.7 MHz & 1805 to 1876.7 MHz (1800 MHz band) 1920 to 1980 MHz & 2110 to 2170 MHz (2100 MHz band) 2350 to 2390 MHz (2.3 GHz band) 3410 to 3800 MHz (3.4-3.8 GHz band)	The Licensee must have written permission for airborne use of its User Terminal (UE) from the mobile network(s) to which that UE connects. The Licensee must adhere to any terms and conditions imposed on it by the network operator(s) in respect to its use on that/(those) network(s). All airborne UE transmissions in the 2500 to 2690 MHz (2.6 GHz band) are prohibited. The Licensee must ensure that under no circumstance should the UE be able to connect to services operating in this band.
Area Navigation (NAV)/Distance Measuring Equipment (DME)	960 to 1215 MHz	
Air Traffic Control (ATC) Transponder	1030/1090 MHz	No FRTOL needed if the operator has no control over the operation of the Transponder, other than to switch it on and off.
Traffic collision avoidance system (TCAS)/ Airborne collision avoidance system (ACAS)	1030/1090 MHz	
Electronic Conspicuity Device (ECD)		The ECD must identify the UAS and must be operated in accordance with the latest version of CAP 1391, published by the CAA.
Distance Measurement Equipment	1165 to 1215 MHz	

System	Frequency	Requirements
Satellite Earth Station Communication	14 to 14.25 GHz	<p>(a) Satellite Earth Station may be used only if authorised to do so under a "Satellite (Earth Station Network)" Licence issued to the operator of the earth station network;</p> <p>(b) The Satellite Earth Station may transmit with an e.i.r.p. no greater than 55 dBW</p> <p>(c) If operating to a geostationary satellite, the Satellite Earth Station must employ a stabilised platform and must maintain a pointing accuracy +/- 0.2 degrees towards the relevant geostationary satellite throughout transmissions;</p> <p>(d) At angles greater than or equal to 2.5 degrees from the antenna main beam axis, the e.i.r.p. of the Satellite Earth Station, if operating to a geostationary satellite, shall not exceed 20 dBW/40 kHz;</p> <p>(e) All transmissions from the Satellite Earth Station must be clearly identifiable;</p> <p>(f) The Satellite Earth Station must at all times operate such that it conforms to Interface Requirement IR 2077, published by Ofcom;</p> <p>(g) The Satellite Earth Station shall meet the conditions given in footnotes 5.504B, 5.504C, 5.508A and 5.509A of the Radio Regulations so as not to cause harmful interference to terrestrial fixed and radio astronomy stations.</p>
	1525 to 1660.5 MHz	
Radio altimeters	4200 to 4400 MHz	
Aeronautical mobile airport communication system	5091 to 5150 MHz	
Earth stations on mobile platforms (ESOMP)	<p>27.5 - 27.8185 GHz, 28.4545 - 28.8265 GHz and 29.4625 - 30 GHz for transmission (Earth-to-space)</p> <p>17.3 - 20.2 GHz for reception (space-to-Earth)</p>	<p>The operation of the ESOMP Equipment shall comply with the Radio Equipment Regulations 2017 and with the technical and operational criteria contained within the UK Interface Requirement 2093.</p> <p>The Licensee must have written permission for airborne use of its User Terminal (UE) from the satellite network(s) to which that UE connects. The Licensee must adhere to any terms and conditions imposed on it by the network operator(s) in respect to its use on that/(those) network(s).</p>

Legal framework

- 2.7 Ofcom is responsible for authorising use of the radio spectrum. Since the radio spectrum is a finite resource crucial to delivering all wireless services, Ofcom is responsible for ensuring that it is used in the best interests of people and businesses in the UK. We authorise the use of the radio spectrum either by granting wireless telegraphy licences under the WT Act or by making regulations exempting the use of particular equipment from the requirement to hold such a licence.
- 2.8 It is unlawful and an offence to install or use wireless telegraphy apparatus without holding a licence granted by Ofcom, unless the use of such equipment is exempt. In Annex 1 we set out in more detail the relevant legal framework, which we have considered in making the proposals set out in this document. This annex should be treated as part of this document.
- 2.9 In addition to Ofcom's legal framework covering the authorisation of radio spectrum, UAS operators are also subject to other regulatory requirements. These are administered by the CAA and cover what can be flown, by whom and where. Examples include the requirement to seek a specific approval for operating a UAS BVLOS, where the safety risks involved are substantially higher than flying a drone within visual distances. These requirements could involve passing tests and labelling equipment. Also, to use some equipment a Flight Radio Telephony Operator's Licence (FRTOL) or other appropriate qualification may be required. For more information on the regulations concerning drone use visit the [CAA website](#).
- 2.10 Operators will also need to adhere to any data protection or privacy laws that may be in place. Any photos or recordings may be covered by the General Data Protection Regulation (GDPR). More information regarding this can be found on the [Information Commissioner's Office website](#).

3. Responses to the consultation

3.1 We received 26 responses to the consultation. Most respondents agreed with our proposal to introduce a new licence, with just two respondents opposing this proposal. A number of respondents provided feedback on specific aspects of our proposals, and we provide our response to these points in this section.

3.2 In the consultation document we asked the following questions:

Question 1: Do you agree with the proposal to license drone equipment rather than to licence exempt? If you disagree, please provide the evidence that would support any disagreement with the proposals.

Question 2: Do you agree with the proposed authorisation approach for UAS? If you disagree, please provide the evidence that would support any disagreement with the proposals.

Question 3: Do you have any comments on the proposed licence conditions?

Question 4: Do you have any comments on the proposed list of equipment and associated conditions?

Question 5: Do you agree with Ofcom's assessment on whether to introduce UAS operator licences? If you disagree, please provide further information.

3.3 We have grouped the responses to these questions into themes. These are set out in this section.

Licensing radio equipment on drones

Our proposed approach

3.4 In our Consultation we proposed to introduce a new licence to authorise the use of radio equipment on drones. We said that we did not believe that exempting all of the equipment on UAS was appropriate due to risks of interference to other services and impacts on the technical quality of service, especially regarding use of mobile networks and some other aeronautical systems. We also considered the safety of life considerations surrounding the flying of UAS and the need for some equipment to be used only if the operator has an appropriate certificate issued by the CAA.

Stakeholder responses

3.5 Overall, most respondents were supportive of our proposal to license drone equipment operating at higher powers and using a wider range of frequencies and technologies compared with the existing licence exemption, rather than to authorise these new categories of drone use via licence exemption.

3.6 The Civil Aviation Authority (CAA) agreed with our proposals but noted that close coordination with the CAA would be required to ensure that the two regulatory regimes

work in parallel. Similar points were made by NATS, CGI and Boeing. CGI advised that spectrum was critical to integration of UAS into airspace with other users.

- 3.7 All four mobile network operators (BT, Virgin Media O2 (VMO2), Vodafone and Hutchison 3G UK (H3G)) agreed with the proposals to licence the use of mobile terminals (hereafter referred to as user equipment or UE) connecting to their networks. H3G advised that there is a clear risk of interference to other services and users and as such, licence exemption was not appropriate. Vodafone cautioned that, while some trials and coexistence studies have shown that UE could be used without interfering with the wider network, the action of making usage licence exempt is fundamentally a one-way step that would be practicably impossible to reverse if issues did subsequently emerge, particularly those that might only manifest themselves at scale. VMO2 also raised concerns, requesting that prior to authorisation there be a trial period to understand further the risk and impact of any interference. It suggested that it would be sensible to trial this in rural areas first before moving to assess potential feasibility in urban areas.
- 3.8 Windracers / Distributed Avionics supported the licensing approach as they believed that the market for UAS related products was not mature enough to define common standards across radio devices that could justify licence exempt use.
- 3.9 Vodafone and Skyports suggested that if in the future no issues arise from the deployment of drones on mobile networks, Ofcom should look to consider licence exemption.
- 3.10 H3G noted Ofcom's suggestion that it may look to remove the requirement for operators to get prior written approval in the future if future technological changes mitigate the interference issue. However, it advised that, due to the issue of legal liability, it would like the requirement for prior written approval to remain. If Ofcom were to consider removing this requirement in future, it would like this consulted on.
- 3.11 Only two respondents, Bristol Drones and Parrot were opposed to a licensing approach. Both objected to the need for UE to be treated differently when used on a drone². Parrot said that it disagreed with the licensing concept as it creates a cost to business and a burden on users as they would have to apply for a licence.
- 3.12 Parrot argued that there was no evidence that the use of micro-drones (below 2 kg) would negatively impact mobile networks and that, for flights below 120m, the 4G use would be like any other terrestrial use. It said no other countries had introduced licences for the use of end user equipment as far as they were aware. It said it could put in place mechanisms to prevent access to certain bands such as 2.6 GHz and that any limitations could not be circumvented by the end user. Finally, Parrot said that the UAS business was in its infancy and that licensing at such an early stage could stifle innovation and create a barrier to entry in an already heavily regulated sector. It noted the support of the UK Government for the use of mobile technologies for UAS use.
- 3.13 While offering support for the proposal for a licence, one respondent, who wished to remain anonymous, felt that the consultation did not fully consider the implications to or

² In normal use, mobile user equipment can be operated on a licence exempt basis, provided it is operated in accordance with the terms of the relevant licence exemption regulations.

from military training activity. It identified some potential bands of conflict for routine use in training of several warships, airborne and land based military radars and the electronic attack (radar and communications jamming) performed during various training exercises.

- 3.14 Birmingham Airport raised a concern that the remote operation of drones could be a national security concern “when you could have someone anywhere in the world”.
- 3.15 The Association of Remotely Piloted Aircraft Systems UK (ARPAS-UK) and VMO2 queried how Ofcom would enforce the proposed licensing regime.

Ofcom response

- 3.16 We note the overall support for our proposed authorisation framework, which we developed as a result of working with the CAA, Government and other stakeholders. We want to support innovation and enable the development of this new emerging area, which, whilst at a relatively early stage, has the potential to deliver benefits for citizens and consumers across many sectors. We recognise that this is an area of fast evolving technology and innovation and there will continue to be wider developments in airspace policy managed by the CAA. We will therefore need to keep the licensing framework under review but would consult with stakeholders in the event that we need to propose any changes to the framework.
- 3.17 One of the benefits of our authorisation framework is that it will allow us to more easily adapt our licence to take account of any equipment or regulatory changes. It can be more challenging to change the authorisation approach at a later date if devices are authorised to operate on a licence exempt basis. A licence exempt approach also presents some other potential disadvantages: it offers less certainty that technical conditions will be followed to avoid undue interference, and ensuring compliance with technical requirements may be more challenging as regulators hold less information about who is operating under a licence exemption regime. For that reason, we believe that our licensed approach will help to foster innovation, enabling this sector to grow whilst ensuring alignment with wider developments in airspace policy.
- 3.18 Regarding VMO2’s request that trials of the technology be undertaken before we proceed with authorising the equipment, we note that over the past two years we have authorised a number of trials through our Innovation and Trial licensing regime. Each request for access to spectrum allocated to an MNO was coordinated with the network. These trials were undertaken as part of a wider programme run by the CAA and other Government departments. We therefore do not believe that we should further delay the ability for users to obtain an operational licence under the terms we proposed.
- 3.19 As we set out in the consultation document, it is a commercial decision for each mobile network operator (MNO) whether to enable the use of airborne UE, such as 4G/5G dongles or modems, on their network. Our decision to introduce the UAS Operator Radio licence enables MNOs that wish to proceed with a mechanism to do so. For other operators, our Innovation and Trial licensing approach remains an option to develop and test UAS technologies before putting them into operational use. Any decision on whether to allow a UAS to operate on its network is a matter for each MNO.

- 3.20 We disagree with the claims of Parrot and Bristol Drones that the use of a UE airborne is no different to normal terrestrial use. This has been the subject of studies undertaken by European Conference of Postal and Telecommunications Administrations ([CEPT](#)), on which Ofcom has based its conclusions. As we explained in paragraphs 3.11 to 3.14 of our June 2022 consultation, [ECC Report 309](#) found that if 33% of traffic on a mobile network cell is airborne then the mobile network will need additional measures in place to mitigate the problems this causes. If in the future the introduction of new technology³ can avoid or mitigate the impact of airborne UE on other users and the networks themselves, we would consider whether it would be appropriate to exempt this equipment from the need for a licence. Any proposals to do so would be subject to consultation.
- 3.21 On the impact of military training activities and concerns over national security these are outside the scope of this consultation and Ofcom's duties. Matters of airspace safety are the responsibility of the CAA. Regarding the potential issues with military training exercises, the CAA has already put in place a process for [notifying airspace users](#) of this activity. Operators of drones will need to adhere to any notices published by the CAA regarding dangers or the closure of airspace. Regarding the wider issues of national security, we note that the Home Office lead on this subject and have developed a [counter-drone strategy](#).
- 3.22 Ofcom currently enforces compliance with a range of different licences covering a wide range of equipment and uses. We do not expect that the enforcement regime will differ from our existing enforcement regime that already covers ship and aircraft licences. Ofcom has statutory powers to protect and manage the radio spectrum. These powers include provisions to address contraventions of licence terms, provisions and limitations including the ability to revoke the licence. These are detailed [on our website](#). For example, where there are reasonable grounds to believe that there is or has been a contravention of terms, provisions and limitations of a licence, Ofcom may serve a Contravention Notice. Ofcom also has the powers to prosecute, warn, caution or serve a fixed penalty notice or issue a financial penalty.

Authorising the use of multiple drones per licence

Our proposed approach

- 3.23 In our Consultation we said that our preferred approach to licensing would be to license each UAS operator rather than each drone. The licensee would be the legal entity responsible for holding the licence and could be an individual, partnership or company. The licence would cover the use of all UAS which the licensee is responsible for and would cover a range of radio equipment that may be required to be fitted. We said that this approach would provide the necessary regulatory oversight to ensure compliance with any conditions that we may need to impose. Furthermore, under this approach, additional

³ For example, [3GPP](#) Releases 15, 16 and 17 have all introduced features to support UAS use on mobile networks. Work continues to develop this in release 18.

radio equipment and frequencies could be added to licences once the CAA had finalised its framework for UAS.

Stakeholder responses

- 3.24 Eighteen respondents agreed with our proposed approach to license each UAS operator, while three respondents disagreed with this approach, raising specific concerns. Several respondents who supported this approach noted their view that an operator licence would create less of a burden than having to individually license each drone.
- 3.25 Inmarsat agreed with the approach to license each UAS operator but proposed that the licence should also be available to a Command and Control link Communications Service Provider (C2CSP). It said it was envisaged that a C2CSP would manage connectivity on behalf of a UAS operator, potentially providing access to multiple mobile and satellite operator networks. It said this would eliminate the need for UAS operators to obtain permission from each MNO and/or satellite operator they intend to subscribe to.
- 3.26 Cranfield University and Airport agreed with the approach to license each operator but asked whether multiple drones operating under a single licence would cause a problem. They raised the example of [International Civil Aviation Organization \(ICAO\)](#) hexadecimal codes⁴ that certain equipment needs in order to transmit the identity of the aircraft. One respondent, who wished to remain anonymous, also agreed with the proposal but said the proposals did not take account of a company employing a number of UAV operators. It considered that “individual licensing akin to pilot licences is all very well, but type ratings and a company UAV operators’ certificate could enhance the monitoring of the regulatory environment between the CAA and Ofcom”.
- 3.27 Windracers / Distributed Avionics was concerned that, if the only licensing option that exists is at “fleet level”, this would prevent any scheduled update rollout, and would effectively place a barrier to innovation as a grounding of all aircraft (and by implication service) would be required. It noted that most of its aircraft would contain identical equipment lists, but it was possible that specific aircraft could be modified as new technologies emerge, and the rate of adoption across the in-service aircraft might not be unified.
- 3.28 NATS supported the licensing of UAS equipment but disagreed with the proposed operator licensing approach. It was concerned that the proposed approach would mean that the full range of equipment in Ofcom’s proposals would be permitted, whether or not a given UAS would require the use of equipment in these frequency bands and irrespective of what is actually appropriate for the airspace within which the UAS is to be permitted to operate. It noted its understanding that, in Aircraft Radio licences, only the categories of equipment / bands to be used on a given (manned) aircraft are authorised and suggested this approach should be mirrored in the UAS licence. However, it agreed with Ofcom’s assessment that

⁴ These codes are unique 24-bit addresses that are used to identify an aircraft. and play an important role in air traffic management.

requiring a licence for each individual piece of equipment on a drone would be inappropriate.

- 3.29 VMO2 agreed that a licensed approach was appropriate but did not agree with the model of licensing an operator rather than specific piece of equipment. It said that, in its view, the key aspect which required management was the interaction with a mobile network, in terms of the equipment and location of each drone. It said that Ofcom's approach should be to license all the equipment on an individual drone on a 'one licence per drone' basis, noting that this mirrors the method currently used to authorise equipment on an aircraft and has benefits as described by Ofcom in the consultation.

Ofcom response

- 3.30 Given the overall support for the model of issuing a licence to authorise an operator, rather than individually licensing equipment or UAS, we intend to proceed on this basis. As we discussed in paragraph 4.9 of the June 2022 Consultation, the aircraft licensing approach relies on the aircraft being individually identifiable. For UAS, there is no central registration scheme for individual drones in place today, meaning it would be difficult to link a specific drone with the corresponding UAS Operator Radio licence. This would make checking compliance with the licence a difficult task. Instead, we believe that our approach will provide similar benefits and oversight to individual UAS licensing but, unlike individual licensing, will be easier to enforce due to the issues associated with individual drone identification. It would also have the added benefit of reducing the administrative burden on both UAS operators and on Ofcom.
- 3.31 We understand that the concept of a C2CSP comes from the airspace regulatory framework. At this time, we do not believe that a C2CSP should hold the licence instead of a UAS operator. However, we agree that a C2CSP could play a role in the future to ensure that the UAS operator has the necessary permissions to access the mobile or satellite networks. We will monitor broader regulatory developments in this area and may consider whether there are any implications for our spectrum authorisation approach. However, at present we will continue to require that each UAS operator obtain written permission from the relevant MNO and satellite network before using airborne UEs.
- 3.32 Hexadecimal codes are a unique address that is issued as part of an aircraft's certificate of registration. These enable the programming of equipment such as transponders. These codes are related to airspace management and issues concerning the allocation of these are for the CAA to consider as part of their wider framework on UAS. Similarly, issues relating to type ratings or UAV operator certificates are matters for the CAA. We will continue to work closely with the CAA and other relevant bodies to ensure that our spectrum access authorisation for drones takes account of wider developments as appropriate.
- 3.33 Concerning comments on the fleet level approach, the licence looks to capture the broad type of equipment that might be deployed on a drone and not the individual make, model or other specific requirements. Any equipment that falls within the parameters described in the licence is authorised. This should enable users to deploy new variants of the

equipment on their fleet as the technology develops. If equipment is not included on the list, then it is not authorised for use. As discussed earlier in this document we will be working closely with the CAA to ensure new technologies are implemented in the licence as appropriate. Further details on this process are set out in paragraphs 3.108 to 3.110 below.

- 3.34 In response to the comments from NATS, we consider that there are sound reasons to use a different approach to the current aircraft licensing regime. The aircraft regime is tied into wider policies regarding equipment inspections, especially if operating overseas. It is for that reason that equipment that is licence exempt for use within the UK, such as receive only equipment, is included in the aircraft licence.

Comments on licence conditions

Our proposed approach

- 3.35 In our Consultation we proposed that the UAS Operator Radio licence should include a range of non-technical licence conditions in addition to the standard terms and conditions set out in our [General Licence Conditions Booklet](#). Specifically, we said the licence would:
- Cover all drones a company or individual operates in the UK and territorial waters but would not cover international flights;
 - Have an indefinite duration but be subject to the payment of an annual licence fee of £75;
 - Authorise a range of specific radio equipment that may be needed for future drone operations, including beacons and safety equipment that may be mandated by the CAA;
 - Include specific conditions relating to the use of certain radio equipment:
 - Require that certain equipment may only be used by a person who holds (or is under the direct supervision of a person who holds) a valid Flight Radio Telephony Operator’s Licence (FRTOL) issued by the CAA; and
 - Require that an aerial UE may only be used on a UAS if written consent has been provided by the MNO and satellite network.

Stakeholder responses

Non-technical licence conditions

- 3.36 The CAA supported the proposals providing that any licence issued makes it clear that additional approvals may be required from the CAA and that the licence is for use of the spectrum from a radio regulatory perspective. It said that the Ofcom licence in isolation may not permit use of the radio spectrum as the use of certain equipment requires an associated aeronautical radio licence such as a FRTOL. Blue Bear System Research (BBSR) asked for further clarification on whether the provisions requiring the supervision of some radio equipment use by a FRTOL holder was ‘By Design’ or ‘Per Flight’.

Spectrum for UAS

- 3.37 NATS was supportive of Ofcom’s position that the WT Act licence does not address flight safety aspects of radio use, nor does it constitute permission to disregard the legitimate interests of other statutory bodies such as the CAA. However, it noted that these conditions did not appear to be contained within the draft licence published in Annex 2 of the June 2022 Consultation document.
- 3.38 NATS further pointed out that Condition 2b in the proposed draft licence refers to use of radio equipment that conforms to the Radio Equipment Regulations 2017 or for which approval has been granted by (or on behalf of) CAA. It advised that the text had lost the additional reference to also permit equipment approved by the European Union Aviation Safety Agency (EASA). They noted that this is included in the sample Aircraft Radio Licence published earlier in 2022 by Ofcom. It asked if the EASA reference should also be included in the proposed UAS Operator Radio licence.
- 3.39 Boeing suggested that the granting of the radio licence should include a condition requiring CAA authorisation before operating, or that a radio licence grant is assured once a CAA authorisation is granted.
- 3.40 Cranfield University and Airport raised a concern over how a licensee could practically ensure the public is protected from electromagnetic fields (EMF) as required by the licence. It suggested that, realistically, compliance would need to be demonstrated through the installation of approved equipment in accordance with manufacturer instructions/guidance. It said that it could be incredibly difficult for an operator to conduct meaningful emissions measurements.

Ofcom response

- 3.41 In response to the points raised by the CAA, NATS and Boeing, we will include in the licence and guidance a note to make clear that the licence from Ofcom only covers authorisation of radio equipment and does not give any permission to fly. In addition to the WT Act licence, licensees will also need to abide by a range of other legislation, from safe operation to privacy laws. Matters relating to FRTOL terms and conditions are for the CAA. We would advise anyone that is unsure what CAA licensing requires to contact the CAA for further information.
- 3.42 After taking advice from the CAA, we have decided to amend the proposed text in the licence relating to the use of radio equipment. The new text will reflect the changes to the equipment approval regime now that the UK exited from the European Union. The licence will include the provision relating to equipment approved by EASA before and after the 31 December 2020. We will also review what this means for aircraft licences and make any necessary amendments.
- 3.43 Compliance with measures relating to public exposure to EMF is a standard requirement in most Ofcom licences. However, licensees are only required to carry out an EMF assessment if their equipment transmits at powers higher than 10 Watts EIRP (or 6.1 Watts ERP). Section 6 of our [“Guidance on EMF Compliance and Enforcement”](#) provides some useful tips on how to determine whether an EMF assessment is required and, if so, how to perform this assessment e.g. by demonstrating that the operator is following manufacturer

instructions relating to EMF. Further information and guidance on Ofcom's rules on EMF can be found on [our website](#).

- 3.44 A marked-up version of the licence showing these and other changes that we set out in Section 4 is included in Annex 3 of this document.

Geographical extent

- 3.45 The CAA advised that the licence should cover only domestic operation within the UK and territorial seas. It explained that UAS operating outside of this limit would be classified as international and fall under the [Convention on International Civil Aviation](#). It said that for international operation, each UAS would have to carry an appropriate aircraft radio station licence.
- 3.46 NATS said that licensing at an operator and not airframe level would mean that the UAS framework could not be readily extended in the future to any UAS capable of flying across an international border. Inmarsat highlighted that in many use cases a UAS would operate internationally, flying between countries, and in some cases flying in international airspace. It noted that there does not seem to be a harmonised international framework for UAS operations and encouraged Ofcom to actively support the development of such an arrangement, for example in CEPT.

Ofcom response

- 3.47 The licence will only cover equipment used within the UK and surrounding seas that Ofcom and the CAA have jurisdiction over. We will amend the licence document to make this clear. We note that discussions on the international rules concerning UAS flights are still ongoing. Until those discussions have been concluded and the airspace policy framework has been put in place, we are not authorising the international use of UAS. As noted in paragraph 3.34, the authorisation of equipment operating internationally or on certain airframes may require a different form of authorisation to that discussed in this document.

Use of satellite communications

Our proposed approach

- 3.48 In our Consultation we advised that the airborne use of satellite terminals is only permitted via our Aircraft Radio licence. This means that there is currently no authorisation for the commercial and operational use of a satellite terminal on a UAS. As the equipment is already used airborne in aircraft, we saw no technical reason why we could not extend the use of the same equipment for a UAS. We therefore proposed to allow the use of satellite terminals under the UAS Operator Radio licence and set out the frequency bands and systems we proposed to authorise on a UAS.

Stakeholder responses

- 3.49 No respondents objected to the inclusion of satellite terminals in the UAS Operator Radio licence. However, we received a number of detailed comments regarding the use of satellite terminals and their operating frequencies.
- 3.50 Inmarsat agreed in principle with the requirement that the UAS only be allowed to use a satellite terminal that is part of a network that has been authorised by Ofcom. However, it said that it was important to clarify what is meant by an authorised network, noting that some satellite networks require an Ofcom satellite network licence in order to operate in the UK while other networks are authorised in a different way, e.g., through ship/aircraft licences or licence exemption of satellite terminals. It said that it was important that UAS are able to use such networks in the UK, even if no formal “network authorisation” exists.
- 3.51 CGI, Inmarsat and Boeing noted that not all L-band frequencies were included in the proposed list of authorised equipment in Table 1. Inmarsat and Boeing proposed that we should extend the frequency range to cover Extended L-band (1518-1525 MHz and 1670-1675 MHz) frequencies, with Inmarsat commenting that these frequencies are currently available for Mobile Satellite Service (MSS) operations in the UK and elsewhere and so would be ideal for UAS communication. CGI additionally highlighted that there may be other services and suppliers now or in the near future that would need to be catered for as new satellites and constellations are deployed.
- 3.52 Intelsat agreed with the technical conditions for UAS operating in the 14-14.25 GHz band but questioned whether the conditions for this use would allow reliability and quality of service requirements for a UAS link to be met. It also stressed that the proposed new use should not have priority over existing aircraft earth stations (AES) use in the band and should not result in any detrimental impact or change the conditions under which the band is used.
- 3.53 Inmarsat proposed that the licence should also cover satellite terminals using the European Aviation Network (EAN), which operates in the S-band frequency range (1980-1995 MHz and 2170-2185 MHz). It suggested that UAS operations within the EAN could operate under the same technical conditions as current aircraft. It also agreed that Ka-band ESOMPs/ESIMs should be available for UAS licensed operations but noted that certain parts of the 27/28 GHz band were not included in Table 1, “presumably because they are not currently available for authorisation in the UK”. It cited [Ofcom’s Space Spectrum Strategy](#) consultation published in March 2022, where we proposed to consider additional capacity for ESOMPs/ESIMs in the 28 GHz band in the near future. It acknowledged that authorisation of UAS in the missing bands may be premature at this time, pending the planned consultation on spectrum for ESIMs, but suggested that Ofcom ensure that any new regulations for UAS are capable of being expanded to the missing bands in the future.
- 3.54 The CAA noted that, where the Ka and Ku frequency bands are used by ESIMs, they cannot be used for safety related systems such as direct command and control (C2) links but could be used for payload data. It said that it would appear appropriate to include such restrictions in the proposed draft UAS Operator Radio licence for these bands and others where there may be similar prohibitions. NATS made a similar comment.

Ofcom response

- 3.55 In response to Inmarsat’s comments seeking clarification on what is meant by authorised networks, we agree that not all satellite networks require a network licence. We have updated Table 1 of the licence to include all satellite communications solutions that are already authorised via Ofcom’s Aircraft Radio licence. This includes the use of systems deployed in S-band, such as EAN. Where the requirement to only use a satellite terminal that is part of a network that has been authorised by Ofcom applies, we have indicated this in the table.
- 3.56 We have decided not to include additional frequency bands such as the Extended L-band and some additional frequencies in Ka band at this stage. As set out in our [Space Spectrum Strategy document](#) we will consider additional capacity for aeronautical ESOMPs/ESIMs, including on drones, following the outcome of the 2023 World Radio Conference (WRC23). In the licence we will make clear that that drone use of the Ka band is currently not permitted where the satellite earth station is operating to a Non-geostationary orbit (NGSO) satellite.
- 3.57 On 10 November 2022, we [published our decision](#) on extending satellite access in the 14 GHz band from 14-14.25 GHz to 14.0-14.5 GHz. However, in order to protect radio astronomy sites in the UK, airborne use is not permitted in 14.47-14.5 GHz. As a result of this decision, we have included these changes in the UAS Operator Radio licence. We are not however going to impose any further restrictions on the use of these frequency bands. It will be for the satellite networks to determine the uses permitted on their networks.
- 3.58 We note CAA and NATS comments on the air safety restrictions relating to the use of equipment for specific aviation purposes. Stakeholders will need to adhere to airspace management and safety restrictions set by the CAA. However, as these relate to the enforcement of air safety rules which are the responsibility of the CAA, we will not be including these restrictions in the UAS Operator Radio licence. We will set this out in our guidance document so that licensees are aware that such restrictions are in place and that they are expected to adhere to them.

Use of mobile network user equipment (UE)

Our proposed approach

- 3.59 In our Consultation we noted that there was interest in using 4G and 5G technologies for control and payload for UAS. We explained that, at present, a UAS is not permitted to use mobile UE airborne. This is because of the high potential for an airborne UE to cause interference to the host mobile network and also to some systems operating in adjacent bands. However, we explained that work undertaken by industry and studies carried out in Europe had now enabled us to consider authorising the use of UE airborne.
- 3.60 Our analysis showed that, for the majority of mobile bands, there was no need to introduce specific measures to achieve compatibility with the incumbent user or adjacent services. However, to protect ATC radars from interference we proposed that under no

circumstances should drones be able to use the 2.6 GHz frequency band. In addition, to mitigate impacts to the technical quality of service on mobile networks, we proposed that the use of an aerial UE on a UAS would be subject to the operator obtaining written permission from the MNO(s) whose network(s) it intended to use.

Stakeholder responses

Restriction on the use of the 2.6 GHz band

- 3.61 Birmingham Airport raised concerns about the use of mobile UEs on drones. It thought that this equipment would be more powerful than a mobile handset and therefore that there should be limitations on where this can be used around aerodromes in order to protect ATC radars which operate in the 2.7-2.9 GHz band.
- 3.62 Skyports thought that Ofcom's assessment and justification on excluding the use of the 2.6 GHz band for aerial UE use was questionable. It said that any assessment should be performance and evidence based and that the risk should be associated with the operations of the licence holder. It said that this would be dependent on various factors including altitude of operation, location and terrain.
- 3.63 BBSR commented that it understood the rationale for excluding access to the 2.6 GHz band but thought that this could be challenging to implement on 'black box' UEs and said it would preclude the use of certain MNOs who operate 4G services in the 2.6 GHz band. Sees.ai made a similar point, arguing that most UAS operators do not have the technical capability or necessary equipment to demonstrate compliance with the requirement to not use 2.6 GHz. It said that the onus for demonstrating compliance should not be on the licensee, but rather the radio/modem provider or the MNO. It also requested that Ofcom provide information to show which MNOs are not licensed to use the 2.6 GHz band.

Ofcom response

- 3.64 The mobile UEs that we propose to authorise under the UAS Operator Radio licence will transmit at the same power levels that we currently permit for normal ground-based use. However, our technical assessment of the impact of airborne UE on ATC radars in the 2.7-2.9 GHz band (in Annex 3 of our June 2022 Consultation) concluded that airborne UEs can cause interference to ATC radars. This followed on from studies undertaken by other European administrations as part of the CEPT work. We have therefore decided not to allow airborne UE transmissions in the 2.6 GHz band anywhere in the UK at this time.
- 3.65 Skyports' suggestion to allow the use of 2.6 GHz subject to an assessment would require a complex bespoke technical coordination process to be undertaken for each flight route. This would be necessary to ensure that interference was not caused to safety of life ATC radars. Also, as we explained in paragraph 3.21 of our consultation, the size of any exclusion zone would depend on the out-of-band emissions of the UE and this information is not easy to ascertain. Noting Sees.ai's point concerning the technical capability of some UAS operators, we did not consider that it is practical at this stage to allow the use of the 2.6 GHz band. We may review this decision in future if specialist airborne UE standards are developed for equipment to comply with a clear out-of-band emission limit.

Spectrum for UAS

- 3.66 We note the points made regarding the challenge of excluding access to the 2.6 GHz band. However, we consider that these are not insurmountable, as is indicated by the response from Parrot which said that it is able to restrict access to the 2.6 GHz band on the drones it manufactures. We have purposely left open the mechanism that UAS operators use to comply with this provision, be it via hardware, software or a network solution provided by the MNO. We would expect UAS operators to take appropriate steps to obtain assurance from the equipment supplier, network provider and/or their own testing to confirm that this condition has been met.
- 3.67 Finally, we note that information on which MNOs are licensed to use the 2.6 GHz frequency band is [already available on our website](#).

Technical parameters for use

- 3.68 In its response, VMO2 advised that mobile networks were not specifically designed with drone usage in mind. It said that this would lead to limitations to the distance and altitude at which the associated UE would be able to operate via connection to a mobile network. Given this, it wanted a 'safe auto-land' feature to be mandated, to ensure that any disconnection from the mobile network did not impact the safe operation of the drone. It said that, without such functionality, there would be a significant issue in relation to authorisation, as well as liability. It also said that UE usage should involve CE certified modules, 0dBm omnidirectional antennas, low power operation, SIM authentication, and use 3GPP Release 15 or later.
- 3.69 Vodafone sought confirmation that the transmit power levels and other technical parameters for the equipment would align with those in the relevant licence exemption regulations for terminal equipment.

Ofcom response

- 3.70 Issues regarding the mandating of auto-land or other solutions are matters of air safety and the responsibility of the CAA regime for flight operation. These are not issues of spectrum authorisation so we will not be including such provisions in the licence. We understand that the CAA is continuing to work on the safety regime for airborne UE terminal use as part of a UAS. MNOs are free to agree with UAS operators the terms and conditions which they want met as a condition of using their network.
- 3.71 UE will be subject to the same technical conditions as set out in the relevant licence exemption regulations. We will include the UE transmission requirements in the licence via a reference to the corresponding Interface Requirement document for that band or outline the provisions directly in the licence.

Written permission process

- 3.72 We received a number of comments concerning the process for obtaining written permission from the MNOs whose network the drone would be operating on. These included requests from MNOs for further clarification and UAS operator queries on the

process for obtaining permission. Although the provision also applied to satellite networks, we received no comments on this.

Mobile network operators (MNOs)

- 3.73 All four MNOs agreed with the proposals that written permission must be obtained from the MNO for airborne use of UE. BT and H3G stated that this is important from a technical perspective as drones have the potential to cause interference or impact other users on the network in certain scenarios and thus a degree of control by the MNO is necessary.
- 3.74 H3G highlighted an issue around legal liability were a drone to cause damage while using a mobile network. In these cases, it said the liability would need to be contractually agreed between the prospective UAS operator and MNO and therefore it was essential for prior written approval to be sought from the MNO.
- 3.75 BT requested Ofcom clarify what action it expects virtual mobile network operators (MVNOs) to take if one of their customers approaches them with a request to operate drones. It said that such permission needed to be from the owner of the physical network rather than the MVNO. It said that it expected that contracts between MVNOs and the relevant MNO could address this matter. It also raised a related issue regarding SIMs issued by a non-UK operator and using international roaming to operate in the UK, noting its expectation that permission would need to be obtained from the UK MNO. VMO2 questioned how Ofcom intends to deal with unauthorised UE being used on a drone.
- 3.76 Vodafone said it assumed that a licensee would not by default be authorised to use all of the MNO spectrum bands in Table 1, whether or not the UAS Operator has asked for this. It suggested that the licence either contain conditions for usage of a specific spectrum band or contain all of the conditions but with a checkbox to state which are applicable.
- 3.77 BT asked Ofcom to clarify in the licence that if an MNO notifies a UAS licensee that it is withdrawing its consent (e.g. due to misuse), the licence would no longer permit the licensee to operate drones on the relevant MNOs network. Vodafone made a related point, suggesting that MNOs should have the opportunity to object to continuation of licensing at the point of annual licence renewal, especially where it can be demonstrated that harm is being caused to wider usage of the mobile network.

UAS operators

- 3.78 Skyports asked how Ofcom would ensure that there would be no further additional administrative charges involved in the process of obtaining permission from MNOs. It also asked what guidance Ofcom would issue to ensure requests are handled in a timely manner. Sees.ai suggested that a simple set of common criteria for MNO approvals would be useful to support the industry. Sees.ai and Skyports both suggested that, to make the process for obtaining written permissions easier, there should be an online single centralised point of information which included who to contact in the MNOs. In this way, the UAS operator could easily identify the responsible and up-to-date contact of the MNOs.

Spectrum for UAS

- 3.79 Skyports suggested that Ofcom should provide guidance or a template so that the terms and conditions imposed by the MNOs could be standardised. It said that it might not be possible for the UAS operator to follow different sets of operating conditions required by the MNOs (e.g. when switching to a different network operator). It also said that any terms or conditions of the written agreement imposed by the MNOs should not mandate the use of certain specific products, plans, hardware or any drone specific service offered by the MNOs.

Ofcom response

- 3.80 Under our proposals MNOs are not obliged to permit any airborne access to their networks. Although the licence lists a number of mobile frequency bands, the use of any particular mobile network or band is subject to the MNO giving permission to do so. We will make clear in our guidance that the permission rests with the physical network provider. If the permission is rescinded at any time, then the UAS operator cannot use that network as they no longer have permission to do so. We will make this clear in our guidance document but we do not believe that the inclusion of a specific provision to cover this scenario needs to be contained in the licence. As MNOs have the ability to withdraw permission, we do not believe any further mechanisms are required.
- 3.81 The conditions that an MNO may require before access is granted and any contractual agreements, including fees, for using the MNO's network are a commercial matter between the parties. We note from the responses that this may cover issues wider than spectrum access and include service and liability agreements, for example.
- 3.82 Ofcom will not become involved in these matters or disputes regarding any refusal to provide permission to use the network. We would however urge all parties involved to work together and come up with solutions to some of the issues highlighted by UAS operators. We plan to approach the MNOs to obtain contact information that could be shared with UAS operators and would look to include these in our licensing guidance document. We also note the role that other organisations like the [Connected Catapult](#) and [Drone Industry Action Group](#) can play in this area.
- 3.83 We would like to emphasise that written permission from an MNO is not a prerequisite for the granting of a UAS Operator Radio licence – that is, applicants will not be required to demonstrate they have written permission from an MNO at the point of application. This is because the licence authorises use of a selection of devices and frequencies, subject to the terms and conditions of the licence being met, and not just mobile UEs. One of those conditions is that any airborne mobile UE use is subject to the agreement of the relevant MNO(s). Thus, if a licensee uses a mobile network without such an agreement, including where an agreement was previously in place but has lapsed or been rescinded, then this will be illegal use. However some licensees may not wish to make use of any mobile networks for connectivity or may not initially require this.
- 3.84 We see this specific licence condition as a temporary measure. This provision has been introduced to allow time for MNOs to put in place mitigations to manage airborne use on their networks, for example via the introduction of new technology, inclusion of specific terms and conditions in contracts and educating their users.

- 3.85 The airborne use of mobile UE is still not permitted under the terms of the licence exemption regulations. Therefore, any airborne mobile use without a UAS Operator Radio licence and without written permission from an MNO(s) will be illegal, as is the case today. We have the necessary enforcement powers to pursue any unauthorised airborne use as set out in paragraph 3.22.
- 3.86 We expect that deployment of new equipment standards such as 3GPP releases 17 and 18 should begin to resolve some of the technical issues caused by airborne UE use. These releases, once implemented, provide a number of facilities to help manage airborne UE use on the network, from positioning information and drone registration to traffic management. We recognise that this is an evolving area and will keep our approach under review. Any decision to change the provision would be subject to consultation.

General comments on other equipment

Our proposed approach

- 3.87 In addition to the proposals to allow the use of satellite and mobile UE equipment we also proposed to include a range of other equipment that users may wish to deploy on a drone. These included beacons, transponders and voice communications equipment that perform an important safety role depending on the airspace the drone is operating in. We proposed that licensees would not need to apply to Ofcom for a licence variation in order to install or remove an additional piece of equipment, provided it is listed in the licence.

Stakeholder responses

- 3.88 Sees.ai queried whether the absence of a list of specific equipment meant that any commercial equipment that transmits within the stipulated frequency ranges is acceptable. It also noted that the table of equipment lists technical parameters for some equipment but not for others. It proposed that it could be helpful to summarise the main limitations such as transmit power, channel size and duty cycle.
- 3.89 The Royal Aeronautical Society suggested that the equipment list should include part numbers, model details and version numbers of equipment but not serial numbers of equipment, allowing operators to use/hold several items of the same type. However, Windracers / Distributed Avionics raised concerns that our proposed approach may place a barrier to adoption when new technologies emerge. It suggested that, in order to support innovation, the licence just define type of technology and radio limitations.
- 3.90 Sees.ai and Cranfield University and Airport noted that 868 MHz radio links that are used for telemetry links between drones and ground control stations were missing from the licence. NATS also highlighted that some equipment covered in the Aircraft Radio licence including GNSS / satellite navigation / GPS receivers and marker beacons were not included in the proposed UAS Operator Radio licence.
- 3.91 NATS noted that the consultation document defines an Unmanned Aircraft System as “an unmanned aircraft and the equipment to control it remotely” and that the remote control equipment, i.e. the Remote Pilot Station (RPS) is most likely to be a ground station. It was

concerned that this implied that permission would be granted for ground station transmissions in frequency bands allocated for aviation safety purposes that are otherwise only authorised under Aeronautical Ground Station licences with specific frequency assignments and subject to other CAA approvals. It commented that such a potential overlap of processes would be of great concern to NATS.

- 3.92 Sees.ai requested that Ofcom permit the use of 2.4GHz and 5GHz at higher power limits than is currently allowed. It pointed to a previous [2006 Ofcom consultation](#) which proposed the ability to use higher power in rural areas. It advised that as most CAA BVLOS licences are for rural areas only this would be very helpful. It also suggested that Ofcom considers moving from radiated to conducted power limits, saying that this would enable the use of high gain directional antennas.
- 3.93 The National Police Air Service, Modini, The Thunderbird Project and Honey Aerospace submitted a joint response arguing that the omission of an authorisation mechanism and spectrum allocation for use of radar on a drone would delay development of BVLOS uses for UAS in the UK.
- 3.94 Boeing and NATS both provided comments on the 5030-5091 MHz band. Boeing noted that Ofcom had decided not to consider this frequency band due to lack of “clear commercial demand for this band to be used by UAS”. It strongly encouraged Ofcom to reconsider this position, noting that the frequency band is unused and can be readily utilised for medium to large UAS terrestrial C2 links. It noted that the spectrum is currently unused and is already allocated for this use. NATS on the other hand said that as these systems are anticipated to require coordinated frequency assignments, it did not believe that the proposed UAS Operator Radio licence would be the appropriate mechanism for this band.
- 3.95 The CAA noted that the frequency band 5091-5150 MHz is used by the MoD for telemetry. Similarly, NATS noted that this band is not widely available, if at all, for civil aviation use in the UK. It asked for clarification on the inclusion of this band, noting that the band is not an option on the Aircraft Radio licence and there is as yet no Aeronautical Ground Station licence product available to permit its use.
- 3.96 VMO2 said that the 3.8-4.2 GHz band authorised through Ofcom Shared Access licence should be considered for UAS use.
- 3.97 Finally, NATS made a number of comments on the table of equipment in the draft licence and proposed a number of technical amendments to ensure consistency with airspace use:
- a) There are two references to DME in the table, one of which incorrectly quotes 1165-1215 MHz; this should be 960-1215 MHz;
 - b) “Area navigation” as an equipment type description in the CAA list includes a number of sensors, including DME – so should not be a frequency band-based category described as it is (DME only) in the Ofcom documentation;
 - c) Instrument Landing System, Glide Path (328.6-335.4 MHz) should be noted as receive only use;
 - d) VDL-4 in 108 and 137 MHz is not supported in the UK; and

- e) 108-117.575 MHz should be 108-117.975 MHz and should be noted as receive only for VOR, ILS localiser and potentially GBAS to support GNSS use.

Ofcom response

- 3.98 The UAS Operator Radio licence pre-authorises a set of radio equipment that can be fitted and used on a drone. The exact equipment used on a drone for a specific flight will also depend on CAA airspace safety requirements for the airspace the drone will be flying in. UAS operators may need to discuss and agree this with the CAA as part of gaining approval before any flights are contemplated. The equipment needs to comply with all necessary standards for both radio equipment, as set out under the [Radio Equipment Regulations 2017](#) and international aviation standards if required by the CAA. It is not the case that any equipment that meets the technical limits set out in the WT Act licence can automatically be used as there could be other restrictions relating to airspace safety and management that take precedence.
- 3.99 We would like to thank NATS for their comments which we have discussed with the CAA. We have made the necessary corrections to the table in the licence. In response to Sees.ai we will also include further technical details such as the maximum transmit power where appropriate.
- 3.100 We have also decided to remove receive-only equipment, including VHF navigation equipment (such as VOR and ILS localiser) and Global Navigation Satellite Systems (GNSS), from the list of equipment in Table 1 of Schedule 2 in the licence. This is because they are already exempt from the requirement to be authorised via a WT Act licence and therefore do not need to be covered under this licence. Users can already use this equipment without obtaining a licence from Ofcom. It was for the same reason that other equipment, such as short range devices (SRDs) using 868 MHz, were not included in Table 1. For consistency, only equipment that is not already authorised for use elsewhere will be included in the licence. However, for information purposes we will include details of these and other licence exempt equipment that may be used on a drone in a separate table in the licence (Table 2).
- 3.101 We note the points raised by NATS concerning Remote Pilot Station (RPS) (ground station) transmissions. We can clarify that the licence does not cover ground station communications that are licensed by Ofcom in coordination with the CAA under the Aeronautical Ground Station licence. Operation of ground stations in the 117.975-137 MHz band are only permitted via these licences. The UAS Operator Radio licence only covers the aeronautical radios that communicate with the licensed ground stations. We will make this clear in the licence.
- 3.102 Whilst Ofcom set out proposals in the 2006 consultation on higher power in the 2.4 GHz band for rural areas, following consultation we decided not to proceed with this proposal because of concerns regarding the increased interference this may cause. Although we note the interest in operating at higher powers in the 2.4 GHz and 5 GHz bands, airborne signals travel further than the same signal emitted terrestrially, meaning that there is a greater risk of interference to other users of the spectrum. Given the extensive use of these bands we do not believe that enabling higher power airborne, even in just rural

areas, is appropriate at this time. In response to the suggestion that we move to setting conducted power limits, our current approach is to use radiated power limits for these licence exempt devices. Presently, all European technical harmonisation work via CEPT is carried out using this approach and we have no current plans to change this.

- 3.103 With regard to comments on the equipment list we are proposing to follow a similar approach to that used in our aircraft radio licence. Under this regime we do not record the make, model or serial number in the WT Act licence. The licence covers the broad type of transmission equipment and not the specific pieces of equipment. It is for licensees to ensure their equipment is compliant with the equipment list and other licence conditions.
- 3.104 We currently have no specific airborne radar authorisation other than that used on an aircraft. We recognise there is interest in this area and are working with the CAA to try to identify possible solutions. However, Ofcom's short range devices (SRDs) interface requirement document IR 2030, which sets out the provisions for licence exempt equipment including whether it can be used airborne, does have specific provisions for radio determination devices and non-specific SRDs. If any radar equipment can comply with these conditions, it can be deployed without a licence. We also plan to carry out further work to explore if any of the restrictions on airborne use in IR 2030 could be relaxed.
- 3.105 We note the comments concerning the potential use of 5030-5091 MHz for C2 links. In cooperation with the CAA we are looking into possible spectrum options for these dedicated links. As part of this work, we may consider the practicalities of using this band and how an authorisation regime that would allow ad-hoc coordinated access could be developed.
- 3.106 In response to VMO2's suggestion, we note that our updated [Spectrum Roadmap](#), published in November 2022, introduced the concept of spectrum sandboxes where, working with industry and other stakeholders, we would look to try out new concepts, explore allowing greater flexibility and explore how equipment coexists in the real world. Our roadmap explained that our initial focus would be on exploring more flexible access to 3.8-4.2 GHz. As part of this, we are open to discussing proposals for testing airborne use of this band.⁵ However, outside of these sandboxes we will not be permitting airborne use due to the potential for interference and challenges for coordination.

Process for updating equipment in the licence

- 3.107 A couple of respondents commented on how new emerging technologies and equipment would be included in the licence. The Royal Aeronautical Society stated that the process to do this needs to be timely and not a burden to operators and/or Ofcom.

⁵ Interested parties should email Ofcom at spectrum.roadmap@ofcom.org.uk (please include 'Sandboxes' in the subject line).

Ofcom response

- 3.108 We acknowledge that as the regulatory framework for air safety and traffic management develops, further new requirements may be placed on UAS operators and new technologies may be needed. We will continue to work closely with industry and the CAA to follow technology developments in this sector.
- 3.109 When new technology is adopted or changes to the airspace regulatory framework require updates to the licence, we will look to include these in the licence as soon as practically possible. This will involve us consulting on the proposed changes, perhaps as part of a consultation on a particular frequency band, and allowing stakeholders to respond to the proposals. Once this process has ended, we will issue a statement with our final decision. We will then incorporate the changes into the licence and, if necessary, we may need to vary the licences of existing users. The process for this is set out in Schedule 1 of the WT Act. We are happy to consider requests from stakeholders for equipment to be added to the licence.
- 3.110 Our proposed authorisation approach should enable a wide range of equipment to continue to be covered by the licence. We already license a wide range of equipment that is deployed on aircraft and ships and therefore have processes in place to update licences as and when required.

4. Decision

Ofcom's assessment framework

- 4.1 The radio spectrum is a finite national resource of considerable economic and social value. In considering whether to introduce the new UAS Operator Radio licence product, we have taken account of our duties, in particular:
- furthering the interests of citizens and consumers;
 - securing optimal spectrum use (including by considering the impact on spectrum users in the same and adjacent bands);
 - promoting competition; and
 - encouraging innovation and investment.
- 4.2 In preparing this document, we have considered the citizen and consumer interests relating to authorising equipment for drones. Furthermore, we have looked at both the likely impact on competition of making these changes and the likely impact on spectrum management, in particular the impact on existing licensed or licence exempt users of the adjacent spectrum bands.
- 4.3 In reaching our decision, we have considered the impact of our proposals. Our Consultation and this Statement represent an impact assessment as defined in section 7 of the Communications Act 2003. In preparing the Consultation document, we considered the costs and benefits of the changes we were proposing. In reaching our decision, we have also taken account of stakeholder comments received in response to our Consultation on the impact of our proposals.

Initial assessment

Furthering the interests of citizens and consumers

- 4.4 Our principal duty is to further the interests of citizens in relation to communications matters and consumers in relevant markets. UAS have the potential to provide benefits to UK citizens and consumers. For example, during the coronavirus pandemic, UAS have been trialed to deliver vital supplies to remote locations where alternative options would either take too long or be too costly.⁶ In other areas, drones have been trialed by the police and search and rescue teams to help them find missing persons.⁷

Securing optimal use of spectrum

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

⁶ Ofcom article "[Ofcom helps hospitals with drone deliveries](#)" June 2020

⁷ Maritime and Coastguard Agency article "[Drones could form key part of next generation of UK search and rescue](#)" February 2020

general policy is to set restrictions that are the minimum necessary to provide adequate protection against undue interference.

- 4.6 Almost all of the equipment that we are proposing to authorise under this licence is already used airborne today on aircraft. These proposals would extend the use of these existing technologies to cover use on UAS, including satellite terminals. In addition, the use of UE on UAS has been studied and the technology has been developed to enable mobile networks to provide this service. This would allow the existing spectrum bands allocated to MNOs to be used to offer these services, making greater use of the spectrum they hold.

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

- 4.7 We expect that our licence conditions on the use of the permitted equipment as part of a UAS will mean that authorising drone use under the new UAS Operator Radio licence will not impact on other users of the radio spectrum.⁸ Most of the equipment covered under the UAS Operator Radio licence is already authorised for airborne use under our Aircraft Radio licence. For new mobile technology we have introduced specific provisions prohibiting airborne mobile UE use in the 2.6 GHz band. This is because airborne use of UE transmitting in the 2.6 GHz band can have an impact on the ATC radars in the adjacent band. As set out in paragraphs 3.15 to 3.20 of the June 2022 Consultation, the use of the 2.6 GHz band must be coordinated with ATC radar otherwise it can cause interference to these systems. As our analysis showed, the protection distances vary greatly depending on the performance of the equipment and for this reason, we will not allow access to the 2.6 GHz band at this time.
- 4.8 As we set out in paragraphs 3.11 to 3.14 of the Consultation, the analysis undertaken by the Electronic Communications Committee (ECC) Project Team 1 (PT1)⁹ to develop [ECC Report 309](#) has also shown that the airborne use of a UE can cause quality of service impacts on the host mobile network. To ensure that this can be managed, the airborne use of any UE would only be permitted with the express written permission of the host MNO(s).
- 4.9 We also do not anticipate any adverse effects on other users of licence exempt devices. The conditions for airborne use of licence exempt equipment are taken into consideration when sharing studies are undertaken by CEPT. As drones will be subject to the same or more restrictive conditions due to the airborne nature of its use, we do not foresee any issues. Most drones on the market today already use licence exempt equipment.

Promoting competition

- 4.10 We have a principal duty to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

⁸ Section 3 of the Consultation.

⁹ The ECC PT1 is responsible for international mobile telecommunications issues, including compatibility studies, development of band plans etc.

4.11 Our decision will enable a wider range of technologies to be deployed on drones. For command and control of drones, users will now have access to a range of technologies from licence exempt Wi-Fi, satellite communications or mobile networks. For electronic conspicuity¹⁰, we are also proposing to authorise a range of technologies that have been permitted/recommended for use on a drone by the CAA. Therefore, we consider that our decision is likely to enable a wider range of services and hence would not have an adverse impact on competition between differing solutions. The flexible licensing regime enables us to include additional equipment as new technologies are deemed safe to use on UAS by the CAA.

Encouraging innovation and investment

4.12 We have also had regard to the economic and other benefits that may arise from the use of UAS, and the ability for them to provide new innovative services. The licensing regime would allow for the commercial operational use of this equipment. This could support innovation and investment in a range of sectors.

Conclusion

4.13 We believe that UK citizens, consumers and organisations are likely to benefit from the introduction of the new UAS Operator Radio licence. The new licence should enable businesses to use new UAS technology (that they would otherwise not be able to legally operate) to provide innovative new services to both other businesses and consumers.

4.14 In our view, our decision to introduce the new UAS Operator Radio licence and associated terms, provisions and limitations is:

- **objectively justified** in that it enables the use of new technologies for drone services in the UK and addresses the risks of undue interference that might otherwise arise from the use of equipment on drones;
- **not unduly discriminatory** against particular persons or against a particular description of persons in that it applies to all drone operators;
- **proportionate** to what it is intended to achieve, in that it is necessary to ensure that use of the relevant equipment would not be likely to have relevant adverse effects on other spectrum users and services; and
- **transparent** in relation to what it is intended to achieve, in that it is described and explained in this document.

4.15 We consider that our decision will further the performance of our general duties in section 3 of the Communications Act 2003 (the '2003 Act'). This is because, as set out above, citizens and consumers will likely benefit from new innovative services and optimal use of spectrum.

4.16 As set out above, in reaching our decision, we have considered both the likely impact on competition of making the relevant changes and the likely impact on spectrum

¹⁰ Electronic Conspicuity (EC) is a term used for a range of technologies that can help aircraft to be visible to other aircraft in the same airspace. These include transponders, such as ADS-B, and radios

management, in particular the impact on existing licensed or licence exempt users of spectrum.

- 4.17 We have also assessed the impact of our decision on persons sharing protected characteristics and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations. In the June 2022 Consultation (paragraphs 5.17-5.18), we said that we did not consider our proposals had any equality implications under the Equality Act 2010 or the Northern Ireland Act 1998. We did not receive any comments in response to this and we remain of this view.

Decision

- 4.18 Having carefully considered comments received in response to our consultation, the potential benefits of enabling a wider range of drone operations over longer distances and taking account of our relevant licensing functions and statutory duties, we have decided to introduce a new licence to cover a range of radio equipment. This licence will include satellite and mobile UE as well as a range of safety equipment such as DME, ADS-B and weather radars that could be deployed on a drone.
- 4.19 In line with our consultation proposals, we have decided to create a new licence that would apply to a range of devices used by a company, partnership or individual (“the operator”) on a drone, other than those already made exempt from holding a WT Act licence. We are not requiring an individual licence to be held for each drone.
- 4.20 Operators of existing drone equipment that use licence exempt equipment, such as Wi-Fi, can continue to operate without the need to obtain a licence from Ofcom. The existing licence exempt framework is likely to be sufficient for most users and therefore they will not be affected by these changes. However, it is the responsibility of the drone operator to ensure they have the appropriate spectrum authorisations. Further information can be found in our licensing guidance document that will be published alongside the licence application form.

Licence conditions

- 4.21 A full marked up copy of the UAS Operator Radio licence terms and conditions are set out at Annex A. The terms and conditions include:
- a) The UAS Operator Radio licence covers the use of equipment within the United Kingdom and territorial seas. At present it does not provide authorisation in the Channel Islands and the Isle of Man. However, it could be extended to include these areas in the future should the relevant island authorities wish to do so.
 - b) The licence will be issued with an indefinite duration, subject to the payment of an annual licence fee of £75. Standard terms and conditions for the licence are set out in our [Wireless Telegraphy Licence Conditions Booklet OfW 597](#). This also sets out the conditions relating to EMF compliance.

- c) However, the use of certain equipment can only be used by a person who holds (or is under the direct supervision of a person who holds) a valid Flight Radio Telephony Operator's Licence (FRTOL) issued by the CAA (or equivalent licence issued by a national aviation authority), unless such a requirement has been exempted under the Air Navigation Order 2016. The operation of a drone and the rules surrounding its use, including how specific equipment must be used for air safety purposes, are set by the CAA. The Ofcom licence only covers the equipment authorisation under the WT Act.
- d) The licence will authorise the use of a range of equipment including radars, beacons, altimeters, satellite and mobile UEs. Details of the spectrum management restrictions placed on the equipment are set out in the licence. When using satellite or mobile networks the licensee must have written permission from that network to do so. When using bands allocated to the MNOs the licensee must ensure that the equipment is not capable of using the 2.6 GHz band (2500-2690 MHz) in order to protect ATC radars.
- e) The issuing of a licence does not mean that Ofcom is granting a 'licence to fly,' something which is solely within the jurisdiction of the CAA. In addition to a licence to use the spectrum, operators will continue to need to adhere to any air safety requirements regarding the operation of UAS set by the CAA.

Changes to the proposed licence

- 4.22 As a result of consultation responses and a further review of the terms and conditions with the CAA we have made a number of changes to the originally proposed licence. These changes are outlined below.

Changes to non-technical licence conditions

- 4.23 We have made the following changes to the non-technical licence conditions in the licence:
- a) Added a note in the licence to make it clear to licensees that the licence only covers the authorisation relating to transmission equipment and does not override any air safety or other legislation.
 - b) Included the geographical extent of the licence to clarify that it covers the UK (including territorial seas and areas of economic interest) but not the Channel Islands or the Isle of Man.
 - c) Updated the provisions relating to the use Radio Equipment set out in provision 3 of Schedule 1 to reflect the aeronautical equipment approval process after the UK exited the European Union.

Changes to the technical licence conditions

- 4.24 We have made the following changes to the technical licence conditions in the licence:
- a) Removed the Aeronautical mobile airport communication system operating in 5091-5150 MHz as it is not used in the UK.
 - b) Deleted a duplicate row for Distance Measuring Equipment that was included in the table of equipment in error.

- c) Removed the allocation for Area Navigation as this covers a range of equipment already listed in the licence.
- d) Removed VDL-4 in the 108-137 MHz band as it is not supported in the UK.
- e) Included a range of transmission parameters for UE and removed the base station transmit frequencies as the drones will not be using these.
- f) Removed the text relating to licensees having to adhere to any terms and conditions imposed on them by a satellite or mobile network from the licence, and instead we will include this in our guidance document. We believe including the written permission requirement clearly in the licence is sufficient as the mobile network operator has the ability to withdraw permission if any terms are breached by the operator. Where MNO permission has been withdrawn, any continued use of that network by the drone operator would be classified as unauthorised use and would be a breach of the UAS Operator Radio licence. The enforcement of the specific terms and conditions of any agreement between the network provider and the drone operator is a contractual matter.
- g) Added the 1980 to 2010 MHz band for Satellite Earth Station communications and 2 GHz Complementary Ground Component (CGC) networks.
- h) Following advice from the CAA we have included the use of weather radars in 9300-9500 MHz band. This equipment is already permitted under the Aircraft Radio licence.
- i) Removed UHF communications in 453-462.5 MHz, as this is included in the Aircraft Radio licence but is for airport ground crew communications with aircraft. It was included in the list of systems on the UAS Operator Radio licence in error.
- j) The upper frequency in the satellite earth stations comms 14 GHz range has been adjusted from 14.25 to 14.47GHz. This is to reflect [Ofcom's recent decision](#) on extending satellite access in the 14 GHz band.
- k) The reference to Electronic Conspicuity Devices has been split into 2 rows to reflect the two separate technologies that use different frequencies; these are ADS-B at 1090 MHz and UAT at 978 MHz. We have also indicated that conditions set by the CAA, in [CAP 1391](#), apply to this equipment.
- l) Replaced the term ESOMP with the more commonly used term Earth Stations In Motion (ESIM) and removed the frequency 17.3-20.2 GHz as this is used for satellite transmissions from space to Earth. We also moved this entry into the Satellite Earth Station communications section. Finally, we have clarified that the ESIM operating to GSO satellites may be used only if authorised to do so under a "Satellite (Earth Station Network)" Licence and that operating to NGSO satellites is not permitted.
- m) Included where the use of equipment requires the operator to hold a FRTOL.

Equipment that is already exempt from the need to hold a WT Act licence

- 4.25 We decided to remove from the list of equipment devices that are already covered under our licence exemption regime. This includes a number of receive only devices and other SRDs. To provide information to licensees, we have included a list in the licence of all the main pieces of equipment that are covered under our licence exemption framework .

Next steps

- 4.26 Following publication of this statement we will prepare all necessary documents and put in place processes for us to begin issuing licences. We expect we will be in a position to do this by 20th January 2023. Information including application forms and a licence guidance document will be [published on our website](#) once licences become available.
- 4.27 As this is an evolving area, we will keep this licence under review in order to take account of any changes in technology or the overarching air safety and airspace management framework for drones. This may require us to adapt the terms and conditions of the licence or update the list of equipment it covers. Regarding the equipment, we will continue to work with the industry, radiocommunications providers and the CAA to ensure that it keeps pace with the industry. Any changes to the licence will be subject to further consultation.

A1. Legal Framework

The legislative framework

- A1.1 Ofcom is responsible for authorising use of the radio spectrum. We permit the use of the radio spectrum by granting wireless telegraphy licences under the WT Act or by making statutory regulations exempting users of particular equipment from the requirement to hold such a licence. It is unlawful and an offence to install or use wireless telegraphy apparatus without holding a licence granted by Ofcom, unless the use of such equipment is exempted.
- A1.2 Ofcom’s statutory powers and duties in relation to spectrum management are set out primarily in the Communications Act 2003 (the “2003 Act”) and the WT Act. Amongst our functions are the making available of frequencies for use for particular purposes and the granting of rights of use of spectrum through wireless telegraphy licences and licence-exemptions.
- A1.3 Our principal duties under the 2003 Act, when carrying out our functions and exercising our powers, are to further the interests of citizens and consumers, where appropriate by promoting competition. In doing so, we are also required (among other things) to secure the optimal use of spectrum and the availability throughout the United Kingdom of a wide range of electronic communications services.
- A1.4 We must also have regard to: (i) the desirability of promoting competition in relevant markets; (ii) the desirability of encouraging investment and innovation in relevant markets; (iii) the different needs and interests, so far as the use of the electro-magnetic spectrum for wireless telegraphy is concerned, of all persons who may wish to make use of it; and (iv) the different interests of persons in the different parts of the United Kingdom, of the different ethnic communities within the United Kingdom and of persons living in rural and in urban areas.
- A1.5 Additionally, in carrying out our spectrum functions we have a duty under section 3 of the WT Act to have regard in particular to: (i) the extent to which the spectrum is available for use, or further use, for wireless telegraphy; (ii) the demand for use of that spectrum for wireless telegraphy; and (iii) the demand that is likely to arise in future for such use.
- A1.6 We also have a duty to have regard to the desirability of promoting: (i) the efficient management and use of the spectrum for wireless telegraphy; (ii) the economic and other benefits that may arise from the use of wireless telegraphy; (iii) the development of innovative services; and (iv) competition in the provision of electronic communications services.
- A1.7 Under section 8(1) of the WT Act, it is unlawful to establish or use a wireless telegraphy station or install or use wireless telegraphy apparatus except under and in accordance with a wireless telegraphy licence granted under the WT Act.
- A1.8 Under sections 8(3) – 8(3B) of the WT Act, Ofcom may make regulations exempting from the licensing requirements under section 8(1), the establishment, installation or use of

wireless telegraphy stations or wireless telegraphy apparatus of such classes or description as may be specified in the regulations, either absolutely or subject to such terms, provisions and limitations as may be specified.

A1.9 Under section 8(4) of the WT Act, we must make regulations to exempt equipment if its installation or use is not likely to:

- involve undue interference with wireless telegraphy;
- have an adverse effect on technical quality of service;
- lead to inefficient use of the part of the electromagnetic spectrum available for wireless telegraphy;
- inhibit the development of effective arrangements for the sharing of frequencies;
- endanger safety of life;
- prejudice the promotion of social, regional or territorial cohesion; or
- prejudice the promotion of cultural and linguistic diversity and media pluralism.

A1.10 In accordance with the requirements of section 8(3B) of the WT Act, the terms, provisions and limitations specified in the regulations must be:

- objectively justifiable in relation to the wireless telegraphy stations or wireless telegraphy apparatus to which they relate;
- not such as to discriminate unduly against particular persons or against a particular description of persons;
- proportionate to what they are intended to achieve; and
- transparent in relation to what they are intended to achieve.

A2. Respondents

AerialWorx

Animal Dynamics

Association of Remotely Piloted Aircraft Systems UK (Arpas-UK)

Blue Bear Systems Research (BBSR)

Boeing

Birmingham Airport

Bristol Drones Ltd

BT

Civil Aviation Authority (CAA)

CGI

Cranfield University and Airport

Deeside Gliding Club

Hexcam

Hutchison 3G UK Ltd (Three)

Inmarsat

Intelsat

National Police Air Service, Modini, The Thunderbird Project, Honeywell Aerospace

Name withheld

NATS

Parrot

Royal Aeronautical Society

Sees.Ai

Skyports

Windracers Limited / Distributed Avionics Limited

Virgin Media O2

Vodafone

A3. UAS licence template

A3.1 Below is a marked up version to the licence. Where we have made changes to the proposed licence set out in our June 2022 Consultation these have been marked in red.

Unmanned Aircraft Systems (UAS) Operator Radio Licence

A3.2

Licensee Details and Validity

Product name	
Licence number	[Licence number]
Date of Issue	[Date licence first issued]
Licence start Date	[Licence start date appears here]
Payment Interval	1 year
Licence Expiry Date	[Licence expiry for short-term licences only]
Licensee Name	[Licensee name]
Licensee address	[Licensee address line(s)]

1. This Licence is issued by the Office of Communications (“Ofcom”) and replaces any previous authority granted in respect of the service subject to this Licence by Ofcom or by the Secretary of State.
2. This Licence authorises [licensee name] (“the Licensee”) to establish, install and/or use radio transmitting and/or receiving stations and/or radio apparatus as described in the schedule(s) (together called "the Radio Equipment") subject to the terms set out below and subject to the terms of the Wireless Telegraphy Licence Conditions Booklet OfW 597.
3. The schedules (and any subsequent schedule(s) Ofcom may issue as a variation to this Licence at a later date) as well as Wireless Telegraphy Licence Conditions Booklet OfW 597 are incorporated into and form part of this Licence.

Note: This Licence does not address flight safety aspects of radio use, nor does it constitute permission to disregard the legitimate interests of other statutory bodies such as the Civil Aviation Authority (CAA).

Schedule 1

Geographical Boundaries

1. Subject to the requirements of any coordination procedures notified to the Licensee pursuant to Schedule 1 to this Licence, the Licensee is authorised to establish, install and use the Radio Equipment in or over the United Kingdom, or in or over United Kingdom territorial sea in accordance with section 115 of the Wireless Telegraphy Act 2006.

Radio Equipment

2. In this Licence, the Radio Equipment means the equipment listed in Schedule 2.

Use of Radio Equipment

3. The Radio Equipment may only be used:
 - a. in accordance with Condition 4 of the Wireless Telegraphy Licence Conditions Booklet OfW 597 and the terms and conditions set out below and in any subsequent schedules; and
 - b. If it conforms to Radio Equipment Regulations 2017; or ~~has the appropriate approval, granted by (or on behalf of) the CAA.~~
 - c. Has the appropriate approval:
 - i. granted by the CAA;
 - ii. granted on behalf of the CAA by the EASA prior to 31/12/20; or
 - iii. approved by EASA under a ETSO approval since 31/12/20 and accepted under EASA/CAA Technical Implementation Procedures of the EU/UK Trade and Cooperation agreement.
4. Certain Radio Equipment may only be used by a person who holds (or is under the direct supervision of a person who holds) a valid Flight Radio Telephony Operator's Licence (FRTOL) issued by the CAA or equivalent licence issued by a national aviation authority, unless such a requirement has been exempted under the Air Navigation Order 2016.

Schedule 2

Table 1

System	Frequency	Requirements
High Frequency (HF) Communications	2.85 to 22 MHz	Flight Radio Telephony Operator's Licence (FRTOL) required
Very High Frequency (VHF) Navigation / Marker	108 to 117.975 MHz	Receive only – VOR, ILS Localiser, GBAS for GNSS
VHF Communications	117.975 to 137 MHz	<p>Analogue voice communications terminals with 8.33 kHz and 25 kHz channelization, VHF Data Link Mode 2 & 4 with 25 kHz channelization.</p> <p>When operating on the emergency frequency (121.5 MHz), the auxiliary frequency for search and rescue operations (123.1 MHz) or the airport fire service frequency (121.6 MHz), the equipment may operate 25 kHz channel spacing on these frequencies.</p> <p>FRTOL required</p> <p>This licence does not cover Aeronautical Ground Radio Stations that are subject to separate WT Act licensing and also approval under the Air Navigation Order 2016.</p>
Instrument Landing System	328.6 to 335.4 MHz	Receive only for Glideslope
Ultra High Frequency (UHF) radio equipment	453.0125 to 462.4875 MHz	
Mobile Network User Terminal Equipment (UE)	<p>703 to 733 MHz & 758 to 788 MHz (700 MHz band)</p> <p>791 to 821 MHz & 832 to 862 MHz (800 MHz band)</p> <p>880 to 915 MHz & 925 to 960 MHz (900 MHz band)</p> <p>1710 to 1781.7 MHz & 1805 to 1867.7 MHz (1800 MHz band)</p> <p>1920 to 1980 MHz & 2110 to 2170 MHz (2100 MHz band)</p>	<p>Technical parameters set out in UK Interface Requirement IR 2107, published by Ofcom.</p> <p>Technical parameters set out in UK Interface Requirement IR 2090, published by Ofcom.</p> <p>Technical parameters set out in UK Interface Requirement IR 2109, published by Ofcom.</p> <p>Technical parameters set out in UK Interface Requirement in IR 2109, published by Ofcom.</p> <p>Technical parameters set out in UK Interface Requirement IR 2092, published by Ofcom.</p>

System	Frequency	Requirements
	2350 to 2390 MHz (2.3 GHz band)	Technical parameters set out in UK Interface Requirement IR 2098, published by Ofcom.
	3410 to 3800 MHz (3.4-3.8 GHz band)	<p>Technical parameters set out in UK Interface Requirement IR 2097, published by Ofcom.</p> <p>The Licensee must have written permission for airborne use of its User Equipment Terminal (UE) from the mobile network(s) to which that UE connects. The Licensee must adhere to any terms and conditions imposed on it by the network operator(s) in respect to its use on that/(those) network(s).</p> <p>All airborne UE transmissions in the 2500 to 2690 MHz (2.6 GHz band) are prohibited. The Licensee must ensure that under no circumstance should the UE be able to connect to services operating in this band.</p>
Area Navigation (NAV)/Distance Measuring Equipment (DME)	960 to 1215 MHz	
Air Traffic Control (ATC) Transponder	1030/1090 MHz	No FRTOL needed if the operator has no control over the operation of the Transponder, other than to switch it on and off.
Traffic Alert and Collision Avoidance System (TCAS)/ Airborne Collision Avoidance System (ACAS)	1030/1090 MHz	
Electronic Conspicuity Device (ECD)		The ECD must identify the UAS and must be operated in accordance with the latest version of CAP 1391, published by the CAA.
Automatic Dependent Surveillance– Broadcast (ADS-B)	1090 MHz	Must be operated in accordance with the latest version of CAP 1391, published by the CAA.
Universal Access Transceiver (UAT)	978 MHz	Must be operated in accordance with the latest version of CAP 1391, published by the CAA.
Distance Measurement Equipment (DME)	1165 -960 to 1215 MHz	FRTOL required.

System	Frequency	Requirements
Satellite Earth Station Communication	14 to 14. 25 47 GHz	<p>(a) Satellite Earth Station may be used only if authorised to do so under a “Satellite (Earth Station Network)” Licence issued to the operator of the earth station network;</p> <p>(b) The Satellite Earth Station may transmit with an e.i.r.p. no greater than 55 dBW;</p> <p>(c) If operating to a geostationary satellite, the Satellite Earth Station must employ a stabilised platform and must maintain a pointing accuracy +/- 0.2 degrees towards the relevant geostationary satellite throughout transmissions;</p> <p>(d) At angles greater than or equal to 2.5 degrees from the antenna main beam axis, the e.i.r.p. of the Satellite Earth Station, if operating to a geostationary satellite, shall not exceed 20 dBW/40 kHz;</p> <p>(e) All transmissions from the Satellite Earth Station must be clearly identifiable;</p> <p>(f) The Satellite Earth Station must at all times operate such that it conforms to Interface Requirement IR 2077, published by Ofcom;</p> <p>(g) The Satellite Earth Station shall meet the conditions given in footnotes 5.504B, 5.504C, 5.508A and 5.509A of the Radio Regulations so as not to cause harmful interference to terrestrial fixed and radio astronomy stations.</p>
	1525 to 1660.5 MHz	
	1980 to 2010 MHz	<p>45 dBm / 200 kHz e.i.r.p. is permitted when operating at altitudes of 1000 metres and above; or</p> <p>24 dBm / 200 kHz e.i.r.p. is permitted when operating at an altitude below 1000 metres.</p>
	27.5 to 27.8185 GHz, 28.4545 to 28.8265 GHz and 29.4625 to 30 GHz for transmission (Earth-to-space)	<p>Satellite Earth Station to geostationary orbit (GSO) satellites may be used only if authorised to do so under a “Satellite (Earth Station Network)” Licence issued to the operator of the earth station network.</p> <p>Satellite Earth Stations operating to Non-GSO (NGSO) satellites are not permitted.</p> <p>The operation of the ESOMP Earth stations in motion (ESIM) Equipment shall comply with the Radio Equipment Regulations 2017 and with the technical and operational criteria contained within the UK Interface Requirement 2093, published by Ofcom.</p>

System	Frequency	Requirements
		The Licensee must have written permission for airborne use of its User Equipment Terminal (UE) from the satellite network(s) to which that UE connects. The Licensee must adhere to any terms and conditions imposed on it by the network operator(s) in respect to its use on that/(those) network(s).
2 GHz Complementary Ground Component (CGC)	1980 -2010 MHz	<p>The Licensee is only authorised to operate the 2 GHz CGC Equipment to connect with a satellite or CGCs operated by Inmarsat Ventures Limited or Echostar forming part of a 2GHz Mobile Satellite System.</p> <p>Transmit power when transmitting to one or more CGCs:</p> <ul style="list-style-type: none"> • 40 dBm e.i.r.p is permitted when operating at altitudes of 1000 metres and above; or • 24 dBm e.i.r.p. is permitted when operating at altitudes below 1000 metres.
Radio altimeters	4200 to 4400 MHz	
Aeronautical mobile airport communication system	5091 to 5150 MHz	
ESOMP	27.5 – 27.8185 GHz, 28.4545 – 28.8265 GHz and 29.4625 – 30 GHz for transmission (Earth-to-space) 17.3 – 20.2 GHz for reception (space-to- Earth)	The operation of the ESOMP Equipment shall comply with the Radio Equipment Regulations 2017 and with the technical and operational criteria contained within the UK Interface Requirement 2093 The Licensee must have written permission for airborne use of its User Terminal (UE) from the satellite network(s) to which that UE connects. The Licensee must adhere to any terms and conditions imposed on it by the network operator(s) in respect to its use on that/(those) network(s).
Weather Radar	9300 to 9500 MHz	

Note: equipment that is receive-only or complies with the conditions set out in regulations permitting licence exempt use are already authorised and are not covered by the terms and conditions of this licence. The following table lists some of this equipment. It is provided for information purposes only and is not an exhaustive list.

Table 2

System	Frequency	Requirements
Very High Frequency (VHF) Navigation	108- 117.5975 MHz	Receive only - VOR, ILS Localiser, GBAS for GNSS.
Instrument Landing System	328.6-335.4 MHz	Receive only for Glideslope.
Global Navigation Satellite System (GNSS)	1227.6-1600.995	Receive only.
WIFI/RLAN	2400- 24835 MHz 57- 71 GHz	Technical parameters and restrictions set out in IR 2030, published by Ofcom.
Short Range Devices (SRDS)	26.96-27.28 MHz 34.945- 35.305 MHz 433.04- 434.79 MHz 458.5-459.5 MHz 862-870 MHz 2400-2483.5 MHz 5725–5875 MHz 24.150–24.250 GHz	Technical parameters and restrictions set out in IR 2030, published by Ofcom.